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  - (i) Choose the correct option
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  - (iii) Fill in the blanks
  - (iv) Choose the odd one out
  - (v) Choose the correct pair
  - (vi) Choose the incorrect pair
  - (vii) Assertion-Reason
  - (viii) Choose the correct or incorrect statements
- Govt. Model Question Paper (2018) ***[Govt. MQP-2018]***, First Mid-Term Test (2018) ***[First Mid-2018]***, Quarterly Exam - 2018 & 2019 ***[QY-2018 & 2019],*** Half Yearly Exam - 2018 & 2019 ***[HY-2018 & 2019],*** March - 2019 & 2020 ***[Mar-2019 & 2020]***, June - 2019 ***[Jun.-2019]*** and Govt.Suppl. Exam September - 2020 & September 2021***[Sep.2020 & Sep.2021]*** questions are incorporated in the appropriate sections.
- Govt. Suppl. Exam **September 2021** Question Paper is given.

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Author :

Mr.J.M.Joseph, *M.Sc.,B.Ed.,*
Chennai.

Reviewed by :

Mr. P. George Paul, *M.Sc.,M.Ed., M.Phil, PGDCA*
Vice-Principal
Annai Veilankanni's Matric Hr. Sec. School
81, VGP Salai, Saidapet, Chennai - 600 015

Head Office:

Sura Publications
1620, 'J' Block, 16th Main Road,
Anna Nagar, Chennai - 600 040.
Phones : 044-4862 9977, 044-486 27755
Mobile : 81242 01000 / 81243 01000
e-mail : orders@surabooks.com
website : www.surabooks.com

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It gives me great pride and pleasure in bringing to you **Sura's Physics** guide for **11th Standard**. It is prepared as per the New Textbooks Vol. I & II. A deep understanding of the text and exercises is rudimentary to have an insight into the subject. The students have to carefully understand the topics and exercises.

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I pray the almighty to bless the students for consummate success in their examinations.

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Author :

Mr. Shanmugasundaram

(Post Graduate Teacher, Chennai)

Head Office:

Sura Publications

1620, 'J' Block, 16th Main Road,
Anna Nagar, **Chennai - 600 040.**

Phones : 044-4862 9977, 044-486 27755.
Mobile : 81242 01000 / 81243 01000
e-mail : orders@surabooks.com
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UNIT- I

FUNDAMENTALS OF COMPUTER AND WORKING WITH A TYPICAL OPERATING SYSTEMS (WINDOWS & LINUX)

CHAPTER 1 INTRODUCTION TO COMPUTERS

CHAPTER SNAPSHOT

- 1.1. Introduction to Computers
- 1.2. Generations of Computers
- 1.3. Sixth Generation Computing
- 1.4. Data and Information
- 1.5. Components of a Computer
  - 1.5.1. Input Unit
  - 1.5.2. Central Processing Unit
  - 1.5.3. Output Unit
  - 1.5.4. Memory Unit
  - 1.5.5. Input and Output devices
- 1.6. Booting of Computer

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER

1. **First generation computers used** *[HY. 2019]*

(a) Vacuum tubes (b) Transistors
(c) Integrated circuits (d) Microprocessors

[Ans. (a) Vacuum tubes]

2. **Name the volatile memory**

(a) ROM (b) PROM
(c) RAM (d) EPROM

[Ans. (c) RAM]

3. **Identify the output device** *[Mar. 2020]*

(a) Keyboard (b) Memory
(c) Monitor (d) Mouse

[Ans. (c) Monitor]

4. **Identify the input device** *[FMT 2018]*

(a) Printer (b) Mouse
(c) Plotter (d) Projector

[Ans. (b) Mouse]

5. **..... Output device is used for printing building plan.**

(a) Thermal printer (b) Plotter
(c) Dot matrix (d) inkjet printer

[Ans. (b) Plotter]

6. **Which one of the following is used to in ATM machines**

(a) Touch Screen (b) Speaker
(c) Monitor (d) Printer

[Ans. (a) Touch Screen]

7. **When a system restarts which type of booting is used.**

(a) Warm booting (b) Cold booting
(c) Touch boot (d) Real boot.

[Ans. (a) Warm booting]

8. **Expand POST** *[FMT 2018; Sep. 2020]*

(a) Post on self Test
(b) Power on Software Test
(c) Power on Self Test
(d) Power on Self Text

[Ans. (c) Power on Self Test]

9. **Which one of the following is the main memory?**

(a) ROM (b) RAM
(c) Flash drive (d) Hard disk

[Ans. (b) RAM]

10. **Which generation of computer used IC's?**

(a) First (b) Second (c) Third (d) Fourth

[Ans. (c) Third]

SECTION - B

VERY SHORT ANSWERS

1. What is a computer? *[Sep. 2021]*

Ans. **(i)** A computer is an electronic device that manipulates information, or data. It has the ability to store, retrieve, and process data.

(ii) Computer works faster than human being and given the values more accuracy and reliable

2. Distinguish between data and information. *[FMT 2018]*

Ans.

Data	Information
Data is defined as an unprocessed collection of raw facts, suitable for communication, interpretation or processing.	Information is a collection of facts from which conclusions may be drawn.
(Eg) 134, 16, 'Kavitha', 'C'	**(Eg)** Kavitha is 16 years old.

3. What are the components of a CPU? *[Sep. 2020]*

Ans. The CPU has three components which are Control unit, Arithmetic and Logic unit (ALU) and Memory unit.

4. What is the function of an ALU? *[Mar. 2020]*

Ans. **(i)** The ALU performs arithmetic operations.

(ii) The result of an operation is stored in internal memory of CPU.

(iii) The logical operations of ALU promote the decision making ability of a computer.

5. Write the functions of control unit.

Ans. The control unit controls the flow of data between the CPU, memory and I/O devices. It also controls the entire operation of a computer.

6. What is the function of memory?

Ans. The primary memory is used to temporarily store the programs and data when the instructions are ready to execute. The secondary memory is used to store the data permanently.

7. Differentiate Input and Output unit.

Ans.

Input Unit	Output Unit
Input unit is used to feed any form of data to the computer, which can be stored in the memory unit for further processing.	An output unit is any hardware component that conveys information to users in an understandable form.
Example : Keyboard, mouse etc.	**Example :** Monitor, Printer etc.

8. Distinguish Primary and Secondary memory.

Ans.

Primary Memory	Secondary Memory
It is used to temporarily store the programs and data when the instructions are ready to execute.	It is used to store the data permanently.
It is volatile, the content is lost when the power supply is switched off. Eg. RAM.	It is non-volatile, the content is available even after the power supply is switched off. Eg. ROM, CD-ROM, DVD ROM.

SECTION - C

SHORT ANSWERS

1. What are the characteristics of a computer?

Ans. **(i)** Computer is the powerful machine.

(ii) It can perform large number of tasks.

(iii) The main capacities of computer are work length, speed accuracy, diligence, versatility memory and automation and lots of more tasks.

2. Write the applications of computer.

Ans. The various applications of computers are,

(i) Business **(ii)** Education
(iii) Marketing **(iv)** Banking
(v) Insurance **(vi)** Communication
(vii) Health care
(viii) Engineering - Robotics, Nano technology, Bio Engineering

3. What is an input device? Give two examples.

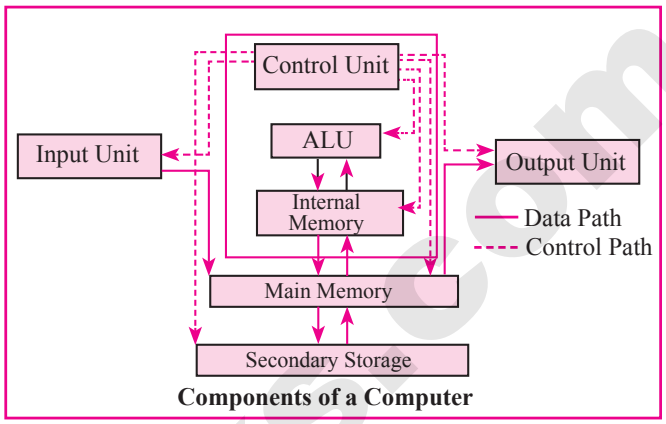
Ans. Input device is used to feed any form of data to the computer, which can be stored in the memory unit for further processing.

Example: Keyboard, Mouse, Scanner, Fingerprint scanner, Track Ball, Retinal Scanner, Light pen etc.

(iii) Arithmetic and Logic Unit : The ALU is a part of the CPU where various computing functions are performed on data. The ALU performs arithmetic operations such as addition, subtraction, multiplication, division and logical operations.

(iv) Control Unit : The control unit controls the flow of data between the CPU, memory and I/o devices. It also controls the entire operation of a computer.

(v) Output Unit : An output unit is any hardware component that conveys information to users in an understandable form. Example : Monitor, Printer etc.



Components of a Computer

(vi) Memory Unit : The Memory Unit is of two types which are primary memory and secondary memory. The primary memory is used to temporarily store the programs and data when the instructions are ready to execute. The secondary memory is used to store the data permanently. The Primary Memory is volatile, that is, the content is lost when the power supply is switched off. The Random Access Memory (RAM) is an example of a main memory. The Secondary memory is non volatile, that is, the content is available even after the power supply is switched off. Hard disk, CD-ROM and DVD ROM are examples of secondary memory.

2. Discuss the various generations of computers. *[QY. 2018; June 2019; Mar. 2020; Sep. 2021]*

Ans.

S.No	Generation	Period	Main Component used	Merits/ Demerits
1	**First Generation**	1940-1956	Vaccum tubes	❑ Big in size ❑ Consumed more power ❑ Malfunction due to overheat ❑ Machine Language was used
First Generation Computer - ENIAC, EDVAC, UNIVAC 1 ENIAC weighed about 27 tons, size 8 feet × 100 feet × 3 feet and consumed around 150 watts of power				
2.	**Second Generation**	1956-1964	Transistors	❑ Smaller compared to First Generation ❑ Generated Less Heat ❑ Consumed less power compared to first generation ❑ Punched cards were used ❑ First operating system was developed - Batch Processing and Multiprogramming Operating System ❑ Machine language as well as Assembly language was used.
Second Generation Computers - **IBM 1401, IBM 1620, UNIVAC 1108**				
3.	**Third Generation**	1964-1971	Integrated Circuits (IC)	❑ Computers were smaller, faster and more reliable ❑ Consumed less power. ❑ High Level Languages were used
Third Generation Computers - **IBM 360 series, Honeywell 6000 series**				

GOVERNMENT EXAM QUESTIONS AND ANSWERS

1 MARK

1. How many types of Booting process in system ?
(a) 3 (b) 2 *[QY. 2018]*
(c) 5 (d) 4 **[Ans. (b) 2]**

2. Which of the following is a Third generation computers? *[Govt.MQP-2018]*
(a) Vacuum tubes (b) Transistor
(c) Integrated Circuits (d) Microprocessor
[Ans. (b) Transistor]

3. Which one of the following is Biometric Device? *[QY. 2018]*
(a) Scanner (b) Fingerprint Scanner
(c) Light Pen (d) Mouse
[Ans. (b) Fingerprint Scanner]

4. Identify the Input device ..... . *[FMT 2018]*
(a) Printer (b) Mouse
(c) Plotter (d) Projector
[Ans. (b) Mouse]

5. Expansion of GUI is ..... . *[QY. 2018]*
(a) Graphics User Interface
(b) Graphical User Information
(c) Geographical User Information
(d) Graphical User Interface
[Ans. (d) Graphical User Interface]

6. Which generation of computer used Transistors?
(a) First (b) Second *[June 2019]*
(c) Third (d) Fourth
[Ans. (b) Second]

7. Plotter is a _____ device. *[QY. 2019]*
(a) storage (b) input
(c) output (d) memory
[Ans. (c) output]

8. Line printers are capable of printing much more than _____ lines per minute. *[QY. 2019]*
(a) 1000 (b) 1200 (c) 1500 (d) 1300
[Ans. (a) 1000]

9. Which Generations of computer used ULSI?
(a) Third (b) Fourth *[HY. 2018]*
(c) Fifth (d) Sixth
[Ans. (c) Fifth]

10. Expand ULSI. *[Sep. 2021]*
(a) Ultra Large Scale Information
(b) Ultra Low Scale Integration
(c) Ultra Low Software Integration
(d) Ultra Large Scale Integration
[Ans. (d) Ultra Large Scale Integration]

2 MARKS

1. Expand (i)BIOS (ii)ENIAC (iii)RAM (iv)ALU *[Govt.MQP-2018]*

Ans.
(i) BIOS - Basic Input Output System.
(ii) ENIAC - Electronic Numerical Integrator And Calculator.
(iii) RAM - Random Access Memory
(iv) ALU - Arithmetic and Logic unit

2. Give examples for Impact and Non impact printers. *[FMT 2018]*

Ans. **Impact :** Dot Matrix printer and line dot matrix printer.
Non - Imapct : Laser printer and Inkjet printer.

3. Write short note on registers. *[FMT 2018]*

Ans. Registers are the high-speed temporary storage locations in the CPU. Hence, their contents can be handled much faster than the contents of memory.

4. Write Demerits of Artificial Intelligence. *[QY. 2018]*

Ans.
(i) Machines need repairing and maintenance which need plenty of cost.
(ii) The increasing number of machines leading to unemployment and job security issues.

5. Write notes on fifith generation computers.

Ans. *[QY. 2019]*
(i) Parallel Processing
(ii) Super conductors
(iii) Computers size was drastically reduced.
(iv) Can recognise Images and Graphics
(v) Introduction of Artificial Intelligence and Expert Systems
(vi) Able to solve high complex problems including decision making and logical reasoning

3 MARKS

1. Write the mechanism of laser mouse. *[FMT 2018]*

Ans.
(i) Measures the motion and acceleration of pointer.
(ii) Laser mouse uses laser light.
(iii) Laser mouse is highly sensitive and able to work on any hard surface.

2. Write the sequence of steps in boot process? (or) Explain the types of booting in computer.

[Govt.MQP, FMT-2018]

Ans. Booting process is of two types.

(i) Cold Booting (ii) Warm Booting *[HY. 2019]*

(i) Cold Booting: When the system starts from initial state i.e. it is switched on, we call it cold booting or Hard Booting. When the user presses the Power button, the instructions are read from the ROM to initiate the booting process.

(ii) Warm Booting: When the system restarts or when Reset button is pressed, we call it Warm Booting or Soft Booting. The system does not start from initial state and so all diagnostic tests need not be carried out in this case. There are chances of data loss and system damage as the data might not have been stored properly.
Differentiate optical mouse and laser mouse.

3. Write notes on multimedia projector. *[QY. 2019]*

Ans. **(i)** Multimedia projectors are used to produce computer output on a big screen.

(ii) These are used to display presentations in meeting halls or in classrooms.

4. How Finger Print Scanner Working? *[QY. 2018]*

Ans. **Finger print Scanner:** Fingerprint Scanners is a fingerprint recognition device used for computer security, equipped with the fingerprint recognition feature that uses biometric technology. Fingerprint Reader / Scanner is very safe and convenient device for security instead of password, that is vulnerable to fraud and is hard to remember.

5 Marks

1. Short answer on the following: *[QY. 2018]*

a) Data b) Hardware c) Natural Language Processing

d) Types of Memory e) Bit

Ans. **(a) Data :** The term data comes from the word datum, which means a raw fact. The data is a fact about people, places or some objects.

(b) Hardware : Hardware is the physical component of a computer like motherboard, memory devices, monitor, keyboard etc.,

(c) Natural Language Processing : Natural Language Processing is a method used in artificial intelligence to process and derive meaning from the human language.

(d) Types of Memory : The memory unit is of two types - Primary memory, Secondary memory.

(e) Bit : Machine language is a collection of binary digits or bits that the computer reads and interprets.

2. Differentiate Impact Printers and Non-Impact Printers. *[QY. 2019]*

Ans.

S.No	Impact Printers	Non-Impact Printers
1.	It uses ribbons / carbon papers to leave the impressions on the paper.	It use ink cartridges and the impressions appear on the paper with the flow of ink.
2.	The quality of printing is a draft quality.	The quality of printing is a high quality.
3.	Striking Mechanism used to produce output.	No striking mechanism used to produce output.
4.	Faster speeds around 250 words per second,	Slower speeds around 1 page per seconds.
5.	**Example :** Dot Matrix printers and line matrix printers	**Example :** Laser printers and Inkjet printers.

ADDITIONAL QUESTIONS AND ANSWERS

CHOOSE THE CORRECT ANSWERS 1 MARK

I. CHOOSE THE CORRECT OPTIONS FOR THE BELOW QUESTIONS.

1. Which of the following led us today to extremely high speed calculating device?
(a) Laptop (b) Tabulating Machine
(c) Abacus (d) ENIAC
[Ans. (c) Abacus]

2. In which year the concept of the analytical engine was invented?
(a) 1837 (b) 1910 (c) 1991 (d) 1836
[Ans. (a) 1837]

3. Which of the following period the first generation computers belongs?
(a) 1956-1963 (b) 1940-1956
(c) 1964-1971 (d) 1980-1990
[Ans. (b) 1940-1956]

4. Which of the following is not a first generation computers?
(a) ENIAC (b) EDVAC
(c) UNIVAC 1 (d) IBM1401
[Ans. (d) IBM1401]

5. Which component used in third generation computers?
(a) Vacuum Tubes (b) Transistors
(c) IC (d) Microprocessor
[Ans. (c) IC]

6. In which generation, the Voice Recognition software developed?
(a) Sixth (b) Fourth (c) Third (d) Second
[Ans. (a) Sixth]

7. Which generation gave a start to parallel computing?
(a) fourth (b) fifth (c) sixth (d) seventh
[Ans. (c) sixth]

8. Which of the following is not a form of parallel computing?
(a) bit level (b) instruction level
(c) task parallelism (d) Robotics
[Ans. (d) Robotics]

9. Which of the following holds the data and instructions during the processing?
(a) Input unit (b) output unit
(c) Memory unit (d) Software
[Ans. (c) Memory unit]

10. Which unit does the processing of data?
(a) CPU (b) Registers
(c) Input unit (d) Output unit
[Ans. (a) CPU]

11. Which of the following is the heart of the computer?
(a) CPU (b) HDD (c) SDD (d) ANN
[Ans. (a) CPU]

12. Which of the following operations of ALU promote decision -making ability of a computer?
(a) Logical (b) Relational
(c) Arithmetic (d) Binary
[Ans. (a) Logical]

13. Which of the following is not a non volatile memory?
(a) ROM (b) Hard disk
(c) CD-ROM (d) RAM
[Ans. (d) RAM]

14. Who invented the computer mouse?
(a) Douglas Engelbart (b) Bill English
(c) Apple Lisa (d) Henry Babbage
[Ans. (a) Douglas Engelbart]

15. Which device works like a xerox machine?
(a) Retinal scanner (b) OCR
(c) OMR (d) Scanner
[Ans. (d) Scanner]

16. Which device is very safe and convenient for security instead of password?
(a) Scanner (b) Fingerprint Scanner
(c) Track ball (d) Retinal Scanner
[Ans. (b) Fingerprint Scanner]

17. Which of the following device uses CCD Electronic chip?
(a) OCR (b) BCR
(c) Voice Input Systems (d) Digital Camera
[Ans. (d) Digital Camera]

18. In which device the keys are arranged in a cluster?
(a) Keyboard (b) Keyer
(c) Barcode Reader (d) Touch Screen
[Ans. (b) Keyer]

19. Who was the inventor of the electronic digital computer?
(a) John Vincent Atanasoft
(b) J. Presper Eckert
(c) John Mauchly
(d) Charles babbage
[Ans. (a) John Vincent Atanasoft]

20. Which company developed first digital computer?
(a) Atanasoft Berry Computer
(b) AT & T bell
(c) IBM
(d) Microsoft
[Ans. (a) Atanasoft Berry Computer]

21. Which of the following are the computer systems inspired by the biological neural networks?
(a) NLP (b) IBM
(c) Robotics (d) ANN **[Ans. (d) ANN]**

22. Which of the following has become the dominant paradigm in computer architecture?
(a) Parallel computing
(b) parallel processing
(c) Multi tasking
(d) Multi processing **[Ans. (a) Parallel computing]**

23. Which of the following concerned with the interactions between computers and human language?
(a) Artificial Neurons
(b) Neural network
(c) Artificial intelligence
(d) Natural language processing
[Ans. (c) Artificial intelligence]

24. Which of the following is the logical machine which interprets and executes software instructions?
(a) CPU (b) ALU
(c) Control Unit (d) Memory Unit
[Ans. (a) CPU]

25. How many classification of memories in memory unit?
(a) 2 (b) 3
(c) 4 (d) more than 2
[Ans. (a) 2]

26. How many types of Keyboards used to input the data?
(a) 3 (b) 2 (c) 4 (d) 5
[Ans. (a) 3]

27. How many types of pointing device are there?
(a) 2 (b) 3 (c) 1 (d) Many
[Ans. (a) 2]

28. Which mouse has as many as 12 buttons?
(a) Laser (b) Optical
(c) Mechanical (d) Both a and b
[Ans. (a) Laser]

29. Which printer do not use striking mechanism for printer?
(a) Inkjet (b) Laser
(c) Thermal (d) All of these
[Ans. (d) All of these]

30. Which device is used to produce computer output on a big screen?
(a) Monitor (b) LED
(c) Projector (d) Monochrome Monitor
[Ans. (c) Projector]

31. Which of the following is the diagnostic testing sequence of the computer hardware?
(a) POST (b) BIOS (c) MAR (d) MBR
[Ans. (a) POST]

32. Which of the following issue an error message if any computer hardware not defected?
(a) BIOS (b) BUS (c) RAM (d) POST
[Ans. (a) BIOS]

33. Which device produce graphical output on papers?
(a) Scanner (b) Touch Screen
(c) Plotter (d) Track ball
[Ans. (c) Plotter]

34. Which code checks partition table for an active partition in a computer?
(a) MBR (b) Marse (c) Binary (d) Object
[Ans. (a) MBR]

2. **The component used in second generation computers is ..... .**
(a) Transistors (b) ICs
(c) Vacuum tubes (d) Microprocessors
[Ans. (a) Transistors]

3. **The Second generation computers belongs to period ..... .**
(a) 1940-1956 (b) 1956-1964
(c) 1980-1990 (d) 1964-1971
[Ans. (b) 1956-1964]

4. **The fourth generation belongs to ..... .**
(a) 1940-1956 (b) 1971-1980
(c) 1964-1971 (d) 1980-1990
[Ans. (b) 1971-1980]

5. **The component used in fourth generation computers are ..... .**
(a) ICS (b) Transistors
(c) VLSI (d) Vacuum tube
[Ans. (c) VLSI]

6. **Laptops, Notebook, Tablets are belongs to ..... generation computers.**
(a) First (b) Second (c) Third (d) Fourth
[Ans. (d) Fourth]

7. **The fifth generation computers belongs to .....**
(a) 1971-1980 (b) 1980- till date
(c) 1964-1971 (d) 1940-1956
[Ans. (b) 1980-till date]

8. **Name the software introduced in fifth generation computers ..... .**
(a) Artificial Neural Networks
(b) Artificial Intelligence
(c) Robotics
(d) Natural language processing
[Ans. (b) Artificial Intelligence]

9. **Robotics developed in ..... generation.**
(a) Third (b) Fourth (c) Fifth (d) Sixth
[Ans. (d) Sixth]

10. **ENIAC was invented by ..... .**
(a) John Vincent
(b) Cliff Berry
(c) Presper Eckert, John Mauchly
(d) Earl R Johnson and Atanasoff
[Ans. (c) Presper Eckert, John Mauchly]

11. **Expand NLP ..... .**
(a) National Language Problem
(b) Natural Language Processing
(c) Network Language Program
(d) Network Local Processing
[Ans. (b) Natural Language Processing]

12. **NLP is a component of ..... .**
(a) Expert systems
(b) Robotics
(c) Parallel computing
(d) Artificial Intelligence
[Ans. (d) Artificial Intelligence]

13. **Every task given to a computer-follows a(n) ..... cycle.**
(a) BPO (b) IPO
(c) ANN (d) NLP **[Ans. (b) IPO]**

14. **Expansion of CPU is ..... .**
(a) Control processing unit
(b) Central processor unique
(c) Central processing unit
(d) Control processor unit
[Ans. (c) Central processing unit]

15. **Expansion of ALU is ..... .**
(a) Arithmetic Logical Unit
(b) Accumulator Logical Unit
(c) Arithmetic Language Unit
(d) None of these
[Ans. (a) Arithmetic Logical Unit]

16. **The memory unit is of ..... kinds.**
(a) 3 (b) 4 (c) 2 (d) 5
[Ans. (c) 2]

17. **Optical Mouse invented in the year ..... .**
(a) 1968 (b) 1973 (c) 1988 (d) 1981
[Ans. (c) 1988]

18. **Laser mouse has as many as ..... buttons.**
(a) 10 (b) 11 (c) 12 (d) 3
[Ans. (c) 12]

19. **Expansion of CCD is .....**
(a) Coupled Changed Device
(b) Changed Coupled Device
(c) Changed Couple Device
(d) Camera changed Divider
[Ans. (b) Changed Coupled Device]

IV. Pick the Odd one Out.

1. (a) Keyboard (b) Mouse
   (c) Track Ball (d) Monitor

[Ans. (d) Monitor]

Reason : Monitor is the most commonly used output device to display the information. Other three are examples of input device.

2. (a) Mechanical Mouse (b) Laser Mouse
   (c) Plotter (d) Optical Mouse

[Ans. (c) Plotter]

Reason : Plotter is an output device that is used to produce graphical output on papers other three are types of mouse.

V. Which one of the following is Not Correctly Matched?

1. (a) Impact printers – Dot Matrix printer
   (b) Non–Impact printers – Laser printer
   (c) Hardware – Keyboard
   (d) Software – CPU

[Ans. (d) Software – CPU]

2. (a) Second generation – Transistors
   (b) Third generation – Integrated circuits
   (c) Fourth generation – Vacuum tubes
   (d) Fifth generation+ – ULSI

[Ans. (c) Fourth generation – Vacuum tubes]

VI. Consider the Following Statement.

1. **Assertion (A) :** Computers have now become an indispensable part of our lives.
   Reason (R) : Computers have revolutionized out lives with their accuracy and speed of performing a job, it is truly remarkable.
   (a) Both (A) and (R) are true and (R) is the correct explanation of A.
   (b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
   (c) (A) is true, but (R) is false.
   (d) (A) is false, but (R) is true.

[Ans. (a) Both (A) and (R) are true and (R) is the correct explanation of (A)]

2. **Assertion (A) :** CPU is the major component which interprets and executes software instructions.
   Reason (R) : The ALU is a part of the CPU where various computing functions are performed on data.
   (a) Both (A) and (R) are true and (R) is the correct explanation of A.
   (b) Both (A) and (R) are true and (R) is not the correct explanation of A.
   (c) (A) is true, but (R) is false.
   (d) (A) is false, but (R) is true.

[Ans. (b) Both (A) and (R) are true and (R) is not the correct explanation of (A)]

3. **Assertion (A) :** Microphone serves as a voice Input device.
   Reason (R) : Digital camera uses a CCD electronic chip.
   (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
   (b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
   (c) (A) is true, but (R) is false.
   (d) (A) is false, but (R) is true.

[Ans. (b) Both (A) and (R) are true and (R) is not the correct explanation of (A)]

VII. Choose the Correct Statement.

1. **Which of the following statements are true?**
   (i) Machine language programs are done in first generation
   (ii) Third generation computers are not more reliable
   (iii) Voice recognition software developed in fifth generation computer
   (iv) Micro processors are used in fourth generation computer
   (a) Only (i)
   (b) Only (i) and (iv)
   (c) Only (iii) and (iv)
   (d) Only (i) (iii) and (iv)

[Ans. (b) Only (i) and (iv)]

Very Short Answers 2 MARKS

1. Name the first generation computers.

Ans. ENIAC, EDVAC, UNIVAC 1.

2. Name the Second generation computers.

Ans. IBM 1401, IBM 1620, UNIVAC 1108.

3. Name the Third generation computers.

Ans. IBM 360 Series, Honeywell 6000 series.

4. Name the softwares introduced in fifth generation computers.

Ans. (i) Artificial Intelligence
(ii) Expert Systems

5. Name the types of computer introduced in Fourth generation computers.

Ans. (i) Microcomputer
(ii) Portal Computers.

6. Write the developments of Sixth generation computers.

Ans. (i) Parallel Computing
(ii) Artificial Neural Networks
(iii) Robotics
(iv) Natural Language Processing

7. What is NLP?

Ans. Natural Language Processing is the ability of a computer program to understand human language. It is a component of artificial intelligence.

8. What is the use of Microphone?

Ans. Microphone serves as a voice Input device. It captures the voice data and send it to the Computer.

9. Write a note on Digital Camera.

Ans. It captures images / videos directly in the digital form. It uses a CCD (Charge Coupled Device) electronic chip. When light falls on the chip through the lens, it converts light rays into digital format.

10. What is use of VGA?

Ans. The screen monitor works with the VGA (Video Graphics Array). The video graphics card helps the keyboard to communicate with the screen. It acts as an interface between the computer and display monitor. Usually the recent motherboard incorporates built in video card.

11. Write the two main categories of Printer.

Ans. Printers are divided into two main categories:
(i) Impact Printers
(ii) Non Impact printers

12. What is booting a computer?

Ans. Booting a computer is to load an operating system into the computer's main memory or random access memory (RAM).

13. What makes Charles Babbage the father of computing?

Ans. Charles Babbage radical ideas and concept of the Analytical Engine (It contained an ALU, basic flow control and integrated memory) makes him the father of computing.

14. What is the goal of neural network approach?

Ans. The original goal of the neural network approach was to solve problems in the same way that a human brain would. Over time, attention focused on matching specific mental abilities, leading to deviations from biology.

15. Write the tools in which nano technology was born.

Ans. The right tools, such as the scanning tunneling microscope (STM) and the atomic force microscope (AFM), the age of nano-technology was born.

16. Define IPO Cycle.

Ans. The functional components of a computer performs. Every task given to a computer follows an Input-Process- Output Cycle (IPO cycle).

17. Name the different keys available in the keyboard.

Ans. There are different set of keys available in the keyboard such as character keys, modifier keys, system and GUI keys, enter and editing keys, function keys, navigation keys, numeric keypad and lock keys.

18. Which device is used to draw a lines?

Ans. Light Pen is an input device which is used to draw lines or figures on a computer screen. It is touched to the CRT screen where it can detect faster on the screen as it passes.

CHAPTER 2 NUMBER SYSTEMS

CHAPTER SNAPSHOT

Part I - Number Systems

- ✶ 2.1 Number Systems - Introduction
- ✶ 2.2 Data Representations
- ✶ 2.3 Different Types of Number Systems
  - 2.3.1 Decimal Number System
  - 2.3.2 Binary Number System
  - 2.3.3 Octal Number System
  - 2.3.4 Hexadecimal Number System
- ✶ 2.4 Number System Conversions
  - 2.4.1 Decimal to Binary Conversion
  - 2.4.2 Decimal to Octal Conversion
  - 2.4.3 Decimal to Hexadecimal Conversion
  - 2.4.4 Conversion of fractional Decimal to Binary
  - 2.4.5 Binary to Decimal Conversion
  - 2.4.6 Binary to Octal Conversion
  - 2.4.7. Binary to Hexadecimal Conversion
  - 2.4.8 Conversion of fractional Binary to Decimal equivalent
  - 2.4.9. Octal to Decimal Conversion
  - 2.4.10 Octal to Binary Conversion
  - 2.4.11 Hexadecimal to Decimal Conversion
  - 2.4.12 Hexadecimal to Binary Conversion
- ✶ 2.5 Binary Representation for Signed Numbers
  - 2.5.1 Signed Magnitude representation
  - 2.5.2 1's Complement representation
  - 2.5.3 2's Complement representation
- ✶ 2.6 Binary Arithmetic
  - 2.6.1 Binary Addition
  - 2.6.2 Binary Subtraction
- ✶ 2.7 Representing Characters in Memory
  - 2.7.1 Binary Coded Decimal (BCD)
  - 2.7.2 American Standard Code for Information Interchange (ASCII)
  - 2.7.3 Extended Binary Coded Decimal Interchange Code (EBCDIC)
  - 2.7.4 Indian Standard Code for Information Interchange (ISCII)
  - 2.7.5 Unicode

Part II - Boolean Algebra

- ✶ 2.8. Boolean Algebra - Introduction
  - 2.8.1 Binary valued quantities
  - 2.8.2 Logical Operations
  - 2.8.3 Truth Table
  - 2.8.4 AND operator
  - 2.8.5 OR operator
  - 2.8.6 NOT operator
  - 2.8.7 NAND operator
  - 2.8.8 NOR operator
- ✶ 2.9. Basic Logic Gates
  - 2.9.1 AND Gate
  - 2.9.2 OR Gate
  - 2.9.3 NOT Gate
  - 2.9.4 NOR Gate
  - 2.9.5 Bubbled AND Gate
  - 2.9.6 NAND Gate
  - 2.9.7 Bubbled OR Gate
  - 2.9.8 XOR Gate
  - 2.9.9 XNOR Gate

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER:

1. Which refers to the number of bits processed by a computer's CPU?

(a) Byte (b) Nibble
(c) Word length (d) Bit

[Ans. (c) Word length]

2. How many bytes does 1 KiloByte contain?

(a) 1000 (b) 8
(c) 4 (d) 1024 **[Ans. (d) 1024]**

3. Expansion for ASCII

(a) American School Code for Information Interchange
(b) American Standard Code for Information Interchange
(c) All Standard Code for Information Interchange
(d) American Society Code for Information Interchange

[Ans. (b) American Standard Code for Information Interchange]

4. 2^50 is referred as

(a) Kilo (b) Tera
(c) Peta (d) Zetta

[Ans. (c) Peta]

5. How many characters can be handled in Binary Coded Decimal System?

(a) 64 (b) 255
(c) 256 (d) 128 **[Ans. (a) 64]**

6. For 1101_2 the equalent Hexadecimal equivalent is?

(a) F (b) E
(c) D (d) B **[Ans. (c) D]**

7. What is the 1's complement of 00100110?

(a) 00100110 (b) 11011001
(c) 11010001 (d) 00101001

[Ans. (b) 11011001]

8. Which amongst this is not an Octal number? *[Sep. 2020]*

(A) 645 (B) 234 (C) 876 (D) 123

[Ans. (c) 876]

SECTION - B

VERY SHORT ANSWERS

1. What is data?

Ans. The term data comes from the word datum, which means a raw fact. The data is a fact about people, places or some objects.

2. Write the 1's complement procedure.

Ans. **Step 1:** Convert given Decimal number into Binary

Step 2: Check if the binary number contains 8 bits, if less add 0 at the left most bit, to make it as 8 bits.

Step 3: Invert all bits (i.e. Change 1 as 0 and 0 as 1).

3. Convert $(46)_{10}$ into Binary number.

Ans.

2	46	
2	23	– 0
2	11	– 1
2	5	– 1
2	2	– 1
2	1	– 0

Answer - $46_{10} = (101110)_2$

4. We cannot find 1's complement for $(28)_{10}$. State reason. *[QY. 2019]*

Ans. $(28)_{10}$ is positive number. 1's Complement represent signed numbers (Negative numbers) only. So, $(28)_{10}$ cannot find 1's complement.

5. List the encoding systems that represents characters in memory. *[FMT 2018]*

Ans. **(i)** BCD – Binary Coded Decimal.

(ii) EBCDIC – Extended Binary Coded Decimal Interchange Code.

(iii) ASCII – American Standard Code for Information Interchange.

(iv) Unicode.

(v) ISCII - Indian Standard Code for Information Interchange.

SECTION - D

EXPLAIN IN DETAIL

1. a) Write the procedure to convert fractional Decimal to Binary

b) Convert $(98.46)_{10}$ to Binary

[FMT 2018 ; Sep.2020]

Ans. **a)** The method of repeated multiplication by 2 has to be used to convert such kind of decimal fractions. The steps involved in the method of repeated multiplication by 2:

Step 1: Multiply the decimal fraction by 2 and note the integer part. The integer part is either 0 or 1.

Step 2: Discard the integer part of the previous product. Multiply the fractional part of the previous product by 2. Repeat Step 1 until the same fraction repeats or terminates (0).

Step 3: The resulting integer part forms a sequence of 0s and 1s that become the binary equivalent of decimal fraction.

Step 4: The final answer is to be written from first integer part obtained till the last integer part obtained.

b) 98.46_{10}

1. Integer part

2	98	
2	49	– 0
2	24	– 1
2	12	– 0
2	6	– 0
2	3	– 0
	1	– 1

2. Fractional part

$0.46 \times 2 = 0.92 = 0$

$0.92 \times 2 = 1.84 = 1$

$0.84 \times 2 = 1.68 = 1$

$0.68 \times 2 = 1.36 = 1$

$0.36 \times 2 = 0.72 = 0$

$0.72 \times 2 = 1.44 = 1$

$98.46_{10} = (1100010.011101....)_2$

2. Find 1's Complement and 2's Complement for the following Decimal number. a) -98 b) -135

Ans. **a)** **-98**

2	98	
2	49	– 0
2	24	– 1
2	12	– 0
2	6	– 0
2	3	– 0
	1	– 1

$98_{10} = 1100010$

8 bit format of 98_{10} = 01100010

1's complement = 10011101

Add 1 bit = +1

2's complement = 10011110

b) **-135**

2	135	
2	67	– 1
2	33	– 1
2	16	– 1
2	8	– 0
2	4	– 0
2	2	– 0
	1	– 0

$135_{10} = 10000111$

1's complement = 01111000

Add 1 bit = +1

2's complement = 01111001

3. a) Add $1101010_2 + 101101_2$ *[Sep. 2020]*

b) Subtract $1101011_2 - 111010_2$

Ans. **a)** **$1101010_2 + 101101_2$**

```
  1101010
+  101101
---------
 10010111
```

$= 10010111_2$

b) **$1101011_2 - 111010_2$** *[HF. 2018]*

```
  1101011
- 111010
--------
   110001
```

$= 110001_2$

WORKSHOP

1. Identify the number system for the following numbers.

Ans.

S.No	NUMBER	NUMBER SYSTEM
1.	$(1010)_{10}$	Decimal Number system
2.	$(1010)_2$	Binary Number System
3.	$(989)_{16}$	Hexadecimal Number System
4.	$(750)_8$	Octal Number System
5.	$(926)_{10}$	Decimal Number System

2. State whether the following numbers are valid or not. If invalid, give reason.

Ans.

S.No	STATEMENT	YES / NO	REASON (IF INVALID)
1.	786 is an Octal number	No	In. octal number, the allowable digits is between 0 and 7
2.	101 is a Binary number	No	No Radix is mentional
3.	Radix of Octal number is 7	No	Radix of octal number is 8

3. Convert the following Decimal numbers to its equivalent Binary, Octal, Hexadecimal.

1) 1920 2) 255 3) 126

Ans. **1)** $1920_{10} = ?_2$

2	1920
2	960 – 0
2	480 – 0
2	240 – 0
2	120 – 0
2	60 – 0
2	30 – 0
2	15 – 0
2	7 – 1
2	3 – 1
	1 – 1

$1920_{10} = 11110000000_2$

$1920_{10} = ?_8$

8	1920
8	240 – 0
8	30 – 0
	3 – 6

$1920 = 3600_8$ *[Mar. 2019]*

16	1920
16	120 – 0
	7 – 8

$= 1920_{10} = 780_{16}$

2) 255_{10} *[Mar. 2019]*

2	255
2	127 – 1
2	63 – 1
2	31 – 1
2	15 – 1
2	7 – 1
2	3 – 1
2	1 – 1

$255_{10} = 11111111_2$

$255_{10} = ?_8$

8	255
8	31 – 7
	3 – 7

$255_{10} = 377_8$

$255_{10} = ?_{16}$

16	255
	15 – 15

15 – F

$255_{10} = FF_{16}$

3) 126_{10}

2	126	
2	63	– 0
2	31	– 1
2	15	– 1
2	7	– 1
2	3	– 1
	1	– 1

$126_{10} = 1111110_2$

$126_{10} = ?_8$

8	126
8	15 – 6
	1 – 7

$126_{10} = 176_8$

$126_{10} = ?_{16}$

16	126
	7 – 14
	14 – E

$126_{10} = 7E_{16}$

4. Convert the given Binary number into its equivalent Decimal, Octal and Hexadecimal number.

1) 101110101 2) 1011010 3) 101011111

Ans. **1) 101110101**

Decimal Equivalent :

$= 1 \times 2^8 + \cancel{0 \times 2^7} + 1 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + \cancel{0 \times 2^3} + 1 \times 2^2 + \cancel{0 \times 2^1} + 1 \times 2^0$

$= 256 + 64 + 32 + 16 + 4 + 1 = 373_{10}$

Octal Equivalent :

$= \overline{101}\ \overline{110}\ \overline{101}$ → 5 6 5

$= 565_8$

Hexadecimal Equivalent :

$= \overline{10}\ \overline{1110}\ \overline{101}$ → 1 7 5

$= 175_{16}$; $10110101_2 = 373_{10} = 565_8 = 175_{16}$

2) 1011010_2

Decimal Equivalent :

$= 1 \times 2^6 + \cancel{0 \times 2^5} + 1 \times 2^4 + 1 \times 2^3 + \cancel{0 \times 2^2} + 1 \times 2^1 + \cancel{0 \times 2^0}$

$= 64 + 16 + 8 + 2 = 90_{10}$

Octal Equivalent :

$= \overline{10}\ \overline{110}\ \overline{110}$ → 1 3 2

$= 132_8$

Hexadecimal Equivalent :

$= \overline{101}\ \overline{1010}$ → 5 10 → 5 A

$= 54_{16}$

$1011010_2 = 90_{10} = 132_8 = 5A_{16}$

3) 101011111

Decimal Equivalent :

$= 1 \times 2^8 + \cancel{0 \times 2^7} + 1 \times 2^6 + \cancel{0 \times 2^5} + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$

$= 256 + 64 + 16 + 8 + 4 + 2 + 1 = 351_{10}$

Octal Equivalent :

$= \overline{101}\ \overline{011}\ \overline{111}$ → 5 3 7

$= 537_8$

Hexadecimal Equivalent :

$= \overline{10}\ \overline{101}\ \overline{1111}$ → 1 5 15 → 1 5 F

$= 15F_{16}$

$101011111_2 = 351_{10} = 537_8 = 15F_{16}$

ADDITIONAL QUESTIONS AND ANSWERS

CHOOSE THE CORRECT ANSWER 1 MARK

I. CHOOSE THE CORRECT OPTIONS FOR THE BELOW QUESTIONS.

1. How the information entered in a computer?
(a) Knowledge (b) data
(c) ASCII Value (d) BCD [Ans. (b) data]

2. Which establishment done convention using groups of 8 bits as a basic unit of storage medium?
(a) Apple (b) Microsoft
(c) IBM (d) DELL [Ans. (c) IBM]

3. Who coined the term byte?
(a) Charles Babbage (b) John von newmann
(c) Werner Buchholz (d) Herman Hollerith
[Ans. (c) Werner Buchholz]

4. How many standard number system are there to use?
(a) 2 (b) 4 (c) 8 (d) 16
[Ans. (b) 4]

5. Which of the following is not a standard number system?
(a) Pentagon (b) Hexadecimal
(c) Decimal (d) Binary
[Ans. (a) Pentagon]

6. What are the two symbols used in Binary number system?
(a) 0, 1 (b) +, –
(c) 2, 4 (d) 2^0, 2^1 [Ans. (a) 0, 1]

7. How many parameters can be considered to know the magnitude of the number?
(a) 2 (b) 4 (c) 3 (d) 5
[Ans. (c) 3]

8. Which is used to measure the number of bits in each word?
(a) Word length (b) length
(c) Size (d) word size
[Ans. (a) Word length]

9. How many ways are there to represent signed binary number?
(a) 2 (b) 4 (c) 1 (d) 6
[Ans. (c) 1]

10. In binary numbers, the signed negative number has a prefix?
(a) – (b) 0 (c) 1 (d) 2
[Ans. (c) 1]

11. How many unique symbols in Octal number system?
(a) 4 (b) 16 (c) 2 (d) 8
[Ans. (d) 8]

12. How many procedures are there to convert from decimal to binary?
(a) 2 (b) 4 (c) 8 (d) 3
[Ans. (a) 2]

13. How many common coding schemes are used to represent a character?
(a) 2 (b) 3 (c) 4 (d) 5
[Ans. (c) 4]

14. How many coding schemes are used to represent character in India?
(a) 2 (b) 3 (c) 4 (d) 5
[Ans. (a) 2]

15. Which complement performs the logical negation on each individual bit?
(a) Signed (b) Unsigned
(c) 2's (d) 1's
[Ans. (b) Unsigned]

16. Which of the following is not a common coding schemes to represent a character?
(a) BCD (b) Unicode
(c) ASCII Code (d) Byte code
[Ans. (d) Byte code]

17. Which of the following programs uses ASCII code?
(a) only C (b) only C++
(c) both C, C++ (d) Java
[Ans. (c) both C, C++]

18. Which of the programs used Unicode?
(a) C (b) C++
(c) Java (d) None of these
[Ans. (c) Java]

19. Which of the following is the idea behind positional numbering systems?
(a) Absolute Value (b) Place Volume
(c) Radix (d) All of these
[Ans. (c) Radix]

20. Which is an elementary building block of the digital circuit?
(a) Gate (b) Digital gate
(c) Logic gate (d) Physical gate
[Ans. (c) Logic gate]

21. Which one of the following are fundamental logic gates?

(a) NAND, NOR, NOT (b) AND, OR, NOT
(c) NAND, XOR, XNOR (d) AND, XOR, NOT

[Ans. (b) AND, OR, NOT]

22. Which one of the following are called universal gates?

(a) AND, OR, NOT (b) XOR AND XNOR
(c) NAND and NOR (d) NAND and AND

[Ans. (c) NAND and NOR]

23. Which digit is not allowed in hexadecimal number system?

(a) G (b) B (c) E (d) D

[Ans. (a) G]

24. Which coding scheme is used to LCD?

(a) Unicode (b) ASCII
(c) EBCDIC (d) BCD **[Ans. (d) BCD]**

25. How many parameters are considered to find the magnitude of a number?

(a) 3 (b) 4 (c) 2 (d) 5

[Ans. (a) 3]

II. Match List I with List II and Select the Correct Answer using the Codes given below.

1.

	List I		List II
(i)	Binary Number System	1	Base 16
(ii)	Hexa Decimal Number System	2	Base 8
(iii)	Decimal Number System	3	Base 2
(iv)	Octal Number System	4	Base 10

Codes:

	(i)	(ii)	(iii)	(iv)
(a)	4	1	3	2
(b)	1	3	2	4
(c)	3	1	4	2
(d)	4	3	1	2

[Ans. (c) (i)-3, (ii)-1, (iii)-4, (iv)-2]

2.

	List I		List II
(i)	0 to 9 , A o F	1	Binary
(ii)	0, 1	2	Hexadecimal
(iii)	0 to 9	3	Octal
(iv)	0 to 7	4	Decimal

Codes:

	(i)	(ii)	(iii)	(iv)
(a)	4	1	3	2
(b)	1	3	2	4
(c)	3	4	1	2
(d)	4	3	1	2

[Ans. (c) (i)-3, (ii)-4, (iii)-1, (iv)-2]

III. Choose the Correct Option and Fill in the Blanks.

1. Data means ..... .

(a) a set of values (b) a set of information
(c) a set of records (d) a set of files

[Ans. (a) a set of values]

2. The singular form of data is ..... .

(a) Record (b) File
(c) Datum (d) Values

[Ans. (c) Datum]

3. "75% of Men likes cricket" is ..... .

(a) Information (b) data
(c) knowledge (d) Record

[Ans. (c) knowledge]

4. The processed data is called ..... .

(a) Information (b) Knowledge
(c) datum (d) files

[Ans. (a) Information]

5. In a computer, a data is converted into ..... .

(a) ASCII form (b) BCD form
(c) Binary form (d) Octal form

[Ans. (c) Binary form]

6. The most basic unit of information in a digital computer is called a ..... .

(a) word (b) data
(c) nibble (d) bit **[Ans. (d) bit]**

7. Expansion of BIT is ..... .

(a) BASIC DIGITS (b) BINARY DIGIT
(c) BINARY INFORMATION TECHNOLOGY
(d) BASE DIGIT **[Ans. (b) BINARY DIGIT]**

CHAPTER 3 COMPUTER ORGANIZATION

CHAPTER SNAPSHOT

- 3.1. Introduction
- 3.2. Basics of Microprocessors
- 3.3. Data Communication between CPU and memory
- 3.4. Types of Microprocessors
  - 3.4.1. Classification of Microprocessors Based on the Data Width
  - 3.4.2. Classification of Microprocessors Based on Instruction set
- 3.5. Memory Devices
  - 3.5.1. Random Access Memory(RAM)
  - 3.5.2. Types of RAM
  - 3.5.3. Read Only Memory (ROM)
  - 3.5.4. Cache Memory
- 3.6. Secondary Storage Devices
  - 3.6.1. Hard Disks
  - 3.6.2. Compact Disc (CD)
  - 3.6.3. Digital Versatile Disc (DVD)
  - 3.6.4. Flash Memory Devices
  - 3.6.5. Blu-Ray Disc
- 3.7. Ports and Interfaces

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER

1. Which of the following is said to be the brain of a computer?
(a) Input devices (b) Output devices
(c) Memory device (d) Microprocessor
[Ans. (d) Microprocessor]

2. Which of the following is not the part of a microprocessor unit?
(a) ALU (b) Control unit
(c) Cache memory (d) register
[Ans. (c) Cache memory]

3. How many bits constitute a word?
(a) 8 (b) 16 (c) 32
(d) determined by the processor used.
[Ans. (d) determined by the processor used]

4. Which of the following device identifies the location when address is placed in the memory address register?
(a) locator (b) encoder
(c) decoder (d) multiplexer
[Ans. (c) decoder]

5. Which of the following is a CISC processor? *[QY. 2018; Sep. 2021]*
(a) Intel P6 (b) AMD K6
(c) Pentium III (d) Pentium IV
[Ans. (c) Pentium III]

6. Which is the fastest memory? *[FMT 2018]*
(a) Hard disk (b) Main memory
(c) Cache memory (d) Blue-Ray disc
[Ans. (c) Cache memory]

7. How many memory locations are identified by a processor with 8 bits address bus at a time?
(a) 28 (b) 1024
(c) 256 (d) 8000 **[Ans. (c) 256]**

8. What is the capacity of 12cm diameter DVD with single sided and single layer?
(a) 4.7 GB (b) 5.5 GB
(c) 7.8 GB (d) 2.2 GB
[Ans. (a) 4.7 GB]

9. What is the smallest size of data represented in a CD?
(a) blocks (b) sectors
(c) pits (d) tracks **[Ans. (c) pits]**

10. Display devices are connected to the computer through
(a) USB port
(b) Ps/2 port
(c) SCSI port
(d) VGA connector **[Ans. (d) VGA connector]**

SECTION - B

VERY SHORT ANSWERS

1. What are the parameters which influence the characteristics of a microprocessor?

Ans. A Microprocessor's performance depends on the following characteristics:
(i) Clock speed
(ii) Instruction set
(iii) Word size

2. What is an instruction?

Ans. A command which is given to a computer to perform an operation on data is called an instruction.

3. What is a program counter? *[Mar. 2019]*

Ans. The Program Counter (PC) is a special register in the CPU which always keeps the address of the next instruction to be executed.

4. What is HDMI? *[FMT 2018; HY. 2019 ; Sep. 2020]*

Ans. High-Definition Multimedia Interface is an audio/video interface which transfers the uncompressed video and audio data from a video controller, to a compatible computer monitor, LCD projector, digital television etc.

5. Which source is used to erase the content of a EPROM?

Ans. Ultra-violet-rays is used to erase the content of a EPROM.

SECTION - C

SHORT ANSWERS

1. Differentiate Computer Organization from Computer Architecture.

Ans.
(i) Computer Organization deals with the hardware components that are transparent to the programmer.
(ii) Computer architecture deals with the engineering considerations involved in designing a computer.

2. Classify the microprocessor based on the size of the data.

Ans. Microprocessors can process instructions. The microprocessors can be classified as follows based on the size of the data.
(i) 8-bit microprocessor
(ii) 16-bit microprocessor
(iii) 32-bit microprocessor
(iv) 64-bit microprocessor

3. Write down the classifications of microprocessors based on the instruction set.

Ans. The two types of microprocessors wich are based on their instruction sets.
(i) Reduced Instruction Set Computers (RISC)
(ii) Complex Instruction Set Computers (CISC)

4. Differentiate PROM and EPROM.

Ans.

	PROM	EPROM
(i)	Programmable Read only memory.	Erasable Programmable Read only memory.
(ii)	It is also a non-volatile memory on which data can be written only once.	It is also a nono-volatile memory and a special type of memory.
(iii)	PROM burner is used to write data to a PROM chip.	EPROM serves as a PROM, but the content can be erased using ultraviolet rays

5. Write down the interfaces and ports available in a computer. *[HY. 2019 ; Sep. 2020]*

Ans.
(i) Serial Port
(ii) Parallel Port
(iii) USB 3.0
(iv) VGA Connector
(v) Audio Plugs
(vi) PS/2 Port
(vii) SCSI Port
(viii) High Definition Multimedia Interface(HDMI).

6. Differentiate CD and DVD.

[FMT 2018; June 2019; Mar. 2020]

Ans.

	CD	DVD
(i)	Expansion is Compact-Disk	Expansion is Digital Versatile Disc.
(ii)	A standard CD can store about 700 MB of Data.	A standard DVD can hold 4.7 GB of data.
(iii)	CD players cannot play DVDs.	DVD players can play CDs.
(iv)	It stores upto 80 min of audio.	It can range from 4.7 GB to 17.08 GB.

7. How will you differentiate a flash memory and an EEPROM?

Ans. **Flash memory devices:**
(i) Flash memory is an electronic (solid-state) non-volatile computer storage medium that can be electrically erased and reprogrammed.
(ii) Flash memories can be used in personal computers, Personal Digital Assistants (PDA), digital audio players, digital cameras and mobile phones.
(iii) Flash memory offers fast access times. The time taken to read or write a character in memory is called access time.
(iv) Examples for Flash memories are pen drives, memory cards etc.

EEPROM:
(i) Electrically Erasable Programmable Read Only Memory can be erased by exposing it to an electrical charge.
(ii) EEPROM is non-volatile.
(iii) EEPROM is slower in performance.

SECTION - D

EXPLAIN IN DETAIL

1. Explain the characteristics of a microprocessor.

[FMT; HY. 2018; June 2019; HY. 2019]

Ans. A Microprocessor's performance depends on the following characteristics:

(i) Clock speed
(ii) Instruction set
(iii) Word size

(i) Clock Speed *[Govt.MQP-2018; QY. 2019]*

Every microprocessor has an internal clock that regulates the speed at which it executes instructions. The speed at which the microprocessor executes instructions is called clock speed. Clock speed is measured in MHz (Mega Hertz) or in GHz (Giga Hertz).

(ii) Instruction set : A command which is given to a computer to perform an operation on data is called an instruction. Basic set of machine level instructions that a microprocessor is designed to execute is called as an instruction set. This instruction set carries out the following types of operations:

1. Data transfer
2. Arithmetic operations
3. Logical operations
4. Control flow
5. Input/output.

(iii) Word Size : *[Govt.MQP-2018]*

The number of bits that can be processed by a processor in a single instruction is called its word size. Word size determines the amount of RAM that can be accessed by a microprocessor at one time and the total number of pins on the microprocessor. Total number of input and output pins in turn determines the architecture of the microprocessor.

2. How the read and write operations are performed by a processor? Explain.

Ans. **(i)** The Central Processing Unit(CPU) has a Memory Data Register (MDR) and a Memory Address Register (MAR).

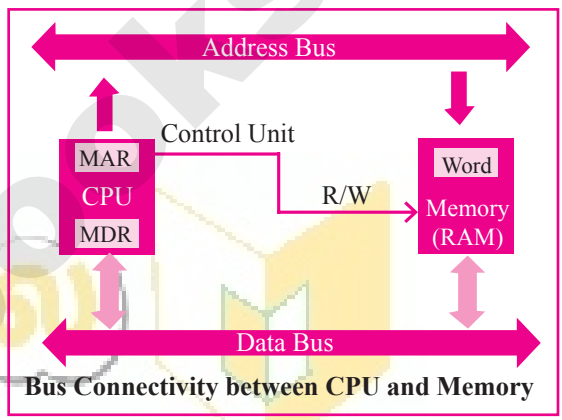
(ii) The Memory Data Register (MDR) keeps the data which is transferred between the Memory and the CPU. The Program Counter (PC) is a special register in the CPU which always keeps the address of the next instruction to be executed.

(iii) A bus is a collection of wires used for communication between the internal components of a computer.

(iv) The address bus is used to point a memory location. A decoder, a digital circuit is used to point to the specific memory location where the word can be located.

(v) The read operation fetches data from memory and transfers to MDR. A single control line performs two operations like read write using 1or 0.

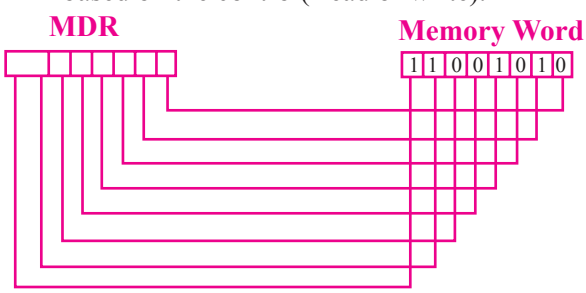
(vi) Also, the write operation transfers data from the MDR to memory.



Bus Connectivity between CPU and Memory

(vii) The word in the RAM has the same size (no. of bits) as the Memory Data Register (MDR).

(viii) The data bus has eight parallel wires to transfer data either from MDR to word or word to MDR based on the control(Read or write).



Before the read operation

(ix) This control line is labeled as R/W, which becomes 1 means READ operation and 0 means WRITE operation. The content of MDR and the Word before the READ operation. Also figure shows the content of MDR and the Word after the READ operation.

Long Answers 5 MARKS

1. Explain the classification of Microprocessor based on Instruction set?

Ans. **(i)** The size of the instruction set is another important consideration while categorizing microprocessors. Initially, microprocessors had very small instruction sets because complex hardware was expensive as well as difficult to build.

(ii) As technology had developed to overcome these issues, more and more complex instructions were added to increase the functionality of microprocessors.

(iii) Reduced Instruction Set Computers (RISC): RISC stands for Reduced Instruction Set Computers. They have a small set of highly optimized instructions. Complex instructions are also implemented using simple instructions thus reducing the size of the instruction set.

Examples of RISC processors are Pentium IV, Intel P6, AMD K6 and K7.

(iv) Complex Instruction Set Computers (CISC): CISC stands for Complex Instruction Set Computers. They support hundreds of instructions. Computers supporting CISC can accomplish a wide variety of tasks, making them ideal for personal computers.

Examples of CISC processors are Intel 386 & 486, Pentium, Pentium II and III, and Motorola 68000.

2. Define the following.
(i) Bus (ii) Data bus
(iii) Address bus (iv) Control Bus

Ans. **(i) Bus :** A bus is a collection of wires used for communication between the internal components of a computer.

(ii) Data bus : Data bus is a collection of wires to carry data in bits. A data bus is used to transfer data between the memory and the CPU. The data bus is bidirectional.

(iii) Address bus : Address bus is a collection of wires to carry data in bits. The address bus is used to point a memory location. The address bus is unidirectional.

(iv) Control bus : Control bus is a control line, collection of wires to control the operation functions. The control bus controls both read and write operations.

3. Explain any two secondary storage devices.

Ans. **Hard disk :**

(i) Hard disk is a magnetic disk on which you can store data. The hard disk has the stacked arrangement of disks accessed by a pair of heads for each of the disks.

(ii) The hard disks come with a single or double sided disk.

Compact Disk (CD) :

(i) A CD or CD-ROM is made from 1.2 millimeters thick, polycarbonate plastic material. A thin layer of aluminum or gold is applied to the surface.

(ii) CD data is represented as tiny indentations known as "pits", encoded in a spiral track moulded into the top of the polycarbonate layer. The areas between pits are known as "lands".

(iii) A motor within the CD player rotates the disk. The capacity of an ordinary CD- ROM is 700MB.

☆☆☆

CHAPTER 4 THEORETICAL CONCEPTS OF OPERATING SYSTEM

CHAPTER SNAPSHOT

- 4.1. Introduction to Software
  - 4.1.1. Types of Software
- 4.2. Introduction to Operating System (OS)
- 4.3. Types of Operating System
  - 4.3.1. Single User Operating Systems
  - 4.3.2. Multi-user Operating Systems
- 4.4. Key features of the Operating System
  - 4.4.1. User Interface (UI)
  - 4.4.2. Memory Management
  - 4.4.3. Process Management
  - 4.4.4. Security Management
  - 4.4.5. Fault Tolerance
  - 4.4.6. File Management
  - 4.4.7. Multi-Processing
  - 4.4.8. Time-sharing
  - 4.4.9. Distributed Operating Systems
- 4.5. Prominent Operating Systems

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER

1. Operating system is a
(a) Application Software (b) Hardware
(c) System Software (d) Component
[Ans. (c) System Software]

2. Identify the usage of Operating Systems
(a) Easy interaction between the human and computer
(b) Controlling Input & Output Devices
(c) Managing use of main memory
(d) All the above **[Ans. (d) All the above]**

3. Which of the following is not a function of an Operating System?
(a) Process Management
(b) Memory Management
(c) Security management
(d) Complier Environment
[Ans. (d) Complier Environment]

4. Which of the following OS is a Commercially licensed Operating system?
(a) Windows (b) UBUNTU
(c) FEDORA (d) REDHAT
[Ans. (a) Windows]

5. Which of the following Operating systems support Mobile Devices? *[June 2019] ; [Sep. 2020]*
(a) Windows 7 (b) Linux
(c) BOSS (d) iOS **[Ans. (d) iOS]**

6. File Management manages
(a) Files (b) Folders
(c) Directory systems (d) All the Above
[Ans. (d) All the Above]

7. Interactive Operating System provides
(a) Graphics User Interface (GUI)
(b) Data Distribution
(c) Security Management
(d) Real Time Processing
[Ans. (a) Graphics User Interface (GUI)]

8. An example for single task operating system is

(a) Linux (b) Windows
(c) MS-DOS (d) Unix

[Ans. (c) MS-DOS]

9. The File management system used by Linux is

(a) ext2 (b) NTFS (c) FAT (d) NFTS

[Ans. (a) ext2]

SECTION - B

VERY SHORT ANSWERS

1. List out any two uses of Operating System.

Ans. **(i)** To ensure that a computer can be used to extract what the user wants it do.

(ii) Easy interaction between the users and computers.

2. What is multi-user Operating system?

Ans. **Multi-user Operating Systems :** *[Mar. 2019]*

(i) It is used in computers and laptops that allow same data and applications to be accessed by multiple users at the same time.

(ii) The users can also communicate with each other. Windows, Linux and UNIX are examples for multi-user Operating System.

3. What is a GUI? *[Govt.MQP-2018; June 2019]*

Ans. The GUI is a window based system with a pointing device to direct I/O, choose from menus, make selections and a keyboard to enter text. Its vibrant colours attract the user very easily.

4. What are the security management features available in Operating System?

[HY. 2018 ; Sep. 2020]

Ans. The Operating System provides three levels of securities to the user end. They are

(i) File access level

(ii) System level

(iii) Network level.

5. What is multi-processing?

Ans. Multi-processing is a one of the features of Operating System. It has two or more processors for a single running process (job). Processing takes place in parallel is known as parallel processing.

6. What are the different Operating Systems used in computer? *[Sep. 2021]*

Ans. The different types of operating system used in the computer:

(i) Single User and Single Task Operating Systems

(ii) Multi User Operating Systems

(iii) Multi Processing Operating Systems

(iv) Distributed Operating Systems

(v) Prominent Operating Systems

SECTION - C

SHORT ANSWERS

1. What are the advantages and disadvantages of Time-sharing features? *[QY. 2018]*

Ans.

Time - Sharing Operating System	
Advantages	**Disadvantages**
Provides the advantage of quick response.	Problem of reliability.
Avoids duplication of software.	Question of security and integrity of uses programs and data.
Reduces CPU idle time.	Problem of data communication.

2. List out the key features of Operating system

Ans. The various key features are given below

(i) User Interface

(ii) File Management

(iii) Memory Management

(iv) Fault Tolerance

(v) Process Management

(vi) Security Management.

3. Write a note on Multiprocessing.

Ans. **(i)** Multi-processing is a one of the features of Operating System.

(ii) It has two or more processors for a single running process (job).

(iii) Processing takes place in parallel is known as parallel processing.

(iv) Since the execution takes place in parallel, this feature is used for high speed execution which increases the power of computing.

ADDITIONAL QUESTIONS AND ANSWERS

CHOOSE THE CORRECT ANSWERS 1 MARK

I. CHOOSE THE CORRECT OPTIONS FOR THE BELOW QUESTIONS.

1. Which of the following acts as an interface between a user and a computer?
(a) Input device (b) Output device
(c) Operating system (d) Bus
[Ans. (c) Operating system]

2. Which one of the following is not a function of an operating system?
(a) Program Management
(b) Process Management
(c) Device Management
(d) Memory Management
[Ans. (a) Program Management]

3. Which is used to perform any computer operation?
(a) Application software
(b) Hardware
(c) Operating system
(d) File Management
[Ans. (c) Operating system]

4. Which of the following operating systems not used in laptops?
(a) Windows (b) Linux
(c) iOS (d) Unix [Ans. (c) iOS]

5. Which of the following operating system are not in mobile phones?
(a) Symbian (b) Linux
(c) Apple iOS (d) Google Android
[Ans. (b) Linux]

6. Which of the following is a concept of having more than one operating system on single PC?
(a) Multiuser (b) Multi tasking
(c) Multiprocessor (d) Virtual
[Ans. (d) Virtual]

7. Which of the following is a single user Operating system?
(a) MS-DOS (b) Unix
(c) Linux (d) Windows
[Ans. (a) MS-DOS]

8. On which operating system more than one tasks executed concurrently?
(a) Single-user
(b) Time sharing
(c) Multi-user
(d) Multiprocessing
[Ans. (b) Time sharing]

9. Which scheduling technique employed by time sharing OS?
(a) Spooling (b) LIFO
(c) FIFO (d) Round Robin
[Ans. (d) Round Robin]

10. Which of the following is not true about Timesharing OS?
(a) Provides the advantage of quick response
(b) Promotes duplication of software
(c) Reduces CPU idle time
(d) Problem of reliability
[Ans. (b) Promotes duplication of software]

11. In which operating system, given tasks done within a fixed timeline?
(a) Real time (b) Multi-tasking
(c) Multiprocessor (d) Online
[Ans. (a) Real time]

12. Which operating system is used to access shared data and files any machine around the world?
(a) Real time (b) Multiuser
(c) Multiprocessor (d) Distributed
[Ans. (d) Distributed]

13. In which operating system the user can exchange the data which each other in real time?
(a) Distributed (b) Real time
(c) Time sharing (d) Multi-user
[Ans. (a) Distributed]

14. Which operating system provides GUI?
(a) Distributed (b) Real time
(c) Interactive (d) Multi-User
[Ans. (c) Interactive]

15. How many functions are there in OS?
(a) 4 (b) 5 (c) 3 (d) 2
[Ans. (b) 5]

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER

1. From the options given below, choose the operations managed by the operating system.

(a) Memory
(b) Processes
(c) Disks and I/O devices
(d) all of the above **[Ans. (d) all of the above]**

2. Which is the default folder for many Windows Applications to save your file?

(a) My Document
(b) My Pictures
(c) Documents and Settings
(d) My Computer **[Ans. (a) My Document]**

3. Under which of the following OS, the option Shift + Delete – permanently deletes a file or folder?

(a) Windows 7 (b) MS-DOS
(c) Linux (d) Android OS
[Ans. (a) Windows 7]

4. What is the meaning of "Hibernate" in Windows XP/Windows 7?

(a) Restart the Computer in safe mode
(b) Restart the Computer in hibernate mode
(c) Shutdown the Computer terminating all the running applications
(d) Shutdown the Computer without closing the running applications
[Ans. (d) Shutdown the Computer without closing the running applications]

5. The shortcut key used to rename a file in windows

(a) F2 (b) F4
(c) F5 (d) F6 **[Ans. (a) F2]**

SECTION - B

VERY SHORT ANSWERS

1. What is known as Multitasking? *[QY. 2018]*

Ans. Microsoft windows is one of the most popular graphical user Interface. Multiple applications can execute simultaneously in windows, and this is known as 'Multitasking'.

2. What are called standard icons?

Ans. The icons which are available on desktop by default while installing Windows OS are called standard icons. The standard icons available in all Windows OS are My Computer, Documents and Recycle Bin.

3. Differentiate Files and Folders.

Ans.

Files	Folders
File is the collection of records.	Folder is a collections of files.
Create a file : Start → All Programs → select application → ok	**Create a folders :** Right click → New → folder → ok

4. Differentiate Save and save As option. *[QY. 2019]*

Ans. "Save" option save a document in first time. "Save As" option save an already saved the document with a new name and also create a copy of already saved document with a new name obviously.

5. How will you Rename a File? *[Sep. 2021]*

Ans. There are number of ways to rename files or folders. You can rename using the File menu, left mouse button or right mouse button.

SECTION - C

SHORT ANSWERS

1. What are the functions of Windows Operating system? *[HY. 2019]*

Ans. Some of the functions of Windows Operating System are:

(i) Access applications (programs) on the computer (word processing, games, spread sheets, calculators and so on).
(ii) Load any new program on the computer.
(iii) Manage hardware such as printers, scanners, mouse, digital cameras etc.,
(iv) File management activities (For example creating, modifying, saving, deleting files and folders).
(v) Change computer settings such as colour scheme, screen savers and the resolution of monitor.

2. Write a note on Recycle bin. *[QY 2018, 2019; Mar.2020]*

Ans. Recycle bin is a special folder to keep the files or folders deleted by the user, which means you still have an opportunity to recover them. The user cannot access the files or folders available in the Recycle bin without restoring it. To restore file or folder from the Recycle Bin

(i) Open Recycle bin.

(ii) Right click on a file or folder to be restored and select Restore option from the pop-up menu.

(iii) To restore multiple files or folders, select Restore all items.

(iv) To delete all files in the Recycle bin, select Empty the Recycle Bin.

3. Write a note on the elements of a window.

Ans. **Elements of a window :**

(i) Title Bar : The title bar will display the name of the application and the name of the document opened. It will also contain minimize, maximize and close button.

(ii) Menu Bar : The menu bar is seen under the title bar. Menus in the menu bar can be accessed by pressing Alt key and the letter that appears underlined in the menu title. Additionally, pressing Alt or F10 brings the focus on the first menu of the menu bar.

(iii) The Workspace : The workspace is the area in the document window to enter or type the text of your document.

(iv) Scroll bars : The scroll bars are used to scroll the workspace horizontally or vertically

(v) Corners and borders : The corners and borders of the window helps to drag and resize the windows. The mouse pointer changes to a double headed arrow when positioned over a border or a corner. Drag the border or corner in the direction indicated by the double headed arrow to the desired size. The window can be resized by dragging the corners diagonally across the screen.

4. Write the two ways to create a new folder.

Ans. There are two ways in which you can create a new folder:

Method I:

Step 1 : Open Computer Icon.
Step 2 : Open any drive where you want to create a new folder. (For example select D:)
Step 3 : Click on File → New → Folder.
Step 4 : A new folder is created with the default name "New folder".
Step 5 : Type in the folder name and press Enter key.

Method II:

In order to create a folder in the desktop:

Step 1 : In the Desktop, right click → New → Folder.
Step 2 : A Folder appears with the default name "New folder" and it will be highlighted as shown.
Step 3 : Type the name you want and press Enter Key.
Step 4 : The name of the folder will change.

5. Differentiate copy and move. *[Sep. 2021]*

Ans.

	Copy	Move
(i)	It means to make a duplicate copy of a file.	It means to transfer a file from one location to another.
(ii)	It uses the 'copy and paste' option.	It uses the 'cut and paste' option.
(iii)	The original file remains at the source location.	The original file is moved to the destination location.

UNIT- II ALGORITHMIC PROBLEM SOLVING

CHAPTER 6 SPECIFICATION AND ABSTRACTION

CHAPTER SNAPSHOT

- 6.1 Algorithms
- 6.2 Algorithmic Problems
- 6.3 Building Blocks of Algorithms
  - 6.3.1 Data
  - 6.3.2 Variables
  - 6.3.3 Control flow
  - 6.3.4 Functions
- 6.4 Algorithm Design Techniques
- 6.5 Specification
  - 6.5.1 Specification as contract
- 6.6 Abstraction
  - 6.6.1 State
  - 6.6.2 Assignment Statement

EVALUATION

SECTION - A

CHOOSE THE CORRECT ANSWER

1. Which of the following activities is algorithmic in nature?

(a) Assemble a bicycle
(b) Describe a bicycle
(c) Label the parts of a bicycle
(d) Explain how a bicycle works

[Ans. (a) Assemble a bicycle]

2. Which of the following activities is not algorithmic in nature?

(a) Multiply two numbers
(b) Draw a kolam
(c) Walk in the park
(d) Swaping of two numbers.

[Ans. (d) Swaping of two numbers.]

3. Omitting details inessential to the task and representing only the essential features of the task is known as

(a) specification (b) abstraction
(c) composition (d) decomposition

[Ans. (b) abstraction]

4. Stating the input property and the input - output relation a problem is known *[Sep. 2021]*

(a) specification (b) statement
(c) algorithm (d) definition

[Ans. (a) specification]

5. Ensuring the input-output relation is

(a) the responsibility of the algorithm and the right of the user.
(b) the responsibility of the user and the right of the algorithm.
(c) the responsibility of the algorithm but not the right of the user.
(d) the responsibility of both the user and the algorithm.

[Ans. (d) the responsibility of both the user and the algorithm.]

6. If i = 5 before the assignment i := i-1 after the assignment, the value of i is

(a) 5 (b) 4 (c) 3 (d) 2

[Ans. (b) 4]

7. If 0 < i before the assignment i := i-1 after the assignment, we can conclude that *[QY. 2018]*

(a) 0 < i (b) 0 ≤ i (c) i = 0 (d) 0 ≥ i

[Ans. (b) 0 ≤ i]

SECTION - B

VERY SHORT ANSWERS

1. Define an algorithm.

Ans. An algorithm is a sequence of instructions to accomplish a task or solve a problem.

2. Distinguish between an algorithm and a process. *[Govt.MQP-2018]*

Ans.

S.No	Algorithm	Process
(i)	An algorithm is a step-by-step sequence of statements to solve a problem.	An instruction describes an action.
(ii)	As an algorithm is executed, a process evolves which solves the problem.	When the instructions are executed, a process evolves which accomplishes the intended task or solves the given problem.

3. Initially,

farmer, goat, grass, wolf = L, L, L, L and the farmer crosses the river with goat. Model the action with an assignment statement.

Ans. (i) -- farmer, goat, grass, wolf = L, L, L, L
(ii) farmer, goat := R, R
(iii) -- farmer , goat , grass , wolf = R, R, L, L
(iv) farmer := L
(v) farmer, goat, grass, wolf = L, R, L, L
(vi) farmer, grass := R, R
(vii) -- farmer , goat , grass , wolf = R, R, R, L
(viii) farmer, goat := L, L
(ix) -- farmer, goat, grass, wolf = L, L, R, L
(x) farmer, wolf := R, R
(xi) -- farmer , goat , grass , wolf = R, L, R, R
(xii) farmer : = L
(xiii) -- farmer , goat , grass , wolf = L, L, R, R
(xiv) farmer , goat : = R, R
(xv) - farmer , goat , grass , wolf = R, R, R, R

4. Specify a function to find the minimum of two numbers.

Ans. (i) Minimum (A, B)
(ii) -- inputs : A an B are integers or real numbers.
(iii) -- outputs : A is minimum, (A < B)
B is minimum, (B < A)

5. If $\sqrt{2}$ = 1.414, and the square_root() function returns -1.414, does it violate the following specification?
-- square_root (x)
-- inputs: x is a real number , x ≥ 0
-- outputs: y is a real number such that $y^2 = X$

Ans. Yes, it violate the specification.

SECTION - C

SHORT ANSWERS

1. When do you say that a problem is algorithmic in nature?

Ans. We usually say that a problem is algorithmic in nature when its solution involves the construction of an algorithm. Some types of problems can be immediately recognized as algorithmic.

2. What is the format of the specification of an algorithm?

Ans. Let P be the required property of the inputs and Q the property of the desired outputs. Then the algorithm S is specified as

1. algorithm_name (inputs)
2. -- inputs : P
3. -- outputs: Q

3. What is abstraction? *[HY. 2018; QY. 2019]*

Ans. A problem can involve a lot of details. Several of these details are unnecessary for solving the problem. Only a few details are essential. Ignoring or hiding unnecessary details and modeling an entity only by its essential properties is known as abstraction.

4. How is state represented in algorithms?

Ans. (i) State is a basic and important abstraction.
(ii) Computational processes have state. A computational process starts with an initial state. As actions are performed, its state changes. Its ends with a final state.
(iii) The state at any point of execution is simply the values of the variables at that point.

5. What is the form and meaning of assignment statement?

Ans. Assignment statement is used to store a value in a variable. It is written with the variable on the left side of the assignment operator and a value on the right side.

Format / Form :

variable := value

Example : m : = 2

When this assignment is executed, the value on the right side is stored in the variable on the left side.

6. What is the difference between assignment operator and equality operator?

Ans. Assignment operator is used to assign the right hand side value into left hand side variable.

Example : A = 5, B = 10

Equality operator is used compare the values of both right hand side variable and left hand side variable and results in either true or false.

Example : A == B (a = 5, b = 5) True

A ≠ B (a = 5, b = 0) True.

SECTION - D

EXPLAIN IN DETAIL

1. Write the specification of an algorithm hypotenuse whose inputs are the lengths of the two Wshorter sides of a right angled triangle, and the output is the length of the third side.

Ans. **(i)** Let us name the algorithm hypotenuse.

(ii) It takes the number as the input. Let us name the input S1, S2 should not be negative.

(iii) It produces the Hypotenuse of S1, S2 as the output. Let us name the output *l*. Then S1, S2 should be the square of *l*.

Now the specification of the algorithm is

Hypotenuse (S1, S2)

- inputs : S1 and S2 are real numbers or integers.

- outputs :*l* is a real number such that $l^2 = S1^2 + S2^2$

2. Suppose you want to solve the quadratic equation $ax^2 + bx + c = 0$ by an algorithm. *[QY. 2018]*

quadratic_solve (a, b, c)

-- inputs : ?

-- outputs: ?

You intend to use the formula and you are prepared to handle only real number roots. Write a suitable specification.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Ans. Quadratic_solve (a, b, c)

-- inputs : a, b, c are real numbers, a ≠ 0

-- outputs : x is a real number, the quadration equation $ax^2 + bx + c = 0$ is satisfied by exactly two values fx, namely

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and}$$

$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

3. Exchange the contents: Given two glasses marked A and B. Glass A is full of apple drink and glass B is full of grape drink. For exchanging the contents of glasses A and B, represent the state by suitable variables, and write the specification of the algorithm. *[HY. 2018]*

Ans. **(i)** Let us name the algorithm exchange.

(ii) It takes the number as the input. Let us name the input a, b. a,b should not be zero.

(iii) It produces the exchange of a,b by using third variable t as the output. Let us name the output. Then a, b, t should be exchange of the drinks.

Now the specification of the algorithm is

Exchange (a, b)

-- inputs : a, b are integers, a ≠ 0, b ≠ 0

-- outputs : a, b are integers,

t : = a

a : = b

b := t

LONG ANSWERS 5 MARKS

1. Explain in detail how will you construct an algorithm. Whatever with in (or) Explain the Building Blocks of Algorithms.

Ans. To construct algorithms using basic building blocks such as. Data, Variables, Control flow, Functions.

Data :

Algorithms take input data, process the data, and produce output data. Computers provide instructions to perform operations on data. For example, there are instructions for doing arithmetic operations on numbers, such as add, subtract, multiply and divide. There are different kinds of data such as numbers and text.

Variables :

Variables are named boxes for storing data. When we do operations on data, we need to store the results in variables. The data stored in a variable is also known as the value of the variable. We can store a value in a variable or change the value of variable, using an assignment statement.

Control flow :

An algorithm is a sequence of statements. However, after executing a statement, the next statement executed need not be the next statement in the algorithm. The statement to be executed next may depend on the state of the process. Thus, the order in which the statements are executed may differ from the order in which they are written in the algorithm. This order of execution of statements is known as the control flow.

Functions :

Algorithms can become very complex. The variables of an algorithm and dependencies among the variables may be too many. Then, it is difficult to build algorithms correctly. In such situations, we break an algorithm into parts, construct each part separately, and then integrate the parts to the complete algorithm.

The parts of an algorithm are known as functions. A function is like a sub algorithm. It takes an input, and produces an output, satisfying a desired input output relation.

2. Explain the types of control flow statements.

Ans. There are three important control flow statements to alter the control flow depending on the state.

(i) In sequential control flow, a sequence of statements are executed one after another in the same order as they are written.

(ii) In alternative control flow, a condition of the state is tested, and if the condition is true, one statement is executed; if the condition is false, an alternative statement is executed.

(iii) In iterative control flow, a condition of the state is tested, and if the condition is true, a statement is executed. The two steps of testing the condition and executing the statement are repeated until the condition becomes false.

☆☆☆

PHYSICS

VOLUME - I

CONTENTS

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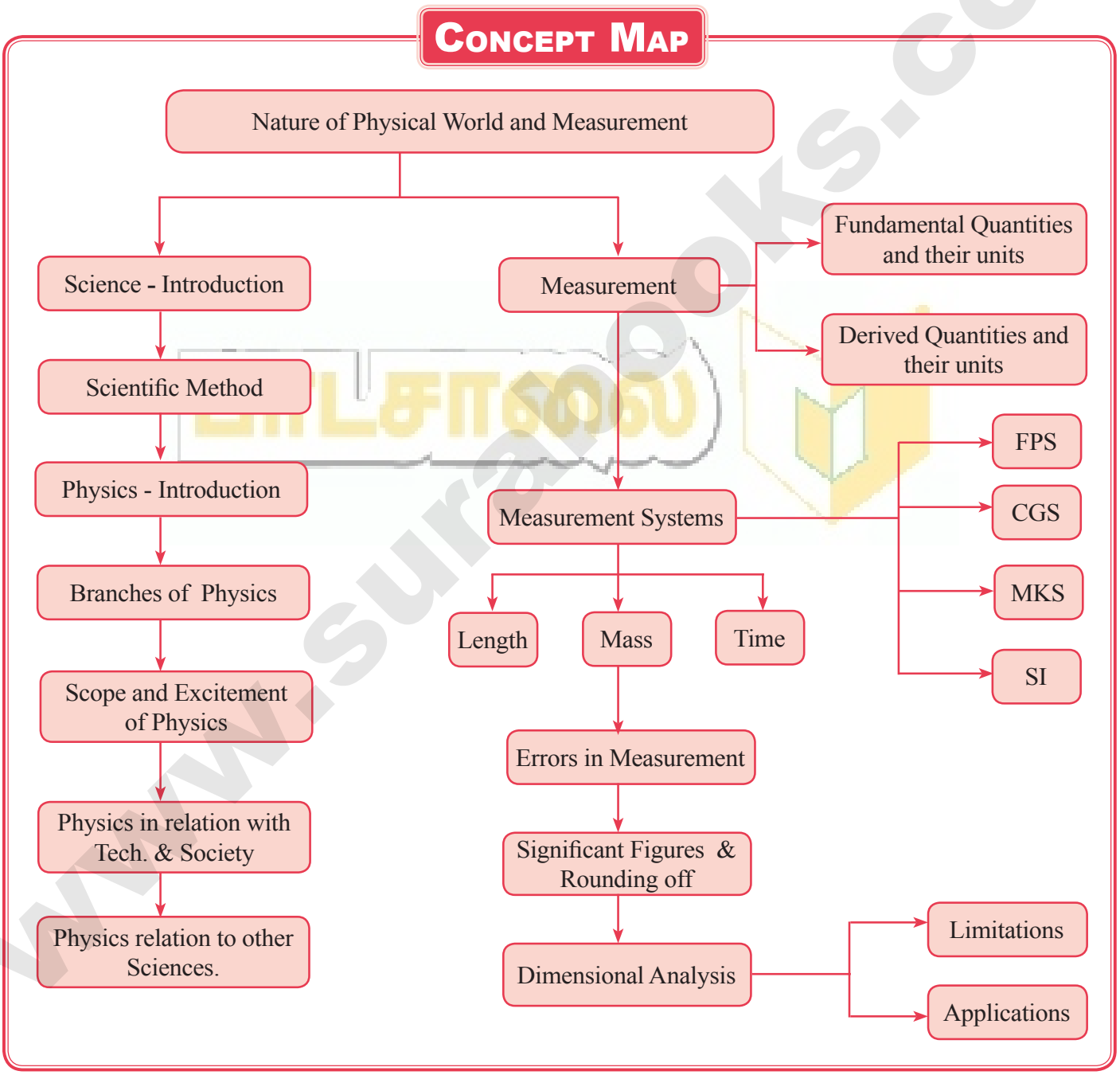
UNIT

01

Nature of Physical World and Measurement

Concept Map



FORMULAE TO REMEMBER

(1) Distance travelled by light in one year in vaccuum = [velocity of light × 1 year in seconds]
$= 3 \times 10^8 \times 365.25 \times 24 \times 60 \times 60$
$= 9.467 \times 10^{15}$m

(2) π radian = 180°

(3) 1 radian = $\frac{180^\circ}{\pi} = \frac{180^\circ \times 7}{22} = 57.27^\circ$

(4) Also 1° (degree of arc) = 60′ (minute of arc) and 1′ (minute of arc) = 60″ (seconds of arc)

Relations between radian, degree and minutes:

(5) $1^\circ = \frac{\pi}{180}$ rad $= 1.745 \times 10^{-2}$ rad

(6) $1' = \frac{1^\circ}{60} = \frac{1.745 \times 10^{-2}}{60} = 2.908 \times 10^{-4}$ rad
$\approx 2.91 \times 10^{-4}$ rad

(7) $1'' = \frac{1^\circ}{3600} = \frac{1.745 \times 10^{-2}}{3600} = 4.847 \times 10^{-6}$ rad
$\approx 4.85 \times 10^{-6}$ rad

(8) Derived unit:
Example : unit of speed = $\frac{\text{unit of distance}}{\text{unit of time}} = \frac{\text{m}}{\text{s}} = \text{ms}^{-1}$

(9) Absolute error $a_m = \frac{a_1 + a_2 + a_3 + \ldots\ldots\ldots + a_n}{n}$ or $a_m = \frac{1}{n}\sum_{i=1}^{i=n} a_i$; $a_m \rightarrow$ true value of measured quantity, $n \rightarrow$ number of values

(10) Mean Absolute error $\Delta a_m = \frac{1}{n}\sum_{i=1}^{n} |\Delta a_i|$; $\Delta a_m \rightarrow$ Mean absolute error, $n \rightarrow$ number of values

(11) Relative error (or) Fractional error $\Delta a = \frac{\Delta a_m}{a_m}$; $a_m \rightarrow$ Mean value

(12) Percentage error, $\Delta a = \frac{\Delta a_m}{a_m} \times 100\%$

SOME COMMON PRACTICAL UNITS

(1) 1 Fermi, 1 fm = 10^{-15} m
(2) 1 Angstrom, 1Å = 10^{-10} m
(3) 1 nanometer, 1nm = 10^{-9} m
(4) 1 micron (or) micro meter, 1µm = 10^{-6} m
(5) 1 Light year = 9.467×10^{15}m
(6) 1 Astronomical unit, 1 AU = 1.496×10^{11} m
(7) 1 Parallactic second, 1 parsec = 3.08×10^{16} m = 3.26 light year
(8) 1 CSL = 1.4 times, the mass of the sun
(9) 1 shake = 10^{-8} s (or) 10 nanoseconds

Prefixes for Powers of Ten

Multiple	Prefix	Symbol	Sub multiple	Prefix	Symbol
10^{1}	deca	da	10^{-1}	deci	d
10^{2}	hecto	h	10^{-2}	centi	c
10^{3}	kilo	k	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	µ
10^{9}	giga	G	10^{-9}	nano	n
10^{12}	tera	T	10^{-12}	pico	p
10^{15}	peta	P	10^{-15}	femto	f
10^{18}	exa	E	10^{-18}	atto	a
10^{21}	zetta	Z	10^{-21}	zepto	z
10^{24}	yotta	Y	10^{-24}	yocto	y

IMPORTANT TERMS & DEFINITIONS

Science : Science is the systematic organization of knowledge gained through observation, experimentation and logical reasoning.

Physics : Physics is most basic science which deals with study of nature and natural phenomena.

Unification : Attempting to explain diverse physical phenomena with a few concepts and laws.

Reductionism : An attempt to explain a macroscopic system in terms of its microscopic constituents.

Technology	:	The application of the principles of physics, i.e. knowledge for practical purposes in various fields to invent and produce useful products or to solve problems.
Classical mechanics	:	The study of forces acting on bodies whether at rest or in motion
Thermodynamics	:	The study of the relationship between heat and other forms of energy
Optics	:	The study of light
Electricity and magnetism	:	The study of electricity and magnetism and their mutual relationship
Acoustics	:	The study of the production and propagation of sound waves
Astrophysics	:	The branch of physics which deals with the study of the physics of astronomical bodies
Relativity	:	One of the branches of theoretical physics which deals with the relationship between space, time and energy particularly with objects moving in different ways .
Quantum mechanics	:	The study of the discrete nature of phenomena at the atomic and subatomic levels
Atomic physics	:	The branch of physics which deals with the structure and properties of the atom
Nuclear physics	:	The branch of physics which deals with the structure, properties and reaction of the nuclei of atoms.
Condensed matter physics	:	The study of the properties of condensed materials (solids, liquids and those intermediate between them and dense gas). It branches into various sub-divisions including developing fields such as nano science, photonics etc. It covers the basics of materials science, which aims at developing new material with better properties for promising applications.
High energy physics	:	The study of the nature of the particles.
Range of time scales	:	Astronomical scales to microscopic scales, 10^{18}s to 10^{-22}s.
Range of masses	:	From heavenly bodies to electron, 10^{55} kg (mass of known observable universe) to 10^{-31} kg (mass of an electron) [the actual mass of an electron is 9.11×10^{-31} Kg].
Measurement	:	The comparison of any physical quantity with its standard unit is known as measurement.
Physical Quantities	:	Quantities that can be measured, and in terms of which, laws of physics are described are called physical quantities.
Fundamental Quantities	:	Fundamental or base quantities are quantities which cannot be expressed in terms of any other physical quantities. These are length, mass, time, electric current, temperature, luminous intensity and amount of substance.
Derived Quantities	:	Quantities that can be expressed in terms of fundamental quantities are called derived quantities. Eg. area, volume, velocity, acceleration, force.
Unit of the quantity	:	An arbitrarily chosen standard of measurement of a quantity, which is accepted internationally is called unit of the quantity.

EVALUATION

I. MULTIPLE CHOICE QUESTIONS:

1. One of the combinations from the fundamental physical constants is $\frac{hc}{G}$. The unit of this expression is

(a) kg^2 (b) m^3 (c) s^{-1} (d) m

[Ans. (a) kg^2]

2. If the error in the measurement of radius is 2%, then the error in the determination of volume of the sphere will be *[Sep. - 2020]*

(a) 8% (b) 2% (c) 4% (d) 6%

[Ans. (d) 6%]

3. If the length and time period of an oscillating pendulum have errors of 1% and 3% respectively then the error in measurement of acceleration due to gravity is

[Related to AMPMT 2008] *[HY-2018]*

(a) 4% (b) 5% (c) 6% (d) 7%

[Ans. (d) 7%]

4. The length of a body is measured as 3.51 m, if the accuracy is 0.01m, then the percentage error in the measurement is *(Mar-2020)*

(a) 351% (b) 1%
(c) 0.28% (d) 0.0s35%

[Ans. (c) 0.28%]

5. Which of the following has the highest number of significant figures?

(a) $0.007\ m^2$ (b) 2.64×10^{24} kg
(c) $0.0006032\ m^2$ (d) 6.3200 J

[Ans. (d) 6.3200 J]

6. If $\pi = 3.14$, then the value of π^2 is *[QY. - 2018; Jun.-2019]*

(a) 9.8596 (b) 9.860
(c) 9.86 (d) 9.9 **[Ans. (c) 9.86]**

7. Round of the following number 19.95 into three significant figures.

(a) 19.9 (b) 20.0
(c) 20.1 (d) 19.5 **[Ans. (b) 20.0]**

8. Which of the following pairs of physical quantities have same dimension? *[Mar-2019]*

(a) force and power (b) torque and energy
(c) torque and power (d) force and torque

[Ans. (b) torque and energy]

9. The dimensional formula of Planck's constant h is *[JEE Main; NEET; Sep-2021]*

(a) $[ML^2T^{-1}]$ (b) $[ML^2T^{-3}]$
(c) $[MLT^{-1}]$ (d) $[ML^3T^{-3}]$

[Ans. (a) $[ML^2T^{-1}]$]

10. The velocity of a particle v at an instant t is given by $v = at + bt^2$. The dimensions of b is

(a) [L] (b) $[LT^{-1}]$
(c) $[LT^{-2}]$ (d) $[LT^{-3}]$

[Ans. (d) $[LT^{-3}]$]

11. The dimensional formula for gravitational constant G is *[Related to AIPMT 2004]*

(a) $[ML^3T^{-2}]$ (b) $[M^{-1}L^3T^{-2}]$
(c) $[M^{-1}L^{-3}T^{-2}]$ (d) $[ML^{-3}T^2]$

[Ans. (b) $[M^{-1}L^3T^{-2}]$]

12. The density of a material in CGS system of units is 4 g cm^{-3}. In a system of units in which unit of length is 10 cm and unit of mass is 100 g, then the value of density of material will be

(a) 0.04 (b) 0.4 (c) 40 (d) 400

[Ans. (c) 40]

13. If the force is proportional to square of velocity, then the dimension of proportionality constant is *[JEE–2000]* *[QY-2019]*

(a) $[MLT^0]$ (b) $[MLT^{-1}]$
(c) $[ML^{-2}T]$ (d) $[ML^{-1}T^0]$

[Ans. (d) $[ML^{-1}T^0]$]

14. The dimension of $(\mu_0\varepsilon_0)^{-\frac{1}{2}}$ is *[HY-2019]* *[Main AIPMT 2011]*

(a) length (b) time
(c) velocity (d) force

[Ans. (c) velocity]

15. Planck's constant (h), speed of light in vacuum (c) and Newton's gravitational constant (G) are taken as three fundamental constants. Which of the following combinations of these has the dimension of length? *[NEET 2016 (phase II)]*

(a) $\frac{\sqrt{hG}}{c^{\frac{3}{2}}}$ (b) $\frac{\sqrt{hG}}{c^{\frac{5}{2}}}$ (c) $\sqrt{\frac{hc}{G}}$ (d) $\sqrt{\frac{Gc}{h^{\frac{3}{2}}}}$

[Ans. (a) $\frac{\sqrt{hG}}{c^{\frac{3}{2}}}$]

II. Short Answer Questions.

1. Briefly explain the types of physical quantities.

Ans. **(i)** Physical quantities are classified into two types. There are fundamental and derived quantities.

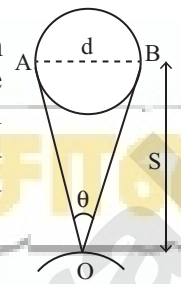
(ii) Fundamental or base quantities are quantities which cannot be expressed in terms of any other physical quantities. These are length, mass, time, electric current, temperature, luminous intensity and amount of substance.

(iii) Quantities that can be expressed in terms of fundamental quantities are called derived quantities. For example, area, volume, velocity, acceleration, force, etc.

2. How will you measure the diameter of the Moon using parallax method? *[HY-2018 & 19; QY-2019]*

Ans. O - observation point on earth.

(i) In diagram, O is the observation point on the earth and *d* is the diameter of moon. An astronomical telescope held at O is focussed on moon, the image is observed into moon of a circular disc.



(ii) ∠AOB = θ

S - average distance between moon and the surface of earth.

(iii) As 'S' is very large compared to the diameter, *d* of the moon, the diameter of the moon is considered as a circular arc of radius, S.

$d = S \times \theta$.

Hence *d* can be calculated, when 'S' is known and θ is measured.

3. Write the rules for determining significant figures.

Ans. **(i)** All non-zero digits are significant

(ii) All zeros between two non-zero digits are significant

(iii) All zeros to the right of a non-zero digit but to the left of a decimal point are significant.

(iv) For the number without a decimal point, the terminal or trailing zero(s) are not significant.

(v) If the number is less than 1, the zero (s) on the right of the decimal point but to left of the first non-zero digit are not significant.

(vi) All zeros to the right of a decimal point and to the right of non-zero digit are significant.

(vii) The number of significant figures does not depend on the system of units used.

4. What are the limitations of dimensional analysis? *[Govt. MQP-2018; HY-2018; Jun.-2019]*

Ans. **Limitations of Dimensional analysis:**

(i) This method gives no information about the dimensionless constants in the formula like 1, 2, ……..π,e, etc.

(ii) This method cannot decide whether the given quantity is a vector or a scalar.

(iii) This method is not suitable to derive relations involving trigonometric, exponential and logarithmic functions.

(iv) It cannot be applied to an equation involving more than three physical quantities.

(v) It can only check on whether a physical relation is dimensionally correct but not the correctness of the relation.

For example using dimensional analysis, $s = ut + 1/3\ at^2$ is dimensionally correct whereas the correct relation is $s = ut + 1/2\ at^2$.

5. Define precision and accuracy. Explain with one example.

Ans. **Precision:** The closeness of two or more measurements to each other is known as precision.

Accuracy: The closeness of a measured value to the actual value of the object being measured is called accuracy.

Example: Suppose a man's true height is exactly 5′9″. When it is measured with a yardstick, the value is 5′0″. Hence measurement is not accurate. When height is measured with a laser yardstick, the value is 5′9″ then measurement is accurate.

If the height is measured consistently as 5′0″ with a yardstick, then measurements are precise.

III. Long Answer Questions

1. (i) Explain the use of screw gauge and vernier caliper in measuring smaller distances.

(ii) Write a note on triangulation method and radar method to measure larger distances.

[Govt. MQP-2018]

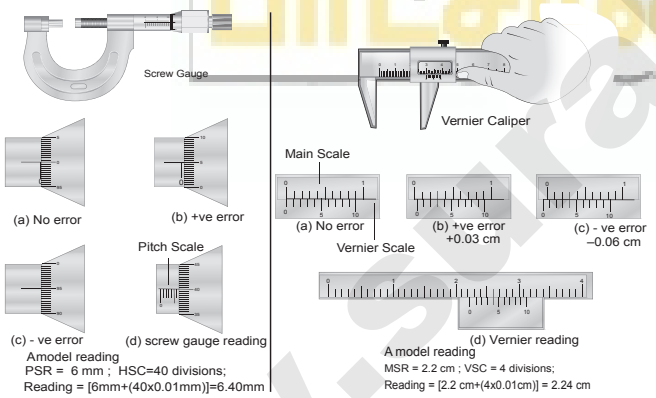
Ans. **Measurement of small distances:**

(i) **(1)** The **screw gauge** is an instrument used for measuring accurately the dimensions of objects up to a maximum of about 50 mm.

(2) The principle of the instrument is the magnification of linear motion using the circular motion of a screw.

(3) The least count of the screw gauge is 0.01 mm.

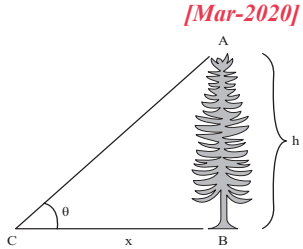
(4) A **vernier caliper** is a versatile instrument for measuring the dimensions of an object namely diameter of a hole, or a depth of a hole. The least count of vernier caliper is 0.01 cm.



Screw gauge and vernier caliper with errors

(ii) Triangulation method for the height of an accessible object : *[Mar-2020]*

(1) Let AB = h be the height of the tree or tower to be measured. Let C be the point of observation at distance x from B. Place a range finder at C and measure the angle of elevation, ∠ACB = θ as shown in Figure.



Triangulation method

(2) From right-angled triangle ABC, $\tan\theta = \frac{AB}{BC} = \frac{h}{x}$ (or) height $h = x \tan\theta$.

(3) Knowing the distance x, the height h can be determined.

RADAR method *[First Mid-2018]*

(1) The word RADAR stands for radio detection and ranging.

(2) A radar can be used to measure accurately the distance of a nearby planet such as Mars. In this method, radio waves are sent from transmitters which, after reflection from the planet, are detected by the receiver.

(3) By measuring, the time interval (t) between the instants the radio waves are sent and received, the distance of the planet can be determined as

Speed = distance travelled / time taken

Distance(d) = Speed of radio waves × time taken

$$d = \frac{v \times t}{2}$$

(4) where v is the speed of the radio wave. As the time taken (t) is for the distance covered during the forward and backward path of the radio waves, it is divided by 2 to get the actual distance of the object.

(5) This method can also be used to determine the height, at which an aeroplane flies from the ground.

2. Explain in detail the various types of errors. *[Mar-QY-2019]*

Ans. **Types of errors :**

(a) Systematic error (b) Random error
(c) Gross error

(a) Systematic errors : They are reproducible inaccuracies that are consistently in the same direction.

It is classified as follows :

(1) Instrumental errors : It arises when an instrument is not calibrated properly at the time of manufacturing. It can be corrected by choosing accurate instruments.

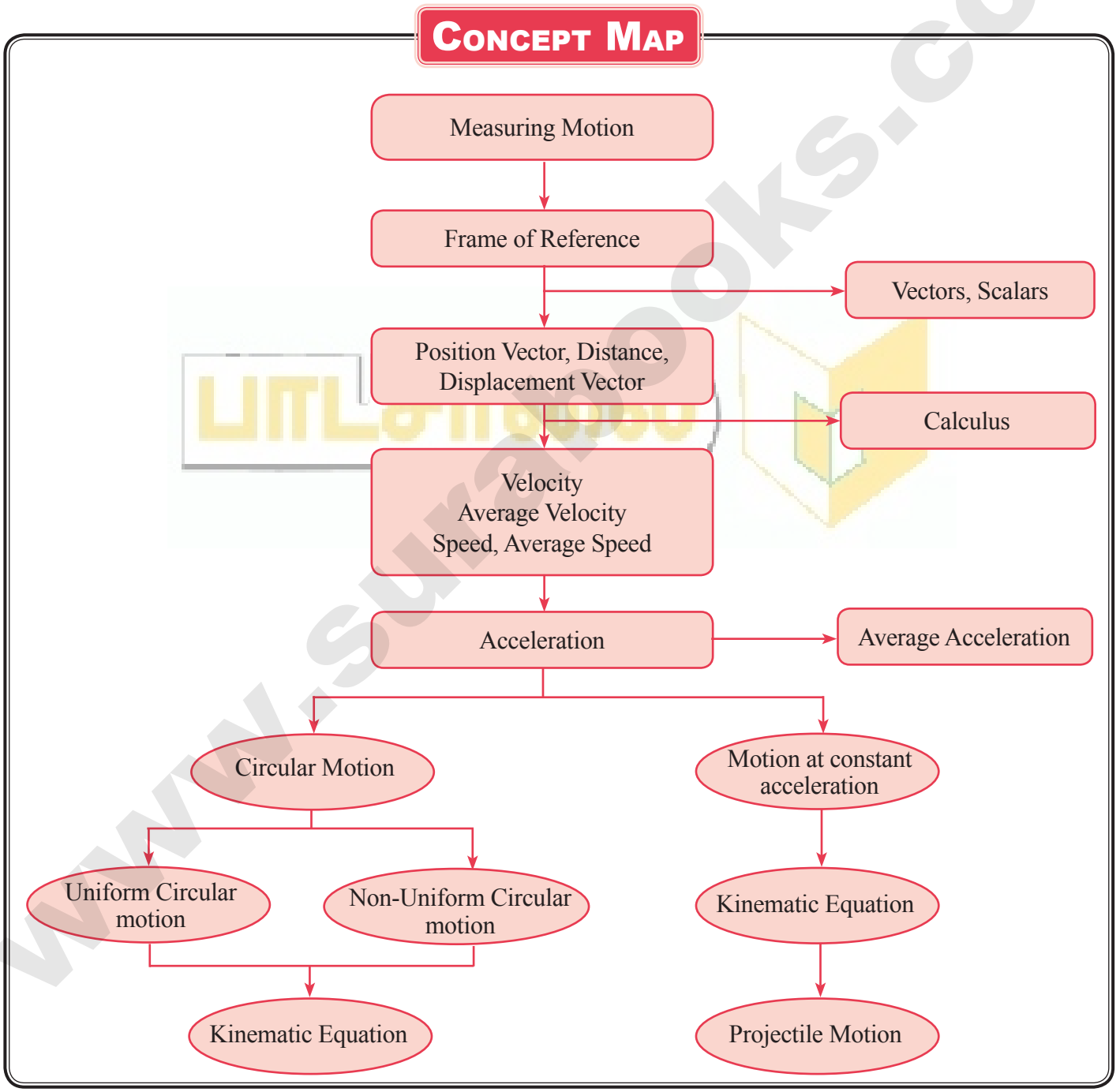
(2) Imperfections in experimental technique or procedure: It is due to the limitations in the experimental arrangement. To overcome this, necessary and proper correction is to be applied.

UNIT

02

KINEMATICS

CONCEPT MAP



FORMULAE TO REMEMBER

(1) Path length of distance, D = speed × time.

(2) Displacement = velocity × time.

(3) $\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$

(4) $\text{Velocity} = \dfrac{\text{Displacement}}{\text{Time}}$

(5) Relative velocity

(i) $\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$ (ii) $\vec{V}_{BA} = \vec{V}_B - \vec{V}_A$

(6) The equations of motion for accelerated body are:

(i) $v = u + at$ (ii) $S = ut + \frac{1}{2}at^2$ (iii) $v^2 = u^2 + 2as$ (iv) $S_n = u + \frac{a}{2}(2n-1)$

(7) The equations of motion for retarded body. Here a is negative.

(i) $v = u - at$ (ii) $S = ut - \frac{1}{2}at^2$ (iii) $v^2 = u^2 - 2as$ (iv) $S_n = u - \frac{a}{2}(2n-1)$

(8) The equations of motion for a body falling down under gravity. Here $a = +g$

(i) $v = u + gt$ (ii) $S = ut + \frac{1}{2}gt^2$ (iii) $v^2 = u^2 + 2gs$ (iv) $S_n = u + \frac{g}{2}(2n-1)$

(9) The equations of motion for a body going up against gravity. Here $a = -g$

(i) $v = u - gt$ (ii) $S = ut - \frac{1}{2}gt^2$ (iii) $v^2 = u^2 - 2gs$ (iv) $S_n = u - \frac{g}{2}(2n-1)$

(10) The maximum height attained by a body thrown vertically upwards with initial velocity u is, $S_{max} = \dfrac{u^2}{2g}$

(11) Total time taken by body in going up and coming down. $T = at = \dfrac{2u}{g}$

(12) The initial velocity of body in order to attain height h is, $u = \sqrt{2gh}$

(13) Unit vector $(\hat{A})$; $\hat{A} = \dfrac{\vec{A}}{A} = \dfrac{A_x\hat{i} + A_y\hat{j} + A_z\hat{k}}{\sqrt{A_x^2 + A_y^2 + A_z^2}}$

(14) Area of parallelogram = $|\vec{A} \times \vec{B}|$

(15) Velocity of projectile at an instant of its flight is $v = \sqrt{v_x^2 + v_y^2}$

(16) Angular projection of projectile:

(i) Time of flight, $T = \dfrac{2u\sin\theta}{g}$

(ii) Maximum height, $h = \frac{u^2 \sin^2 \theta}{2g}$

(iii) Horizontal range, $R = \frac{u^2 \sin 2\theta}{g}$

(iv) Maximum horizontal range $R_{max} = \frac{u^2}{g}$

(17) Centripetal acceleration $a_c = \omega^2 r$

(18) For motion along x axis, $v_x = u_x + a_x t$ and $x = x_0 + u_x t + \frac{1}{2} a_x t^2$

(19) For motion along y axis, $v_y = u_y + a_y t$ and $y = y_0 + u_y t + \frac{1}{2} a_y t^2$

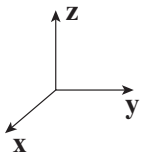
IMPORTANT TERMS & DEFINITIONS

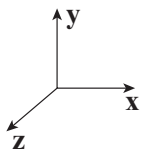
Rest	:	An object or a particle is said to be in the state of rest when it does not change its position with time with respect to its surroundings. Depending upon the position of observer, the state of rest (i) Absolute state of rest (ii) Relative state of rest
Motion	:	An object or a particle is said to be in the state of motion when it changes its position with time with respect to its surroundings. The motion of an object can be linear or curvilinear, circular or in a plane or in a space.
Motion in 1 - Dimensional	:	Motion of a body in a straight line is called one dimensional motion.
Motion in 2 – Dimensional	:	Motion of body in a plane is called two dimensional motion.
Motion in 3 – Dimensional	:	Motion of body in a space is called three dimensional motion.
Distance	:	It is the actual length of the path covered by a moving particle in a given interval of time, unit : metre (SI).
Displacement	:	Displacement is the difference between the final and initial positions of the object in a given interval of time. It can also be defined as the shortest distance between these two positions of the object and its direction is from the initial to final position of the object, during the given interval of time. It is a vector quantity.
Speed	:	The rate of the path length (or) the distance covered by an object to the time taken. It's SI unit is m/s.
Uniform Speed	:	When a particle covers equal distances in equal intervals of time, then it is said to be moving with uniform speed.

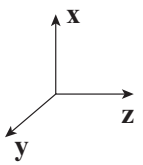
EVALUATION

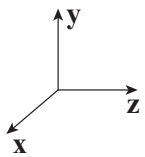
I. Multiple Choice Questions:

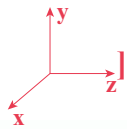
1. Which one of the following Cartesian coordinate systems is not followed in physics?

(a) 

(b) 

(c) 

(d) 

[Ans. (d) 

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2. Identify the unit vector in the following. *[Mar-2020]*

(a) $\hat{i}+\hat{j}$ (b) $\frac{\hat{i}}{\sqrt{2}}$

(c) $\hat{k}-\frac{\hat{j}}{\sqrt{2}}$ (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

[Ans. (d) $\frac{\hat{i}+\hat{j}}{\sqrt{2}}$]

3. Which one of the following physical quantities cannot be represented by a scalar?

(a) Mass (b) length
(c) momentum
(d) magnitude of acceleration

[Ans. (c) momentum]

4. Two objects of masses m_1 and m_2 fall from the heights h_1 and h_2 respectively. The ratio of the magnitude of their momenta when they hit the ground is *(AIPMT 2012)*

(a) $\sqrt{\frac{h_1}{h_2}}$ (b) $\sqrt{\frac{m_1 h_1}{m_2 h_2}}$

(c) $\frac{m_1}{m_2}\sqrt{\frac{h_1}{h_2}}$ (d) $\frac{m_1}{m_2}$

[Ans. (c) $\frac{m_1}{m_2}\sqrt{\frac{h_1}{h_2}}$]

5. If a particle has negative velocity and negative acceleration, its speed *[First Mid. - 2018; HY-2018; QY-2019]*

(a) increases (b) decreases
(c) remains same (d) zero

[Ans. (a) increases]

6. If the velocity is $\vec{v}=2\hat{i}+t^2\hat{j}-9\vec{k}$, then the magnitude of acceleration at t = 0.5 s is *[QY. - 2018]*

(a) 1 ms^{-2} (b) 2 ms^{-2}
(c) zero (d) –1 ms^{-2}

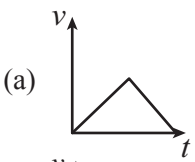
[Ans. (a) 1 ms^{-2}]

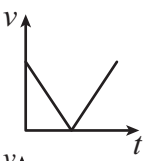
7. If an object is dropped from the top of a building and it reaches the ground at t = 4 s, then the height of the building is (ignoring air resistance) (g = 9.8 ms^{-2})

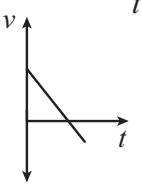
(a) 77.3 m (b) 78.4 m
(c) 80.5 m (d) 79.2 m

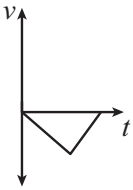
[Ans. (b) 78.4 m]

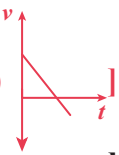
8. A ball is projected vertically upwards with a velocity *v*. It comes back to ground in time *t*. Which *v*-*t* graph shows the motion correctly? *(NSEP 00-01) [First Mid. - 2018]*

(a) 

(b) 

(c) 

(d) 

[Ans. (c) 

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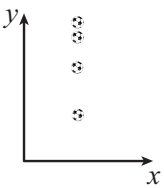
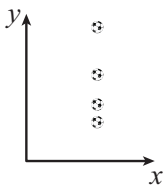
9. If one object is dropped vertically downward and another object is thrown horizontally from the same height, then the ratio of vertical distance covered by both objects at any instant t is

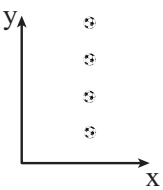
(a) 1 (b) 2 (c) 4 (d) 0.5

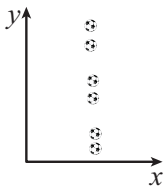
[Ans. (a) 1]

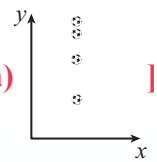
10. A ball is dropped from some height towards the ground. Which one of the following represents the correct motion of the ball?

(a) 

(b) 

(c) 

(d) 



[Ans. (a)]

11. If a particle executes uniform circular motion in the *xy* plane in clock wise direction, then the angular velocity is in *[Sep-2020; Sep-2021]*

(a) $+y$ direction (b) $+z$ direction

(c) $-z$ direction (d) $-x$ direction

[Ans. (c) $-z$ direction]

12. If a particle executes uniform circular motion, choose the correct statement *(NEET 2016)*

(a) The velocity and speed are constant

(b) The acceleration and speed are constant.

(c) The velocity and acceleration are constant.

(d) The speed and magnitude of acceleration are constant. **[Ans. (d) The speed and magnitude of acceleration are constant.]**

13. If an object is thrown vertically up with the initial speed *u* from the ground, then the time taken by the object to return back to ground is *[Jun-2019; Sep-2021]*

(a) $\frac{u^2}{2g}$ (b) $\frac{u^2}{g}$

(c) $\frac{u}{2g}$ (d) $\frac{2u}{g}$ **[Ans. (d) $\frac{2u}{g}$]**

14. Two objects are projected at angles 30° and 60° respectively with respect to the horizontal direction. The range of two objects are denoted as R_{30° and R_{60°. Choose the correct relation from the following.

(a) $R_{30^\circ} = R_{60^\circ}$ (b) $R_{30^\circ} = 4R_{60^\circ}$

(c) $R_{30^\circ} = \frac{R_{60^\circ}}{2}$ (d) $R_{30^\circ} = 2R_{60^\circ}$

[Ans. (a) $R_{30^\circ} = R_{60^\circ}$]

15. An object is dropped in an unknown planet from height 50 m, it reaches the ground in 2s . The acceleration due to gravity in this unknown planet is *[HY-2018]*

(a) $g = 20\ m\ s^{-2}$ (b) $g = 25\ m\ s^{-2}$

(c) $g = 15\ m\ s^{-2}$ (d) $g = 30\ m\ s^{-2}$

[Ans. (b) $g = 25\ m\ s^{-2}$]

II. Short Answer Questions.

1. Explain what is meant by Cartesian coordinate system?

Ans. At any given instant of time, the frame of reference with respect to which the position of the object is described in terms of position coordinates (x, y, z) is called **"Cartesian coordinate system"**.

2. Define a vector. Give examples.

Ans. Vector is a quantity which can be described by both magnitude and direction.

Examples:

Force, velocity, displacement, acceleration, etc.

3. Define a scalar. Give examples. *[QY. - 2019]*

Ans. Scalar is a property which can be described only by magnitude.

Examples :

Distance, mass, temperature, speed and energy.

4. Write a short note on the scalar product between two vectors.

Ans. **(i)** The scalar product (or dot product) of two vectors is defined as the product of the magnitudes of both the vectors and the cosine of the angle between them.

(ii) Thus if there are two vectors $\vec{A}$ and $\vec{B}$ having an angle θ between them, then their scalar product is defined as $\vec{A} \cdot \vec{B} = AB \cos\theta$. Here, A and B are magnitudes of $\vec{A}$ and $\vec{B}$.

VALUE BASED QUESTIONS

1. Balu went to kuttraalam with his grandpa, when he saw the waterfalls falling down from the top of a mountain he could not believe his eyes. He loved admiring it. He asked grandpa how this is possible. Grandpa said even now the answer to this question from where the water is coming from the top of a mountain is a puzzle, but we got some scientific truths behind this flow.

(i) What is the science behind this flow or falling of these water falls?

(ii) Give the formula for time of flight of the waterfall.

(iii) What is the speed of flow of waterfall, when it reaches the ground.

Ans. **(i)** Actually the science behind this flow of water fall is an example for the projectile motion. In horizontal projection water comes from the top of the mountain with an initial horizontal velocity (u)

(ii) Time of flight: It is the time taken for the projectile (here waterfall) to complete its trajectory.

It's expression is $T = \sqrt{\frac{2h}{g}}$

h → vertical displacement from top to the ground level.

g → gravity

(iii) Using equations of linear motion,

$$v^2 = u^2 + 2as$$

If v is the final velocity after waterfall hits the ground, u is the initial velocity, $a = g$, $s = h$

Then $v^2 = u^2 + 2gh$

Final velocity of the waterfall $v = \sqrt{u^2 + 2gh}$

2. All planets were once fire balls from the sun, which have been projected out so many long years back. Now these fire balls have attained their solid surface, even though the central core is still hot. Neptune is the last planet in our solar system (out of eight). At what angle it should have been projected from the sun?

Ans. Since Neptune has been thrown at angle of 45°, it would have reached longer distance.

3. Lord Rama and Arjuna were skilled in archery. As we apply more action (tension) to the string, the faster an arrow flies. After reading about Rama and Arjuna, Raju asked his friend Bhaskar is there any scientific facts behind Archery. He also asked Bhaskar about how to find force of the arrow.

(i) Is there any physics concept behind this archery?

(ii) Does Raju trouble Bhaskar psychologically?

(iii) What is the resultant force of the arrow?

Ans. (i) Yes, the physics concept behind this is, Parallelogram law of vectors. When we pull the arrow the string forms two forces as A & B. The direction of arrow is the resultant force here, ($A = F_1$, $B = F_2$, $R = F$)

To find direction of force, $\tan B = \frac{B \sin \theta}{A + B \cos \theta}$

(ii) No, Psychologically Raju is anxious of knowing scientific reasons behind everything, because he knew anxiety is the mother of Invention

(iii) Resultant force, $R = \sqrt{A^2 + B^2 + 2AB \cos \theta}$

[θ → angle between two forces A & B]

Creative Questions (HOTS)

1. Find the speed of the projectile when it hits the ground.

Ans. **(i)** When the projectile hits the ground after initially thrown horizontally from the top of tower of height h, the time of flight is

$$t = \sqrt{\frac{2h}{g}}$$

(ii) The horizontal component velocity of the projectile remains the same i.e $v_x = u$.

(iii) The vertical component velocity of the projectile at time T is

$$v_y = gt = g\sqrt{\frac{2h}{g}} = \sqrt{2gh}$$

(iv) The speed of the particle when it reaches the ground is $v = \sqrt{u^2 + 2gh}$

2. (i) Name the quantity which remains unchanged during the flight of an oblique projectile.

(ii) If the velocity of projectile is 10 ms^{-1} at what angle to the horizontal should be projected as that it covers maximum horizontal distance?

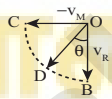
Ans. **(i)** Horizontal component of velocity.

(ii) At an angle of 45° to the horizontal covers maximum distance.

3. A man moving in rain holds an umbrella inclined to the vertical eventhough the rain drops are falling vertically. Why?

Ans. **(i)** Consider a person moving horizontally with velocity $\vec{V}_M$. Let rain fall vertically with velocity $\vec{V}_R$.

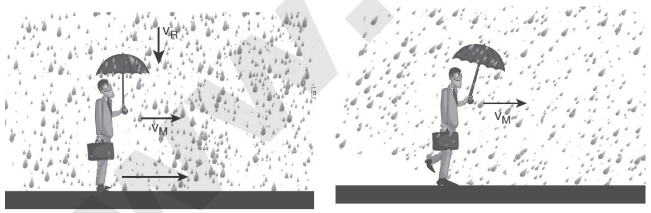
(ii) An umbrella is held to avoid the rain. Then the relative velocity of the rain with respect to the person is



$$\vec{V}_{RM} = \vec{V}_R - \vec{V}_M \text{ Since } \vec{OB} + \vec{OC} = \vec{OD}$$

$$\left|\vec{V}_{RM}\right| = \sqrt{V_R^2 + V_M^2}\ ;\ \tan\theta = \frac{DB}{OB} = \frac{V_M}{V_R} \text{ and}$$

$\Rightarrow \theta = \tan^{-1}\left(\frac{V_M}{V_R}\right)$ with the vertical as shown in fig.



(iii) In order to save himself from the rain, he should hold an umbrella at an angle θ with the vertical direction.

4. A train 20 *m* long is moving with a speed of 40 km/h. In what time shall it cross a bridge of 500 *m* long?

Solution:

Length of the train $l_1 = 20$ m

Length of the bridge $l_2 = 500$ m ; Time $(t) = ?$

Total length $L = l_1 + l_2 = 20 + 500 = 520$ m

$$\text{Speed of train, } s = 40\,\text{kmh}^{-1} = 40 \times \frac{5}{18}\,\text{m/s} = 11\,\text{ms}^{-1}$$

$$\text{Time}\,(t) = \frac{\text{Distance}}{\text{Speed}} = \frac{520}{11} = 47\,\text{s}$$

5. The position of an particle is given by $x = 6t + 2t^3$. Find out whether its motion is uniform or non-uniform.

Solution:

The position of an particle $x = 6t + 2t^3$

By differentiating with respect to 't'

$$\frac{dx}{dt} = \frac{d}{dt}(6t + 2t^3);\ \frac{dx}{dt} = 6 + 6t^2$$

$$\because \quad \text{velocity } v = \frac{dx}{dt} = 6 + 6t^2 \qquad \left[\because x^n = nx^{n-1}\right]$$

$$v = 6 + 6t^2$$

$\Rightarrow$ Velocity is dependent with time.

$\therefore$ The motion is non-uniform motion.

6. A bus starting from rest moves with a uniform acceleration of 0.2 ms^{-2} for 3 minutes. Find the speed and distance travelled.

Solution:

Initial velocity 'u' = 0

Acceleration 'a' = 0.2 ms^{-2}

Time (t) = 3 minutes = 180 seconds.

Speed of a bus, $v = u + at = 0 + 0.2 \times 180$

$= 36$ m/s.

$$\text{Displacement } s = ut + \frac{1}{2}at^2$$

$$= 0 \times 180 + \frac{1}{2} \times 0.2 \times (180)^2 = 0 + \frac{1}{2} \times 0.2 \times 32400$$

$= 3240$ m $= 3.24$ km

7. A train moving with a speed of 100 km/h can be stopped by brakes after atleast 15*m*. What will be the minimum stopping distance, if the same train is moving at a speed of 120 km/h?

Solution:

Speed = 100 km/h

Initial Velocity $u = 100 \times \frac{5}{18} = 27.7 \text{ ms}^{-1}$

Distance travelled $s = 15$ m ; Final velocity $v = 0$.

$\therefore$ Acceleration $a = -\frac{u^2}{2s}$

$$a = -\frac{(27.7)^2}{2 \times 15} = -\frac{767.29}{30} = -25.58 \text{ ms}^{-2}$$

$$a = -25.58 \text{ ms}^{-2}$$

For $u = 120$ km / s $= 120 \times 5 / 18 = 33 \text{ ms}^{-1}$

Distance covered,

$$s = -\frac{u^2}{2a} = -\frac{(33)^2}{2 \times (-25.58)} = \frac{-1089}{-51.16} = 21.29 \text{ m} \simeq 21 \text{ m}$$

$\therefore$ Minimum Shopping distance = 21 m.

8. A person travels along a straight road for the first half distance 4 m with a velocity 1 ms^{-1} and the second half distance 3 m with a velocity 0.7 ms^{-1}. What is the mean velocity of the person?

Solution:

Time taken by person to travel 4 m

$$t_1 = \frac{\left(\frac{d}{2}\right)}{v_1} = \frac{d}{2v_1}$$

Time taken by person to travel 3 m,

$$t_2 = \frac{\left(\frac{d}{2}\right)}{v_2} = \frac{d}{2v_2}$$

Mean (or) average velocity,

$$v_m = \frac{d}{t_1 + t_2} = \frac{d}{\frac{d}{2v_1} + \frac{d}{2v_2}} = \frac{\cancel{d}}{\cancel{d}\left(\frac{1}{2v_1} + \frac{1}{2v_2}\right)}$$

$$= \frac{2v_1v_2}{v_1 + v_2} = \frac{2 \times 1 \times 0.7}{1 + 0.7} = \frac{1.4}{1.7} = 0.82 \text{ ms}^{-1}$$

$\therefore$ Mean Velocity = 0.82 ms^{-1}

9. If three cars A, B and C move with velocities along different directions on the road side, what is the vector hidden in this case.

Ans. When two or more vectors lie on the same plane, those vectors are said to be coplanar vectors. Let velocity vector is taken for the three cars. All the velocity vectors are lying on the same plane called road surface. So, the vector concept behind this is coplanar vector.

10. (i) Name the quantity which remains unchanged during the flight of an oblique projection.

(ii) If the velocity of the projectile is 10 ms^{-1} at what angle to the horizontal should be projected as that it covers maximum horizontal distance?

Ans. (i) Horizontal component of velocity $u_x = u \cos \theta$

(ii) At an angle of 45° to the horizontal. Covers maximum distance.

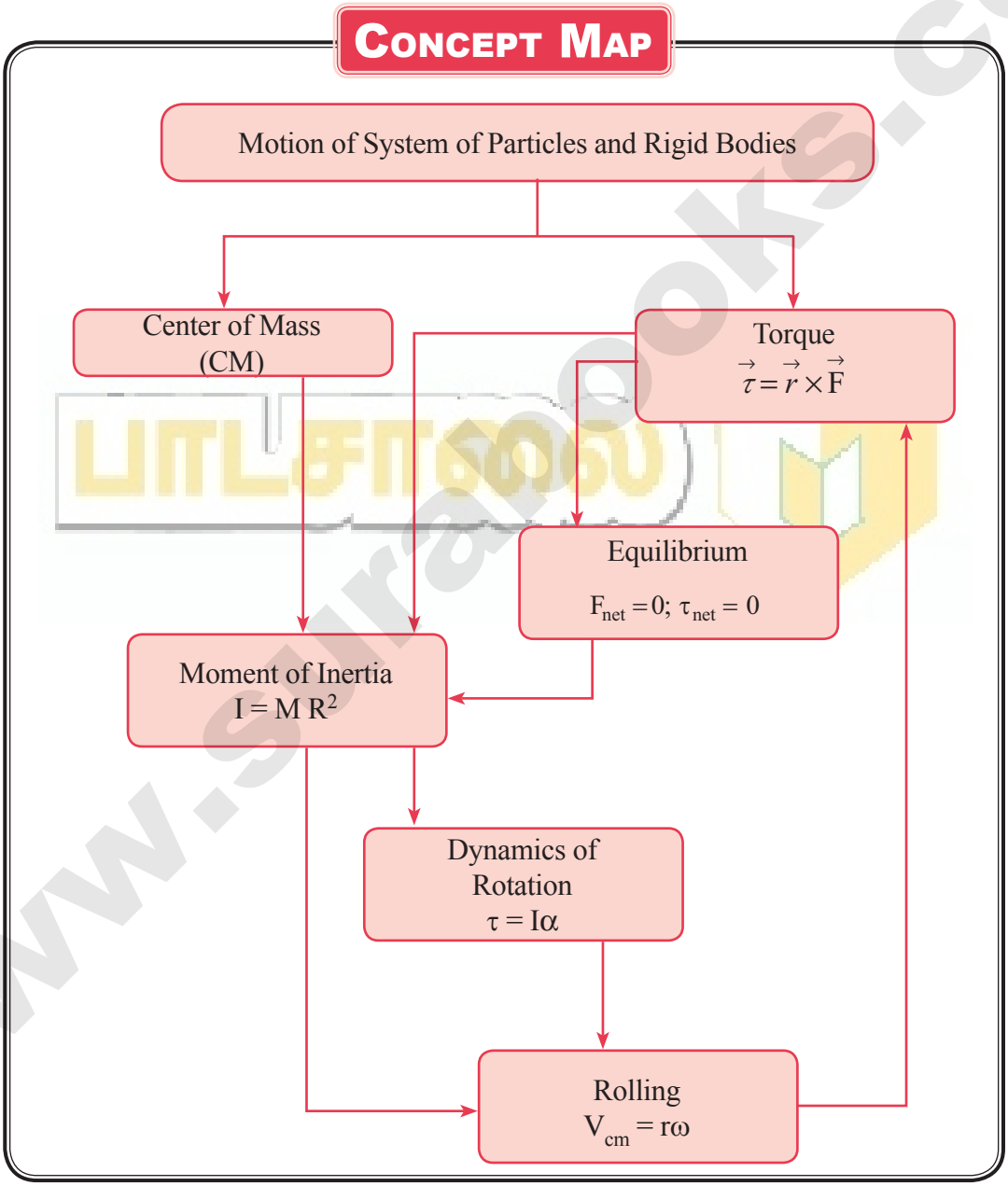
★ ★ ★ ★ ★

UNIT

05

Motion of System of Particles and Rigid Bodies

Concept Map



FORMULAE TO REMEMBER

(1) Position Vector of Center of Mass (CM) of two particles system : $x_{CM} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2}$ where m_1, m_2 are two point masses, at positions x_1 & x_2.

(2) $x_{CM} = \frac{\sum m_i x_i}{M}$, where M is the total mass of all the particles.

(3) $\vec{v}_{CM} = \frac{\sum m_i \vec{v}_i}{\sum m_i}$, where v_{CM} is Velocity of Center of Mass.

(4) $\vec{a}_{CM} = \frac{\sum m_i \vec{a}_i}{\sum m_i}$, where a_{CM} is acceleration of CM.

(5) $\vec{\tau} = \vec{r} \times \vec{F}$ where, τ is torque, $\vec{r}$ is position vector of the point & $\vec{F}$ is the force.

(6) $\vec{\tau} = (r F \sin\theta)\hat{n}$ $\hat{n}$ →Unit Vector

(7) $\tau = (mr^2)\alpha$, where m is point mass at a position, r. α is angular acceleration.

(8) $\vec{L} = \vec{r} \times \vec{p}$, where L is angular momentum, p is linear momentum at a position r.

(9) $L = (mr^2)\,\omega$, $L = r\,m\,v$, where L is angular momentum, ω is angular velocity, v is linear velocity & m is the point mass.

(10) $I = \sum m_i r_i^2$, where I - moment of inertia, m - point mass at a position r.

(11) $\vec{L} = \left(\sum m_i r_i^2\right)\vec{\omega}$

(12) $\vec{L} = I\vec{\omega}$

(13) $\tau = I\,\frac{d\omega}{dt}$; $\alpha = \frac{d\omega}{dt}$; $\tau = I\,\alpha$.

(14) $\frac{F_1}{F_2} = \frac{d_2}{d_1}$, where F_1 & F_2 are two parallel forces act at the two ends at distances d_1 & d_2.

(15) $\tan\theta = \frac{v^2}{rg}$ where v - velocity, r - radius of circular level road, g - acceleration due to gravity, θ – angle in which a cyclist bends.

(16) $I = MR^2$, where I - moment of inertia, M - mass of a uniform ring, R - radius.

(17) $I = MK^2$, where, K - radius of gyration, M - total mass of the object, I - moment of inertia.

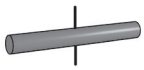
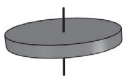
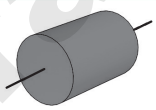
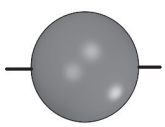
(18) $dw = F\,ds$, where dw - workdone, F - force, ds - displacement.

(19) $KE = \frac{1}{2}\,mv^2$

(20) Power, $P = \vec{F}.\vec{v}$ (in linear motion) : $P = \tau.\omega.$ (in rotational motion)

(21) $KE = \frac{1}{2}Mv_{CM}^2\left(1 + \frac{K^2}{R^2}\right)$

Moment of Inertia of some Rigid bodies :

Object	Axis of rotation	Diagram	Moment of Inertia (I) kg m^2	Radius of Gyration (K)	Ratio $\left(\frac{K^2}{R^2}\right)$
Thin uniform Rod Mass = M Length = l	Perpendicular to rod at mid-point		$\frac{1}{12}ml^2$	$\frac{l}{\sqrt{12}}$	-
Thin Uniform circular ring Mass = M; Radius = R	Passing through the center and perpendicular to the plane		MR^2	R	1
	Along its diameter		$\frac{1}{2}MR^2$	$\left(\frac{1}{\sqrt{2}}\right)R$	$\frac{1}{2}$
Thin Circular Disc Mass = M Radius = R	Perpendicular to disc at centre		$\frac{1}{2}MR^2$	$\left(\frac{1}{\sqrt{2}}\right)R$	$\frac{1}{2}$
	Along its diameter		$\frac{1}{2}MR^2$	$\left(\frac{1}{\sqrt{2}}\right)R$	$\frac{1}{2}$
Thin Uniform Hollow Cylinder Mass = M Length = l; Radius = R	Along its axis		MR^2	R	1
Solid Cylinder Mass = M Length = l; Radius = R	Along its axis		$\frac{1}{2}MR^2$	$\left(\frac{1}{\sqrt{2}}\right)R$	$\frac{1}{2}$
Solid Sphere Mass = M Radius = R	Along its diameter		$\frac{2}{5}MR^2$	$\left(\sqrt{\frac{2}{5}}\right)R^2$	$\frac{2}{5}$

IMPORTANT TERMS & DEFINITIONS

Internal forces : The forces acting among the particles within a system that constitute the body.

External forces : The forces acting on the particles of a system from outside.

Rigid body : It is the one which maintains its definite and fixed shape even when an external force acts on it.

Center of mass of a body : A point where the entire mass of the body appears to be concentrated. This point can represent the entire body.

For regular shaped bodies with uniform mass distribution, **center of mass** always lies at the geometrical center.

Law of conservation of angular momentum	:	When no external torque acts on the body, the net angular momentum of a rotating rigid body remains constant. This is known as law of conservation of angular momentum.
Rolling friction	:	When the round object moves, it always tends to roll on any surface which has a coefficient of friction any value greater than zero ($\mu > 0$). The friction that enabling the rolling motion is called rolling friction.
Rolling motion	:	is the combination of translational and rotational motions.
Momentary rotation	:	Rolling can also be treated as the momentary rotation about the point of contact.
Pure rolling	:	In pure rolling, the total kinetic energy is the sum of kinetic energies of translational and rotational motions.
Sliding	:	In sliding, the translational motion is more than rotational motion.
Slipping	:	In slipping, the rotational motion is more than translational motion.

EVALUATION

I. Multiple Choice Questions:

1. The center of mass of a system of particles does not depend upon, *(AIPMT 1997, AIEEE 2004) (QY.-2018)*

(a) position of particles
(b) relative distance between particles
(c) masses of particles
(d) force acting on particle

[Ans. (d) force acting on particle]

2. A couple produces, *(AIPMT 1997) [QY.-2018; Sep-2021]*

(a) pure rotation (b) pure translation
(c) rotation and translation
(d) no motion **[Ans. (a) pure rotation]**

3. A particle is moving with a constant velocity along a line parallel to positive X-axis. The magnitude of its angular momentum with respect to the origin is, *(IIT 2002)*

(a) zero (b) increasing with x
(c) decreasing with x
(d) remaining constant

[Ans. (d) remaining constant]

4. A rope is wound around a hollow cylinder of mass 3 kg and radius 40 cm. What is the angular acceleration of the cylinder if the rope is pulled with a force 30 N? *(NEET 2017) [HY-2018]*

(a) 0.25 rad s^{-2} (b) 25 rad s^{-2}
(c) 5 m s^{-2} (d) 25 m s^{-2}

[Ans. (b) 25 rad s^{-2}]

5. A closed cylindrical container is partially filled with water. As the container rotates in a horizontal plane about a perpendicular bisector, its moment of inertia, *(IIT 1998) [Mar., QY.-2019]*

(a) increases (b) decreases
(c) remains constant
(d) depends on direction of rotation.

[Ans. (a) increases]

6. A rigid body rotates with an angular momentum L. If its kinetic energy is halved, the angular momentum becomes, *(AFMC 1998, AIPMT 2015) [QY., Jun.-2019] [Sep.-2020]*

(a) L (b) L/2
(c) 2L (d) $L/\sqrt{2}$

[Ans. (d) $L/\sqrt{2}$]

7. A particle undergoes uniform circular motion. The angular momentum of the particle remain conserved about, *(IIT 2003)*

(a) the center point of the circle.
(b) the point on the circumference of the circle.
(c) any point inside the circle.
(d) any point outside the circle

[Ans. (a) the center point of the circle.]

8. When a mass is rotating in a plane about a fixed point, its angular momentum is directed along, *(AIPMT 2012)*

(a) a line perpendicular to the plane of rotation
(b) the line making an angle of 45° to the plane of rotation
(c) the radius (d) tangent to the path

[Ans. (a) a line perpendicular to the plane of rotation]

9. Two discs of same moment of inertia rotating about their regular axis passing through center and perpendicular to the plane of disc with angular velocities ω_1 and ω_2. They are brought in to contact face to face coinciding the axis of rotation. The expression for loss of energy during this process is, *(NEET 2017)*

(a) $\frac{1}{4} I(\omega_1 - \omega_2)^2$ (b) $I(\omega_1 - \omega_2)^2$

(c) $\frac{1}{8} I(\omega_1 - \omega_2)^2$ (d) $\frac{1}{2} I(\omega_1 - \omega_2)^2$

[Ans. (a) $\frac{1}{4} I(\omega_1 - \omega_2)^2$]

10. A disc of moment of inertia I_a is rotating in a horizontal plane about its symmetry axis with a constant angular speed ω. Another disc initially at rest of moment of inertia I_b is dropped coaxially on to the rotating disc. Then, both the discs rotate with same constant angular speed. The loss of kinetic energy due to friction in this process is, *(AIPMT 2001)*

(a) $\frac{1}{2}\frac{I_b^2}{(I_a + I_b)}\omega^2$ (b) $\frac{I_b^2}{(I_a + I_b)}\omega^2$

(c) $\frac{(I_b - I_a)^2}{(I_a + I_b)}\omega^2$ (d) $\frac{1}{2}\frac{I_b I_b}{(I_a + I_b)}\omega^2$

[Ans. (d) $\frac{1}{2}\frac{I_b I_b}{(I_a + I_b)}\omega^2$]

11. The ratio of the acceleration for a solid sphere (mass *m* and radius R) rolling down an incline of angle θ without slipping and slipping down the incline without rolling is, *(AIPMT 2014)*

(a) 5 : 7 (b) 2 : 3

(c) 2 : 5 (d) 7 : 5 [Ans. (a) 5 : 7]

12. From a disc of radius R, a mass M, a circular hole of diameter R, whose rim passes through the center is cut. What is the moment of inertia of the remaining part of the disc about a perpendicular axis passing through it *(NEET 2016)*

(a) $15MR^2/32$ (b) $13MR^2/32$

(c) $11MR^2/32$ (d) $9MR^2/32$

[Ans. (b) $13MR^2/32$]

13. The speed of a solid sphere after rolling down from rest without sliding on an inclined plane of vertical height *h* is,

(a) $\sqrt{\frac{4}{3}gh}$ (b) $\sqrt{\frac{10}{7}gh}$

(c) $\sqrt{2gh}$ (d) $\sqrt{\frac{1}{2}gh}$

[Ans. (b) $\sqrt{\frac{10}{7}gh}$]

14. The speed of the center of a wheel rolling on a horizontal surface is v_0. A point on the rim in level with the center will be moving at a speed of *(PMT 1992, PMT 2003, IIT 2004)* *[QY. - 2019]*

(a) zero (b) v_0

(c) $\sqrt{2}v_0$ (d) $2v_0$ [Ans. (c) $\sqrt{2}v_0$]

15. A round object of mass M and radius R rolls down without slipping along an inclined plane. The frictional force, *(PMT 2005)* *[Jun.-2019]*

(a) dissipates kinetic energy as heat.
(b) decreases the rotational motion.
(c) decreases the rotational and transnational motion
(d) converts transnational energy into rotational energy [Ans. (d) converts transnational energy into rotational energy]

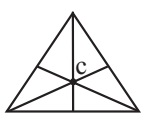
II. Short Answer Questions.

1. Define center of mass. *[QY & HY-2019]*

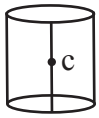
Ans. The center of mass of a body is defined as a point where the entire mass of the body appears to be concentrated.

2. Find out the center of mass for the given geometrical structures.
(a) Equilateral triangle
(b) Cylinder
(c) Square

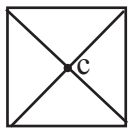
Ans. **(a)** Equilateral triangle
Lies in center



(b) Cylinder
Lies on its central axis



(c) Square
Lies at their diagonals meet



3. Define torque and mention its unit. *[QY. - 2019]*

Ans. Torque is defined as the moment of the external applied force about a point or axis of rotation.

The expression for torque is, $\vec{\tau} = \vec{r} \times \vec{F}$

Its unit is Nm.

4. What are the conditions in which force can not produce torque?

Ans. **(i)** The torque is zero when $\vec{r}$ and $\vec{F}$ are parallel or anti-parallel.

(ii) If parallel, then $\theta = 0$ and $\sin 0 = 0$.

(iii) If anti-parallel, then $\theta = 180$ and $\sin 180 = 0$.

(iv) Hence, $\tau = 0$. The torque is zero if the force acts at the reference point. i.e as $\vec{r} = 0, \tau = 0$

5. Give any two examples of torque in day-to-day life. *[QY.-2019; Sep-2021]*

Ans. **(i)** The opening and closing of a door about the hinges.

(ii) Turning of a nut using a wrench.

(iii) Opening a bottle cap (or) water top.

6. What is the relation between torque and angular momentum?

Ans. We have the expression for magnitude of angular momentum of a rigid body as, $L = I\omega$. The expression for magnitude of torque on a rigid body is, $\tau = I\alpha$.

We can further write the expression for torque as,

$$\tau = I \frac{d\omega}{dt} \quad \because \left(\propto = \frac{d\omega}{dt} \right) \quad \ldots (1)$$

Where, ω is angular velocity and $\propto$ is angular acceleration. We can also write equation (1) as.

$$\tau = \frac{d(I\omega)}{dt}; \quad \tau = \frac{dL}{dt}$$

7. What is equilibrium?

Ans. A rigid body is said to be in mechanical equilibrium when both its linear momentum and angular momentum remain constant.

8. How do you distinguish between stable and unstable equilibrium? *[HY-2018]*

Ans. Distinguish between stable and unstable equilibrium

Stable equilibrium	Unstable equilibrium
The body tries to come back to equilibrium if slightly disturbed and released.	The body cannot come back to equilibrium if slightly disturbed and released.
The center of mass of the body shifts slightly higher if disturbed from equilibrium.	The center of mass of the body shifts slightly lower if disturbed from equilibrium.
Potential energy of the body is minimum and it increases if disturbed..	Potential energy of the body is not minimum and it decreases if disturbed.

9. Define couple.

Ans. A pair of forces which are equal in magnitude but opposite in direction and separated by a perpendicular distance so that their lines of action do not coincide that causes a turning effect is called a couple.

10. State principle of moments. *[QY.-2019]*

Ans. Sum of the clockwise moments is equal to sum of the anticlock wise moments when a body is in rotational equilibrium or algebraic sum of moments at any point is zero.

11. Define center of gravity. *[Jun.-2019; QY.-2019; Sep-2021]*

Ans. The center of gravity of a body is the point at which the entire weight of the body acts irrespective of the position and orientation of the body.

12. Mention any two physical significance of moment of inertia.

Ans. **(i)** For rotational motion, moment of inertia is a measure of rotational inertia.

(ii) The moment of inertia of a body is not an invariable quantity. It depends not only on the mass of the body, but also on the way the mass is distributed around the axis of rotation.

13. What is radius of gyration? *[Sep-2020]*

Ans. The radius of gyration of an object is the perpendicular distance from the axis of rotation to an equivalent point mass, which would have the same mass as well as the same moment of inertia of the object. Its unit is metre (m).

14. State conservation of angular momentum. *[QY.-2018; Mar-2020]*

Ans. When no external torque acts on the body, the net angular momentum of a rotating rigid body remains constant. This is known as law of conservation of angular momentum.

$\tau = \frac{dL}{dt}$; If $\tau = 0$ then, L = constant

4. **The position vectors of two point masses 10 kg and 5 kg are $\left(-3\vec{i}+2\vec{j}+4\vec{k}\right)$ m and $\left(3\vec{i}+6\vec{j}+5\vec{k}\right)$ m respectively. Locate the position of center of mass.** *[QY-2019]*

Solution: $m_1 = 10$ kg ; $m_2 = 5$ kg

$$\vec{r}_1 = \left(-3\hat{i}+2\hat{j}+4\hat{k}\right)m$$

$$\vec{r}_2 = \left(3\hat{i}+6\hat{j}+5\hat{k}\right)m$$

$$\vec{r} = \frac{m_1\vec{r}_1+m_2\vec{r}_2}{m_1+m_2}$$

$$\vec{r} = \frac{10\left(-3\hat{i}+2\hat{j}+4\hat{k}\right)+5\left(3\hat{i}+6\hat{j}+5\hat{k}\right)}{10+5}$$

$$= \frac{-30\hat{i}+20\hat{j}+40\hat{k}+15\hat{i}+30\hat{j}+25\hat{k}}{15}$$

$$= \frac{-15\hat{i}+50\hat{j}+65\hat{k}}{15}$$

$$\vec{r} = \left(-\hat{i}+\frac{10}{3}\hat{j}+\frac{13}{3}\hat{k}\right)m$$

The center of mass is located at position $\vec{r}$

Additional Questions

I. Multiple Choice Questions :

1 Mark

A. Choose the best answer :

1. **Where will be the centre of mass on combining two masses m and M (M > m)?**

(a) Towards m (b) Towards M
(c) Between m & M
(d) away from m & M **[Ans. (b) Towards M]**

2. **Two bodies of masses 2 kg and 3 kg have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $(-4\hat{i}-3\hat{j}+6\hat{k})$ respectively. The centre of mass of this system has a position vector.**

(a) $-3i-j$ (b) $5i-j+2k$
(c) $-2\hat{i}-\hat{j}+4\hat{k}$ (d) $-3\hat{i}-\hat{j}+7\hat{k}$

Hint: **[Ans. (c) $-2\hat{i}-\hat{j}+4\hat{k}$]**

$$R_{cm} = \frac{m_1\vec{r}_1+m_2\vec{r}_2}{m_1+m_2}$$

$$= \frac{2(\hat{i}+2\hat{j}+\hat{k})+3(-4\hat{i}-3\hat{j}+6\hat{k})}{2+3}$$

$$= \frac{2\hat{i}+4\hat{j}+2\hat{k}-12\hat{i}-9\hat{j}+18\hat{k}}{5}$$

$$= \frac{-10\hat{i}-5\hat{j}+20\hat{k}}{5} = -2\hat{i}-\hat{j}+4\hat{k}$$

3. **Four identical spheres each of mass *m* are placed at the corners of square of side 2 m. Taking the point of intersection of the diagonals as the origin the coordinates of the centre of mass are?**

(a) (1, 1) (b) (0, 0)
(c) (1, –1) (d) (–1, 1)
[Ans. (b) (0, 0)]

4. **Two blocks of masses 20 kg and 5 kg are connected by a spring of negligible mass and placed on a frictionless horizontal surface. An impulse gives a velocity of 15 m/s to the heavier block in the direction of lighter block. The velocity of centre of mass is**

(a) 22 ms^{-1} (b) 30 ms^{-1}
(c) 12 ms^{-1} (d) 15 ms^{-1}
[Ans. (c) 12 ms^{-1}]

Hint:

$$V_{cm} = \frac{m_1v_1+m_2v_2}{m_1+m_2}$$ [$v_1 = 15$ m/s, $v_2 = 0$, $m_1 = 20$kg, $m_2 = 5$ kg]

$$V_{cm} = \frac{20\times15+5\times0}{25} = \frac{300}{25} = 12$$

5. **Moment of force is called**

(a) angular momentum (b) torque
(c) couple (d) none
[Ans. (b) torque]

6. Two identical particles move towards each other with velocity 2 *v* and *v* respectively. The velocity of centre of mass is

(a) v (b) $\frac{v}{3}$

(c) $\frac{v}{2}$ (d) zero **[Ans. (c) $\frac{v}{2}$]**

Hint:

$$V_{cm} = \frac{m_1 v_1 + m_2 v_2}{m_1 + m_2} \quad [m_1 = m_2 = m,\ 2v = v_1,\ v_2 = -v]$$

$$= \frac{m(2v - v)}{2m} = \frac{v}{2}$$

7. Two objects which are initially at rest, move towards each other under the action of their internal attraction. If their speeds are 4 v and 2 v at any instant, then the speed of centre of mass of the system will be

(a) $2v$ (b) zero

(c) v (d) 1.5 v **[Ans. (b) zero]**

Hint:

[No. external force is acting on the C. M. of system. It remains at rest. The speed of CM is zero.]

8. If force acts on a body, whose line of action does not pass through its CG, then the body will experience

(a) angular acceleration
(b) linear acceleration
(c) both (a) and (b)
(d) none **[Ans. (c) both (a) and (b)]**

9. A couple produces _____ motion.

(a) linear and rotational (b) purely rotational

(c) purely linear (d) no

[Ans. (b) purely rotational]

10. Angular momentum is.

(a) moment of linear momentum
(b) product of mass and angular velocity
(c) product of M.I. and velocity
(d) moment of angular motion

[Ans. (a) moment of linear momentum]

11. If I, α and τ are MI, angular acceleration and torque respectively of a body rotating about any axis with angular velocity ω, then

(a) $\tau = I\omega$ (b) $\tau = I\alpha$

(c) $I = r\omega$ (d) $\alpha = r\omega$

[Ans. (b) $\tau = I\alpha$]

12. Which of the following has largest M.I

(a) Ring about its axis perpendicular to its plane
(b) Disc about its axis perpendicular to its plane
(c) Solid sphere
(d) Bar magnet **[Ans. (a) Ring about its axis perpendicular to its plane]**

13. A dancer on ice spins faster when she folds her arms. This is due to

(a) increase in energy & increase in angular momentum
(b) increase in K.E & decrease in angular momentum
(c) increase in K.E & constant in angular momentum
(d) Decrease in friction at the skates

[Ans. (c) increase in K.E & constant in angular momentum]

14. A bomb travelling in a parabolic path explodes in mid air. The C.M. of fragments will

(a) move vertically downwards
(b) move irregularly
(c) move vertically upwards & then downwards
(d) move in parabolic path the unexploded bomb would have travelled **[Ans. (d) move in parabolic path the unexploded bomb would have travelled]**

15. Consider a system of two identical particles. One is at rest and the other has an acceleration $\vec{a}$. The centre of mass has an acceleration

(a) $\frac{1}{2}\vec{a}$ (b) $\vec{a}$ (c) $2\vec{a}$ (d) zero

[Ans. (a) $\frac{1}{2}\vec{a}$]

16. The least coefficient of friction for an inclined plane inclined at an angle α with horizontal, in order that a solid cylinder will roll down it without slipping?

(a) $\frac{2}{3}\tan\alpha$ (b) $\frac{1}{3}\tan\alpha$

(c) $\frac{2}{7}\tan\alpha$ (d) $\frac{4}{3}\tan\alpha$ **[Ans. (b) $\frac{1}{3}\tan\alpha$]**

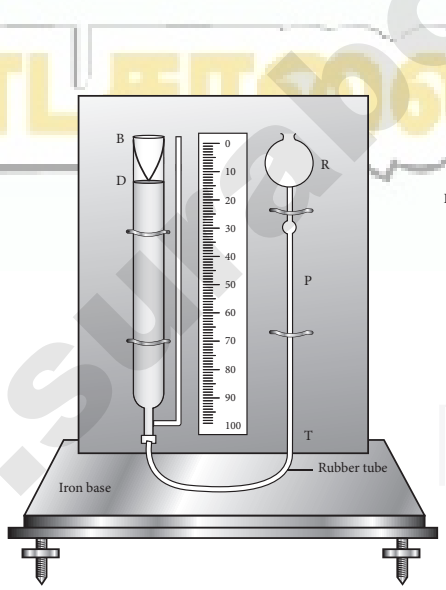
17. A ball rolls without slipping. The radius of gyration of the ball about an axis passing through its center of mass is K. If radius of the ball be R, then the fraction of total energy associated with its rotational energy be

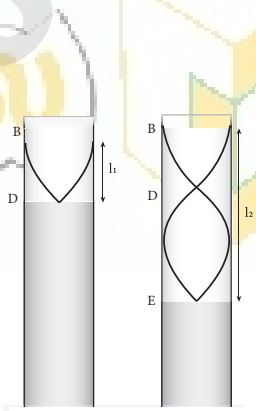
(a) $\frac{K^2 + R^2}{R^2}$ (b) $\frac{K^2}{K^2 + R^2}$

(c) $\frac{K^2}{R^2}$ (d) $\frac{R^2}{K^2 + R^2}$ **[Ans. (b) $\frac{K^2}{K^2 + R^2}$]**

PHYSICS

VOLUME - II





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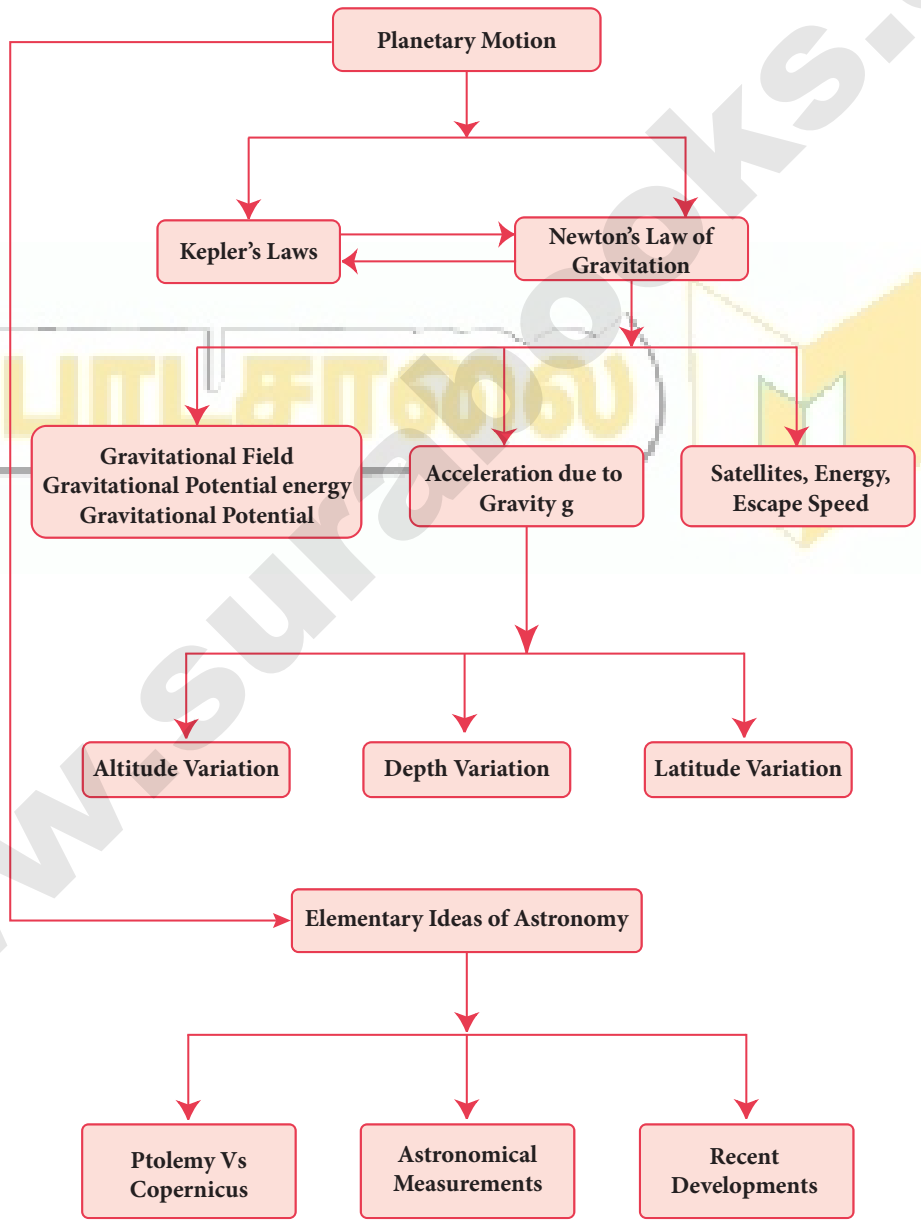
UNIT

06

GRAVITATION

CONCEPT MAP



IMPORTANT TERMS & DEFINITIONS

Newton's law of gravitation : It states that every body in this universe attracts every other body with a force, which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

$$F = G\frac{m_1 m_2}{r_1^2}$$

Acceleration due to gravity : The force of attraction exerted by the earth on a body is called gravitational pull or gravity.

Gravitational field : The space surrounding a material body in which gravitational force of attraction can be experienced is called its gravitational field.

Gravitational field intensity : The intensity of the gravitational field of a material body at any point in its field is defined as the force experienced by a unit mass (test mass) placed at that point. If a test mass m at a point in a gravitational field experiences a force $\vec{F}$ then $E = \frac{F}{m}$

Gravitational Potential (V_r) : Gravitational Potential at a distance 'r' due to a mass is defined as the amount of work required to bring unit mass from infinity to the distance 'r' i.e.

$$V_{(r)} = -\frac{GM}{r}$$

Gravitational potential energy (U_r) : Gravitational potential energy of a system of two masses m_1 & m_2 separated by a distance r as the amount of work done to take the mass m_2 from a distance r to infinity assuming m_1 to be fixed in its position. Formula : $U_{(r)} = -\frac{Gm_1 m_2}{r}$

Escape velocity : The minimum velocity with which a body must be projected up so as to enable it to just overcome the gravitational pull, is known as escape velocity.

$$v_e = \sqrt{2gR_E} \; ; \; R_E \rightarrow \text{Radius of Earth}$$

Kepler's laws of planetary motion :

(i) The law of orbits: Every planet moves around the sun in an elliptical orbit with sun at one of the foci.

(ii) The law of area: According to this law plant will move slowly when it is farthest from sun and more rapidly when it is nearest to sun. It is similar to law of conservation of angular momentum.

$$\frac{dA}{dt} = \frac{L}{2m}$$

(iii) The law of periods: The square of period of revolution (T) of any planet around sun is directly proportional to the cube of the semi-major axis of the orbit.

$$T^2 \propto a^3 \quad or \quad T^2 \; a\left(\frac{a_1 + a_2}{2}\right)^3 \; ; \; a \rightarrow \text{Semi - major axis}$$

EVALUATION

I. MULTIPLE CHOICE QUESTIONS:

1. The linear momentum and position vector of the planet is perpendicular to each other at *[HY-2019]*

(a) perihelion and aphelion
(b) at all points
(c) only at perihelion
(d) no point **[Ans. (a) perihelion and aphelion]**

2. If the masses of the Earth and Sun suddenly double, the gravitational force between them will

(a) remain the same
(b) increase 2 times
(c) increase 4 times
(d) decrease 2 times **[Ans. (c) increase 4 times]**

3. A planet moving along an elliptical orbit is closest to the Sun at distance r_1 and farthest away at a distance of r_2. If v_1 and v_2 are linear speeds at these points respectively. Then the ratio $\frac{v_1}{v_2}$ is *(NEET 2016)*

(a) $\frac{r_2}{r_1}$ (b) $\left(\frac{r_2}{r_1}\right)^2$ (c) $\frac{r_1}{r_2}$ (d) $\left(\frac{r_1}{r_2}\right)^2$

[Ans. (a) $\frac{r_2}{r_1}$]

4. The time period of a satellite orbiting Earth in a circular orbit is independent of

(a) Radius of the orbit
(b) The mass of the satellite
(c) Both the mass and radius of the orbit
(d) Neither the mass nor the radius of its orbit

[Ans. (b) The mass of the satellite]

5. If the distance between the Earth and Sun were to be doubled from its present value, the number of days in a year would be *[Mar-2020]*

(a) 64.5 (b) 1032
(c) 182.5 (d) 730 **[Ans. (b) 1032]**

6. According to Kepler's second law, the radial vector to a planet from the Sun sweeps out equal areas in equal intervals of time. This law is a consequence of

(a) conservation of linear momentum
(b) conservation of angular momentum
(c) conservation of energy
(d) conservation of kinetic energy

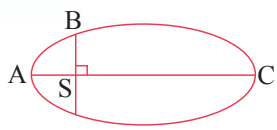
[Ans. (b) conservation of angular momentum]

7. The gravitational potential energy of the Moon with respect to Earth is *[Sep-2021]*

(a) always positive
(b) always negative
(c) can be positive or negative
(d) always zero **[Ans. (b) always negative]**

8. The kinetic energies of a planet in an elliptical orbit about the Sun, at positions A, B and C are K_A, K_B and K_C respectively. AC is the major axis and SB is perpendicular to AC at the position of the Sun S as shown in the figure. Then *(NEET 2018)*

(a) $K_A > K_B > K_C$
(b) $K_B < K_A < K_C$
(c) $K_A < K_B < K_C$
(d) $K_B > K_A > K_C$



[Ans. (a) $K_A > K_B > K_C$]

9. The work done by the Sun's gravitational force on the Earth is

(a) always zero
(b) always positive
(c) can be positive or negative
(d) always negative

[Ans. (c) can be positive or negative]

10. If the mass and radius of the Earth are both doubled, then the acceleration due to gravity g'

(a) remains same (b) $\frac{g}{2}$
(c) 2 g (d) 4g **[Ans. (b) $\frac{g}{2}$]**

11. The magnitude of the Sun's gravitational field as experienced by Earth is *[HY-2018]*

(a) same over the year
(b) decreases in the month of January and increases in the month of July
(c) decreases in the month of July and increases in the month of January
(d) increases during day time and decreases during night time.

[Ans. (c) decreases in the month of July and increases in the month of January]

12. If a person moves from Chennai to Trichy, his weight

(a) increases (b) decreases
(c) remains same
(d) increases and then decreases

[Ans. (b) decreases]

13. An object of mass 10 kg is hanging on a spring scale which is attached to the roof of a lift. If the lift is in free fall, the reading in the spring scale is *[Sep. - 2020]*

(a) 98 N (b) zero
(c) 49 N (d) 9.8 N **[Ans. (b) zero]**

14. If the acceleration due to gravity becomes 4 times its original value, then escape speed

(a) remains same
(b) 2 times of original value
(c) becomes halved
(d) 4 times of original value

[Ans. (b) 2 times of original value]

15. The kinetic energy of the satellite orbiting around the Earth is

(a) equal to potential energy
(b) less than potential energy
(c) greater than kinetic energy
(d) zero **[Ans. (b) less than potential energy]**

II. Short Answer Questions:

1. State Kepler's three laws. *[HY-2018 & 19; Jun-2019 ; Mar-2020]*

Ans. **1. Law of orbits:**
Each planet moves around the Sun in an elliptical orbit with the Sun at one of the foci.

2. Law of area:
The radial vector (line joining the Sun to a planet) sweeps equal areas in equal intervals of time.

3. Law of period:
The square of the time period of revolution of a planet around the Sun in its elliptical orbit is directly proportional to the cube of the semi-major axis of the ellipse. It can be written as $T^2 \alpha a^3$

$$\frac{T^2}{a^3} = \text{constant.}$$

2. State Newton's Universal law of gravitation. *[Sep-2020]*

Ans. Newtons law of gravitation states that a particle of mass M_1 attracts any other particle of mass M_2 in the universe with an attractive force. The strength of this force of attraction was found to be directly proportional to the product of their masses and is inversely proportional to the square of the distance between them. In mathematical form, it can be written as:

$$\vec{F} = -\frac{GM_1M_2}{r^2}\hat{r}$$

3. Will the angular momentum of a planet be conserved? Justify your answer.

Ans. Yes. Because

$$\vec{\tau} = \vec{r} \times \vec{F} = \vec{r} \times \left(-\frac{GM_SM_E}{r^2}\hat{r}\right) = 0$$

$$\text{Since } \vec{r} = r\hat{r}, (\hat{r} \times \hat{r}) = 0$$

$$\text{So, } \vec{\tau} = \frac{d\vec{L}}{dt} = 0.$$

It implies that angular momentum $\vec{L}$ is a constant vector. The angular momentum of the Earth about the Sun is constant throughout the motion.

4. Define the gravitational field. Give its unit.

Ans. The gravitational field intensity $\vec{E}_1$ at a point which is at a distance r from m_1 is defined as the gravitational force experienced by unit mass placed at that point.

$$\vec{E}_1 = -\frac{Gm_1}{r^2}\hat{r}$$

It's unit N / *kg* (or) ms^{-2}

5. What is meant by superposition of gravitational field?

Ans. The total gravitational field at a point P due to all the masses is given by the vector sum of the gravitational field due to the individual masses. This principle is known as superposition of gravitational fields.

$$\vec{E}_{total} = \vec{E}_1 + \vec{E}_2 + ...\vec{E}_n$$

$$= -\frac{Gm_1}{r_1^2}\hat{r}_1 - \frac{Gm_2}{r_2^2}\hat{r}_2 - ..... - \frac{Gm_n}{r_n^2}\hat{r}_n = -\sum_{i=1}^{n}\frac{Gm_i}{r_i^2}\hat{r}_i$$

ADDITIONAL QUESTIONS

I. MULTIPLE CHOICE QUESTIONS :

1 Mark

A. CHOOSE THE BEST ANSWER :

1. According to Kepler's second law the radius vector of a planet sweeps out equal areas in equal intervals of fire. The law is consequence of conservation of
(a) linear momentum
(b) angular momentum
(c) energy
(d) Newton's law of gravitations
[Ans. (b) angular momentum]

2. Two particles of equal mass m go round a circle of radius R under the action of their mutual gravitational attraction, then the speed of each particle is
(a) $\frac{1}{2R}\sqrt{\frac{1}{Gm}}$ (b) $\sqrt{\frac{Gm}{2R}}$
(c) $\frac{1}{2}\sqrt{\frac{Gm}{R}}$ (d) $\sqrt{\frac{4GM}{R}}$ **[Ans. (c) $\frac{1}{2}\sqrt{\frac{Gm}{R}}$]**

3. A body projected electrically from the earth reaches a height equal to earth's radius before returning to the earth. The power exerted by the gravitational force is greatest
(a) at the highest position of the body
(b) at the instant just before the body hits the earth
(c) it remains constant all through
(d) at the instant just after the body is projected
[Ans. (b) at the instant just before the body hits the earth]

4. A rocket is fired from the earth. The distance between the moon and earth is *r* & the mass of the earth is 81 times the mass of the moon. The gravitational force on the rocket will be zero, when its from the moon is
(a) $\frac{r}{5}$ (b) $\frac{r}{10}$ (c) $\frac{r}{15}$ (d) $\frac{r}{20}$
[Ans. (a) $\frac{r}{5}$]

5. A satellite is launched into a circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius 4R. The ratio of their respective periods is
(a) 4 : 1 (b) 1 : 8
(c) 8 : 1 (d) 1 : 4 **[Ans. (b) 1 : 8]**

6. A body of mass 500g is town upwards with a velocity $20ms^{-1}$ and reaches back to the surface of a planet after 20s. Then the weight of the body on that planet is
(a) 2 N (b) 4 N (c) 5 N (d) 1 N
[Ans. (d) 1 N]

7. A body of mass m falls from earth's surface at a height equal to twice the radius (R) each. Then the change in P.E of body will be
(a) 2 mgR (b) $\frac{2}{3}$mgR
(c) 3 mgR (d) $\frac{1}{3}$mgR
[Ans. (b) $\frac{2}{3}$mgR]

8. Three bodies of each of mass 2 kg are situated on *x*-axis at distance 1m, 2m, 4m from origin. The resolving gravitational potential due to the system at the origin will be
(a) 2G (b) $\frac{8}{3}$G (c) $\frac{4}{3}$G (d) $-\frac{7}{2}$G
[Ans. (d) $-\frac{7}{2}$G]

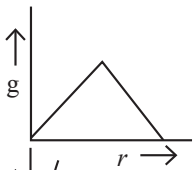
Hint:

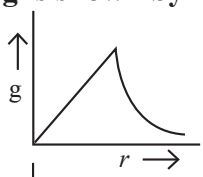
$$= \left[-\frac{2G}{1}-\frac{2G}{2}-\frac{2G}{4}\right]$$

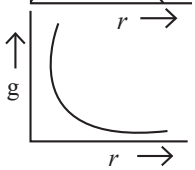
$$= -2G\left[1+\frac{1}{2}+\frac{1}{4}\right] = -2G.\frac{7}{4_2} = -\frac{7}{2}G$$

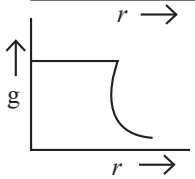
9. Let V & E be gravitational potential & gravitational field at a distance *r* from the centre of a uniform solid sphere, consider the 2 statements
(A) the plot of V against *r* is discontinuous
(B) the plot of E against *r* is discontinuous
(a) both A & B correct
(b) A is correct but B i s wrong
(c) B is correct but A is wrong
(d) both A & B wrong
[Ans. (d) both A & B wrong]

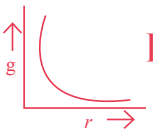
10. Starting from the centre of be each having radius R, the variation of g is shown by

(a) 

(b) 

(c) 

(d) 

[Ans. (c) 

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11. If the acceleration due to gravity at the surface of the earth is g, the work done in slowly lifting a body of mass in from the earth's surface to a height R equal to the radius of the earth is

(a) $\frac{1}{2}$ mgR (b) 2 mgR
(c) mgR (d) $\frac{1}{4}$ mg R

[Ans. (a) $\frac{1}{2}$ mgR]

12. Two spherical balls of mass 10hg are placed 10cm apart. Find gravitational force of attraction between them

(a) the earth does not attract the objects in a satellite
(b) the normal force by chair on the person balances the earth attraction
(c) the normal force is zero
(d) the person in sattelite is not accelarated

[Ans. (c) the normal force is zero]

13. A body is suspended from a spring balance kept in a satellite. The reading of the balance is W_1 when the satellite goes in an orbit of radius R and is W_2 when it goes in an orbit of radius 2R

(a) $W_1 = W_2$ (b) $W_1 < W_2$
(c) $W_1 > W_2$ (d) $W_1 \neq W_2$

[Ans. (a) $W_1 = W_2$]

14. Which of following quantities remain constant in a planetary motion (consider elliptical orbits) as seen from the sun?

(a) speed (b) angular momentum
(c) kinetic energy (d) angular speed

[Ans. (b) angular momentum]

15. A particle is kept at rest at a distance R (earth's radius) above the earth's surface, the minimum speed with which it should projected so that it does not return is

(a) $\sqrt{\frac{GM}{4R}}$ (b) $\sqrt{\frac{GM}{2R}}$ (c) $\sqrt{\frac{GM}{R}}$ (d) $\sqrt{\frac{2GM}{R}}$

[Ans. (c) $\sqrt{\frac{GM}{R}}$]

16. A satellite is orbiting the earth close to its surface. A particle is to be projected from the satellite to just escape from the earth the escape speed from the earth is V_e its speed with respect to the satellite

(a) will be less than V_e
(b) will be more than V_e
(c) will be equal to V_e
(d) will depend on direction of projection

[Ans. (d) will depend on direction of projection]

B. Match the following :

1.

(1)	Kepler's I law	(a)	Law of area
(2)	Kepler's II law	(b)	Geocentric theory
(3)	Kepler's III law	(c)	Law of orbits
(4)	Ptolemy	(d)	Law of period

	(1)	(2)	(3)	(4)
a)	c	a	d	b
b)	d	a	b	c
c)	b	c	d	a
d)	d	c	b	a

[Ans:(a) c a d b]]

2.

(1)	Universal Gravitational Constant	(a)	$\vec{E}$
(2)	Gravitational field	(b)	V (r)
(3)	Gravitational Potential	(c)	U (r)
(4)	Gravitational Potential Energy	(d)	G

	(1)	(2)	(3)	(4)
a)	c	b	a	d
b)	d	a	b	c
c)	b	c	d	a
d)	b	a	d	c

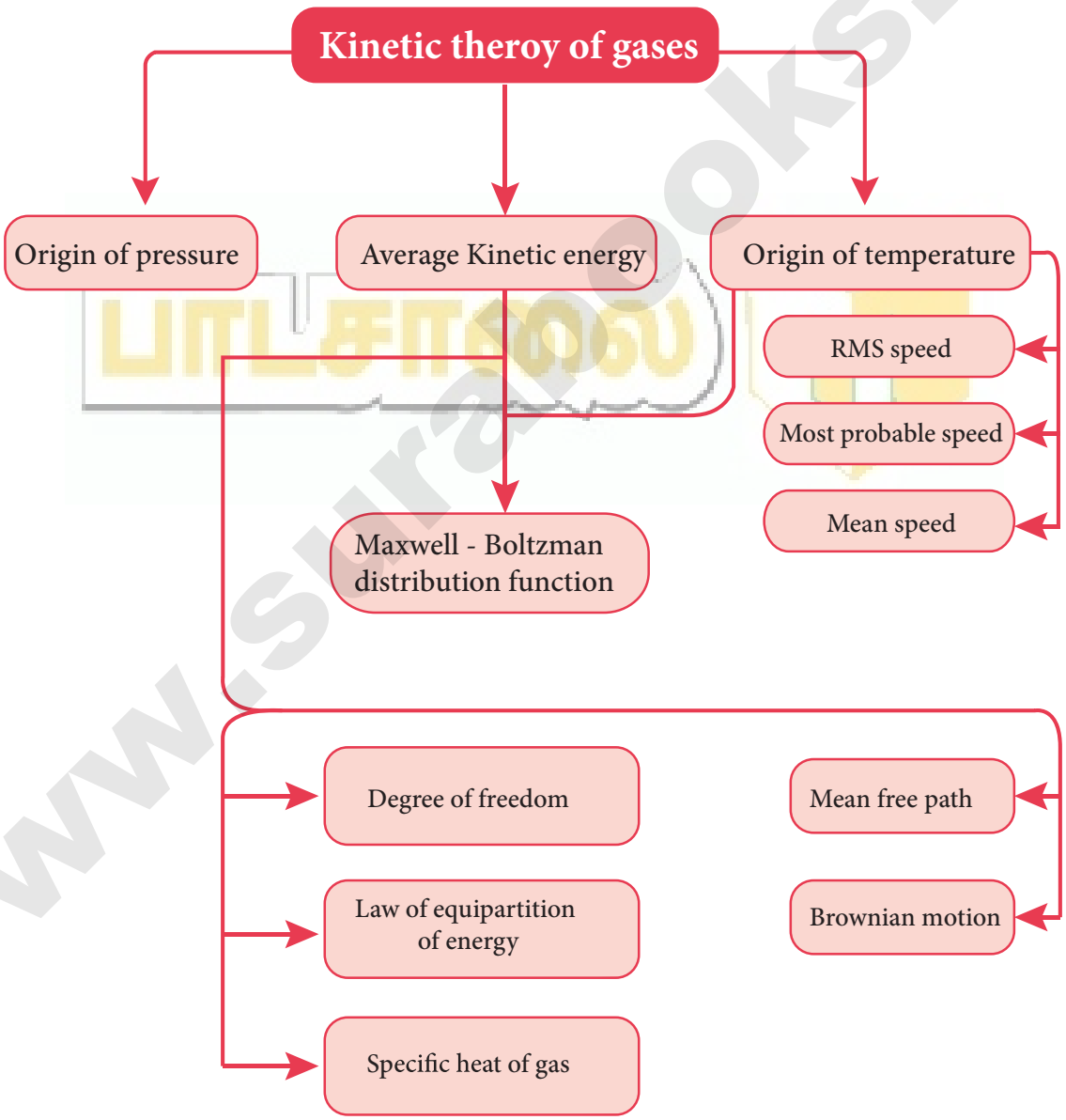
[Ans:(b) d a b c]

UNIT

09

KINETIC THEORY OF GASES

CONCEPT MAP



FORMULAE TO REMEMBER

(1) Ideal gas equation: $PV = nRT$

(2) Charles's law: $\frac{V}{T} = \text{constant}$

(3) Boyle's law: $PV = \text{constant}$

(4) Gay Lussac's law: $\frac{P}{T} = \text{constant}$

(5) Boltzmann's constant: $k_B = \frac{R}{N}$

$R \rightarrow$ Gas Constant; $N \rightarrow$ No. of gas molecules

(6) Pressure exerted by a gas: $P = \frac{1}{3} \cdot \frac{MN}{V} \cdot V_{rms}^2$

(or) $P = \frac{1}{3} PV_{rms}^2$

(7) *rms* velocity of gas molecule $V_{rms} = \sqrt{\frac{V_1^2 + V_2^2 + ...V_n^2}{N}} = \sqrt{\frac{3RT}{M}}$

$R \rightarrow$ Gas Constant
$M \rightarrow$ Molar Mass
$T \rightarrow$ Temperature

(8) Average K.E of a gas $E = \frac{3}{2} PV = \frac{3}{2} RT = \frac{3}{2} k_B NT$

(9) Ave. k . E per molecule of a gas $E = \frac{3}{2} k_B T$

(10) Relation between pressure and K.E: $P = \frac{2}{3} E$

IMPORTANT TERMS & DEFINITIONS

Boyle's law : It states that at constant temperature the volume of a g_n mass of a gas is inversely proportional to the pressure, i.e. $V \propto \frac{1}{P}$ or $PV = \text{constant}$

Charles's law : At constant pressure the volume of a g_n mass of a gas is directly proportional to its absolute temperature.

$$\frac{V}{T} = \text{constant} \quad \text{(or)} \quad V \propto T$$

Graham's law of diffusion : It states that the rate of diffusion of a gas is inversely proportional to the square root of its density.

Avogadro's law : It states that equal volume of all gases under similar conditions of temperature and pressure contain equal number of molecules.

Avogadro's no. : It is the number of particles present in one mole of a substance.

Degrees of freedom : The total number of independent modes in which a system can possess energy.

Law of equipartition of energy : For any system in thermal equilibrium, the total energy is equally distributed among its various degree of freedom and the energy associated with each degree of freedom is $\frac{1}{2} kT$.

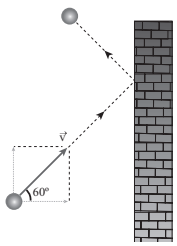
Mean free path : The average distant travelled by a gas molecule is known as mean free path.

Brownian motion : The zig – zag motion of gas molecules is Brownian motion. ∵ it occurs due to random collision of molecules.

EVALUATION

I. Multiple Choice Questions:

1. A particle of mass m is moving with speed u in a direction which makes 60° with respect to x axis. It undergoes elastic collision with the wall. What is the change in momentum in x and y direction?



(a) $\Delta p_x = -mu, \Delta p_y = 0$
(b) $\Delta p_x = -2mu, \Delta p_y = 0$
(c) $\Delta p_x = 0, \Delta p_y = mu$
(d) $\Delta p_x = mu, \Delta p_y = 0$

[Ans. (a) $\Delta p_x = -mu, \Delta p_y = 0$]

2. A sample of ideal gas is at equilibrium. Which of the following quantity is zero?

(a) rms speed (b) average speed
(c) average velocity (d) most probable speed

[Ans. (c) average velocity]

3. An ideal gas is maintained at constant pressure. If the temperature of an ideal gas increases from 100K to 10000K then the rms speed of the gas molecules

(a) increases by 5 times (b) increases by 10 times
(c) remains same (d) increases by 7 times

[Ans. (b) increases by 10 times]

4. Two identically sized rooms A and B are connected by an open door. If the room A is air conditioned such that its temperature is 4°C lesser than room B, which room has more air in it?

(a) Room A (b) Room B
(c) Both room has same air
(d) Cannot be determined **[Ans. (a) Room A]**

5. The average translational kinetic energy of gas molecules depends on

(a) number of moles and T
(b) only on T
(c) P and T
(d) P only **[Ans. (a) number of moles and T]**

6. If the internal energy of an ideal gas U and volume V are doubled, then the pressure *[Sep-2021]*

(a) doubles (b) remains same
(c) halves (d) quadruples

[Ans. (b) remains same]

7. The ratio $\gamma = \frac{C_P}{C_V}$ for a gas mixture consisting of 8 g of helium and 16 g of oxygen is *(Physics Olympiad -2005)* *[Jun.-2019]*

(a) $\frac{23}{15}$ (b) $\frac{15}{23}$ (c) $\frac{27}{17}$ (d) $\frac{17}{27}$

[Ans. (c) $\frac{27}{17}$]

8. A container has one mole of monoatomic ideal gas. Each molecule has f degrees of freedom. What is the ratio of $\gamma = \frac{C_P}{C_V}$?

(a) f (b) $\frac{f}{2}$ (c) $\frac{f}{f+2}$ (d) $\frac{f+2}{f}$

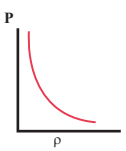
[Ans. (d) $\frac{f+2}{f}$]

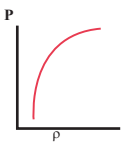
9. If the temperature and pressure of a gas is doubled the mean free path of the gas molecules

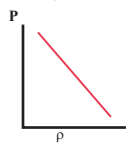
(a) remains same (b) doubled
(c) tripled (d) quadrapoled

[Ans. (a) remains same]

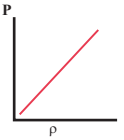
10. Which of the following shows the correct relationship between the pressure and density of an ideal gas at constant temperature? *[HY-2019]*

(a) 

(b) 

(c) 

(d) 

[Ans. (d) 

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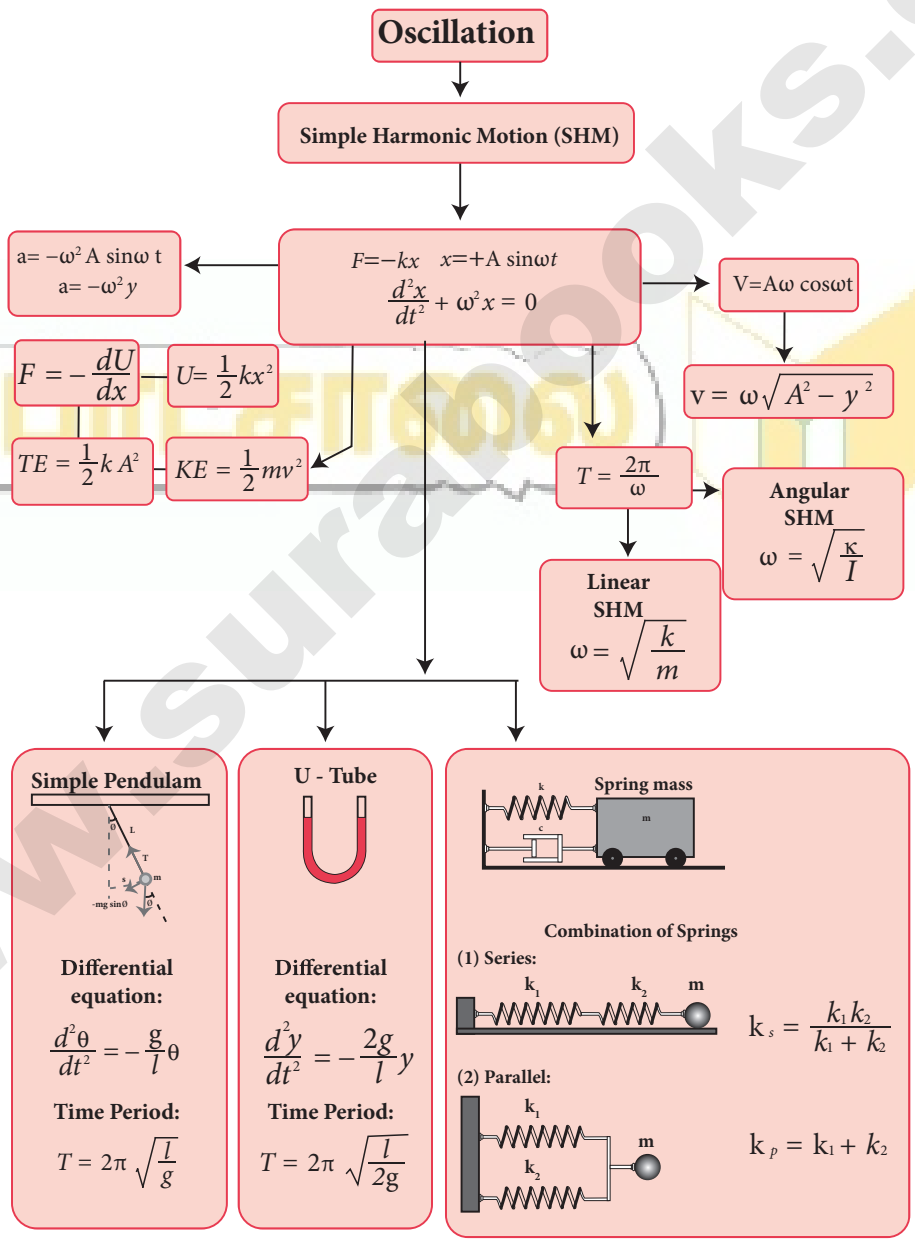
UNIT

10

OSCILLATIONS

CONCEPT MAP



FORMULAE TO REMEMBER

(1) Periodic Motion :

(i) Frequency, $v = \frac{1}{T}$

(ii) Angular Frequency, $\omega = 2\pi v = \frac{2\pi}{T}$

(2) Phase, $= (\omega t + \phi_\circ) = \left(\frac{2\pi t}{T} + \phi_\circ\right) = (2\pi v t + \phi_\circ)$

$\phi_\circ \rightarrow$ Initial phase
$\omega \rightarrow$ Angular frequency
$\varphi \rightarrow$ Phase of the vibrating particle

or

$$\phi = \frac{2\pi t}{T} + \phi_\circ$$

(3) Simple Harmonic Motion:

(i) Differential Equation,

(a) Linear S.H.M. $= \frac{d^2y}{dt^2} + \omega^2 y$, where $\omega^2 = \frac{k}{m}$

(b) Angular S.H.M. $= \frac{d^2y}{dt^2} + \omega^2\theta = 0$, where $\omega^2 = \frac{\kappa}{I}$

$\theta \rightarrow$ Angular displacement
$\kappa \rightarrow$ (Kappa)
$I \rightarrow$ Moment of Inertia

(ii) General equation

(a) Linear S.H.M : $y = y_0 \sin(\omega t + \phi)$

(b) Angular S.H.M : $\theta = \theta_0 \sin(\omega t + \phi)$

(iii) Displacement, $y = A \sin \omega t$, $y = A \cos \omega t$

(iv) Velocity $N = \omega\sqrt{A^2 - y^2}$

(v) Acceleration, $a = \frac{dv}{dt} = -\omega^2 A \sin \omega t$

(vi) Time period, $T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{y}{A}}$

(4) Oscillations:

(a) Loaded Spring:

(i) Horizontal direction, $T = 2\pi\sqrt{\frac{\text{Inertia factor}}{\text{Spring factor}}} - 2\pi\sqrt{\frac{m}{k}}$

Frequency, $v = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

(ii) Vertical direction, $T = 2\pi\sqrt{\frac{l}{g}}$

Frequency, $v = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$

(b) Coaded spring combinations:

Case (I): Two springs in parallel, $T = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$, $k_1 = k_2 = k$

$$\Rightarrow T = 2\pi\sqrt{\frac{m}{2k}}$$

Case (II): Two springs in series, $T = 2\pi\sqrt{\frac{m(k_1 + k_2)}{k_1 \bullet k_2}}$

$$k_1 = k_2 = k \Rightarrow T = 2\pi\sqrt{\frac{2m}{k}}$$

(5) Spring constant: $k = \frac{F}{y}$

(i) In parallel $k = k_1 + k_2$

(ii) In series $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} \Rightarrow \frac{1}{k} = \frac{k_1 + k_2}{k_1 k_2} \Rightarrow k = \frac{k_1 k_2}{k_1 + k_2}$

EVALUATION

I. Multiple Choice Questions

1. In a simple harmonic oscillation, the acceleration against displacement for one complete oscillation will be

(Model NSEP 2000-01) [HY - 2019]

(a) an ellipse (b) a circle
(c) a parabola (d) a straight line

[Ans. (d) a straight line]

2. A particle executing SHM crosses points A and B with the same velocity. Having taken 3 s in passing from A to B, it returns to B after another 3 s. The time period is

(a) 15 s (b) 6 s
(c) 12 s (d) 9 s **[Ans. (c) 12 s]**

3. The length of a second's pendulum on the surface of the Earth is 0.9 m. The length of the same pendulum on surface of planet X such that the acceleration of the planet X is n times greater than the Earth is

(a) $0.9n$ (b) $\frac{0.9}{n}$ m
(c) $0.9n^2$ m (d) $\frac{0.9}{n^2}$ **[Ans. (a) $0.9n$]**

4. A simple pendulum is suspended from the roof of a school bus which moves in a horizontal direction with an acceleration a, then the time period is

(a) $T \alpha \frac{1}{g^2 + a^2}$ (b) $T \alpha \frac{1}{\sqrt{g^2 + a^2}}$
(c) $T \alpha \sqrt{g^2 + a^2}$ (d) $T \alpha (g^2 + a^2)$

[Ans. (b) $T \alpha \frac{1}{\sqrt{g^2 + a^2}}$]

5. Two bodies A and B whose masses are in the ratio 1:2 are suspended from two separate massless springs of force constants k_A and k_B respectively. If the two bodies oscillate vertically such that their maximum velocities are in the ratio 1:2, the ratio of the amplitude A to that of B is

(a) $\sqrt{\frac{k_B}{2k_A}}$ (b) $\sqrt{\frac{k_B}{8k_A}}$
(c) $\sqrt{\frac{2k_B}{k_A}}$ (d) $\sqrt{\frac{8k_B}{k_A}}$

[Ans. (b) $\sqrt{\frac{k_B}{8k_A}}$]

6. A spring is connected to a mass *m* suspended from it and its time period for vertical oscillation is T. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is *[Sep-2021]*

(a) $T' = \sqrt{2}T$ (b) $T' = \frac{T}{\sqrt{2}}$

(c) $T' = \sqrt{2T}$ (d) $T' = \sqrt{\frac{T}{2}}$

[Ans. (b) $T' = \frac{T}{\sqrt{2}}$]

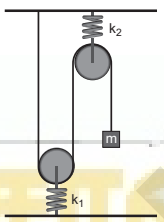
7. The time period for small vertical oscillations of block of mass m when the masses of the pulleys are negligible and springs constant k_1 and k_2 is

(a) $T = 4\pi \sqrt{m\left(\frac{1}{k_1} + \frac{1}{k_2}\right)}$

(b) $T = 2\pi \sqrt{m\left(\frac{1}{k_1} + \frac{1}{k_2}\right)}$

(c) $T = 4\pi \sqrt{m(k_1 + k_2)}$

(d) $T = 2\pi \sqrt{m(k_1 + k_2)}$



[Ans. (a) $T = 4\pi \sqrt{m\left(\frac{1}{k_1} + \frac{1}{k_2}\right)}$]

8. A simple pendulum has a time period T_1. When its point of suspension is moved vertically upwards according as $y = kt^2$, where y is vertical distance covered and $k = 1\ ms^{-2}$, its time period becomes T_2. Then, $\frac{T_1^2}{T_2^2}$ is ($g = 10\ ms^{-2}$) *(IIT 2005)*

(a) $\frac{5}{6}$ (b) $\frac{11}{10}$ (c) $\frac{6}{5}$ (d) $\frac{5}{4}$

[Ans. (c) $\frac{6}{5}$]

9. An ideal spring of spring constant k, is suspended from the ceiling of a room and a block of mass M is fastened to its lower end. If the block is released when the spring is un-stretched, then the maximum extension in the spring is *(IIT 2002)*

(a) $4\frac{Mg}{k}$ (b) $\frac{Mg}{k}$ (c) $2\frac{Mg}{k}$ (d) $\frac{Mg}{2k}$

[Ans. (c) $2\frac{Mg}{k}$]

10. A pendulum is hung in a very high building oscillates to and fro motion freely like a simple harmonic oscillator. If the acceleration of the bob is 16 ms^{-2} at a distance of 4 m from the mean position, then the time period is *(NEET 2018 model)*

(a) 2 s (b) 1 s (c) 2πs (d) πs

[Ans. (d) πs]

11. A hollow sphere is filled with water. It is hung by a long thread. As the water flows out of a hole at the bottom, the period of oscillation will *[Sep-2021]*

(a) first increase and then decrease
(b) first decrease and then increase
(c) increase continuously
(d) decrease continuously

[Ans. (a) first increase and then decrease]

12. The damping force on an oscillator is directly proportional to the velocity. The units of the constant of proportionality are *(AIPMT 2012)*

(a) kg m s^{-1} (b) kg m s^{-2}

(c) kg s^{-1} (d) kg s

[Ans. (c) kg s^{-1}]

13. When a damped harmonic oscillator completes 100 oscillations, its amplitude is reduced to $\left(\frac{1}{3}\right)$ of its initial value. What will be its amplitude when it completes 200 oscillations? *[Sep-2020]*

(a) $\frac{1}{5}$ (b) $\frac{2}{3}$ (c) $\frac{1}{6}$ (d) $\frac{1}{9}$

[Ans. (d) $\frac{1}{9}$]

14. Which of the following differential equations represents a damped harmonic oscillator ?

(a) $\frac{d^2y}{dt^2} + y = 0$ (b) $\frac{d^2y}{dt^2} + \gamma\frac{dy}{dt} + y = 0$

(c) $\frac{d^2y}{dt^2} + k^2y = 0$ (d) $\frac{dy}{dt} + y = 0$

[Ans. (b) $\frac{d^2y}{dt^2} + \gamma\frac{dy}{dt} + y = 0$]

11th STD.

GOVT. SUPPLEMENTARY EXAM. SEPT. - 2021

Part - III

PHYSICS

TIME ALLOWED : 3.00 HOURS MAXIMUM MARKS : 70

Instructions : (1) Check the question paper for fairness of printing. If there is any lack of fairness, inform the Hall Supervisor immediately.
(2) Use **Blue** or **Black** ink to write and underline and pencil to draw diagrams.

PART - I

Note : (1) Answer all the questions. **(15 × 1 = 15)**
(ii) Choose the most appropriate answer from the given **four alternatives** and write the option code and the corresponding answer.

1. Two equal masses m_1 and m_2 are moving along the same straight line with velocities $5ms^{-1}$ and $-9\ ms^{-1}$ respectively. If the collision is elastic, then calculate the velocities after the collision of m_1 and m_2, respectively
   (a) $-9ms^{-1}$ and $5\ ms^{-1}$ (b) $-4ms^{-1}$ and $10\ ms^{-1}$
   (c) $5\ ms^{-1}$ and $1\ ms^{-1}$ (d) $10ms^{-1}$ and $0\ ms^{-1}$
2. If a particle executes uniform circular motion in the xy plane in clockwise direction, then the angular velocity is in :
   (a) –z direction (b) +y direction
   (c) –x direction (d) +z direction
3. A hollow sphere is filled with water. It is hung by a long thread. As the water flows out of a hole at the bottom, the period of oscillation will :
   (a) increase continuously
   (b) first increase and then decrease
   (c) decrease continuously
   (d) first decrease and then increase
4. Which of the following is not a Scalar?
   (a) Pressure (b) Viscosity
   (c) Stress (d) Surface tension
5. If an object is thrown vertically up with the initial speed u from the ground, then the time taken by the object to return back to ground is :
   (a) $\frac{u}{2g}$ (b) $\frac{u^2}{2g}$ (c) $\frac{2u}{g}$ (d) $\frac{u^2}{g}$
6. The efficiency of a heat engine working between the freezing point and boiling point of water is :
   (a) 26.8% (b) 6.25% (c) 12.5% (d) 20%
7. When an object is at rest on the inclined rough surface,
   (a) static friction is not zero and kinetic friction is zero
   (b) static and kinetic frictions acting on the object is zero
   (c) static and kinetic frictions are not zero
   (d) static friction is zero but kinetic friction is not zero
8. A couple produces :
   (a) rotation and translation
   (b) pure rotation
   (c) no motion
   (d) pure translation
9. A transverse wave moves from a medium A to a medium B. In medium A, the velocity of the transverse wave is $500\ ms^{-1}$ and the wavelength is 5 m. The frequency and the wavelength of the wave in medium B when its velocity is $600\ ms^{-1}$, respectively are
   (a) 120 Hz and 6 m (b) 120 Hz and 5 m
   (c) 100 Hz and 6 m (d) 100 Hz and 5 m
10. The dimensional formula of Planck's constant h is :
    (a) $[MLT^{-1}]$ (b) $[ML^2T^{-1}]$
    (c) $[ML^3T^{-3}]$ (d) $[ML^2T^{-3}]$
11. The unit of surface energy is :
    (a) Nm^3 (b) Nm^{-2} (c) Nm (d) Nm^{-1}
12. The gravitational potential energy of the Moon with respect to Earth is
    (a) can be positive or negative
    (b) always positive
    (c) always zero
    (d) always negative

13. A spring is connected to a mass 'm' suspended from it and its time period for vertical oscillation is 'T'. The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillation is :
(a) $T' = \sqrt{2}T$ (b) $T' = \sqrt{2T}$
(c) $T' = \sqrt{\frac{T}{2}}$ (d) $T' = \frac{T}{\sqrt{2}}$

14. If the internal energy of an ideal gas U and volume V are doubled then, the pressure
(a) halves (b) doubles
(c) quadruples (d) remains same

15. Consider a circular leveled road of radius 10 m having coefficient of static friction 0.81. With what speed a car has to move on the turn so that it will have safe turn? ($g = 10\ ms^{-2}$) :
(a) $12\ ms^{-1}$ (b) $8\ ms^{-1}$ (c) $14\ ms^{-1}$ (d) $10\ ms^{-1}$

Part - II

Answer any six questions. Q.No 24 is compulsory. **(6 × 2 = 12)**

16. Define angular velocity.
17. State Wien's law.
18. Check he correctness of the equation $v = u + at$ using dimensional analysis method.
19. Give any two examples of torque in day-to-day life.
20. Define frequency of simple harmonic motion.
21. A book of mass m is at rest on the table. Draw the free body diagram for the book.
22. Compute the distance between anti-node and neighbouring node.
23. Why the energy of a satellite or any other planet is negative?
24. Calculate energy consumed in electrical units when a 75 W fan is used for 8 hours daily for one month (30 days).

Part - III

Answer any six questions. Q. No 33 is compulsory. **(6 × 3 = 18)**

25. Derive the relation between Momentum and Kinetic energy.
26. State the law of transverse vibrations in stretched strings.
27. Show that in horizontal projection, the path of a projectile is a Parabola.
28. Define centre of gravity
29. State Stefan-Boltzmann Law.
30. What are the salient features of Static and Kinetic friction?
31. What are the applications of Dimensional Analysis?
32. Define the degrees of freedom. Give an example.
33. If excess pressure is balanced by a column of oil with specific gravity 0.8, 4 mm high, where R = 2.0 cm, find the surface tension of the soap bubble.

Part - IV

Answer all the questions. **(5 × 5 = 25)**

34. (a) Explain the oscillations of liquid column in U-tube.
(or)
(b) Derive the Kinematics equations of motion for constant acceleration.

35. (a) State and explain work energy principle.
(or)
(b) Explain how overtones are produced in a closed organ pipe.

36. (a) Convert 76 cm of mercury pressure into Nm^{-2} using the method of dimensions.
(or)
(b) Explain in detail Newton's law of cooling.

37. (a) State and Prove Bernoulli's theorem.
(or)
(b) Derive an expression for Kinetic Energy in Rotation.

38. (a) Explain the need for banking of tracks.
(or)
(b) Explain the variation of g with depth from the Earth's surface.

★★★

ANSWERS

Part - I

1. (a) $-9ms^{-1}$ and $5\ ms^{-1}$
2. (a) –z direction
3. (b) first increase and then decrease
4. (c) Stress
5. (c) $\frac{2u}{g}$
6. (a) 26.8%
7. (a) static friction is not zero and kinetic friction is zero
8. (b) pure rotation
9. (c) 100 Hz and 6 m
10. (b) $[ML^2T^{-1}]$
11. (d) Nm^{-1}
12. (d) always negative
13. (d) $T' = \frac{T}{\sqrt{2}}$
14. (d) remains same
15. (d) $10\ ms^{-1}$