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# HIGHER SECONDARY FIRST YEAR

## SUBJECT : PHYSICS

### PART II

2 MARK

1. Check the following equation by dimensional method  $E = mc^2$
2. What is the difference between scalar and vector? Give examples.
3. State Lami's theorem
4. Define center of gravity.
5. An electron moving with velocity  $2.2 \times 10^6 \text{ m/s}$ . Revolving in circular orbit of radius  $0.53053 \text{ \AA}$ . Calculate its angular velocity.
6. What is Reynold's Number? Give example its significance.
7. Define specific heat capacity.
8. Define root mean square speed.
9. A particle executing SHM, covers a displacement of half of amplitude in one second. Calculate its time period.
10. Write any two errors of systematic errors. Explain them.
11. What is projectile? Give two examples.
12. State Newton's second law of motion.
13. A car takes a turn with the velocity  $50 \text{ ms}^{-1}$  on a circular road of radius of curvature  $10 \text{ m}$ . calculate the centrifugal force experienced by a person of mass  $60 \text{ kg}$  inside the car.
14. Why is it more difficult to revolve a stone tied to a longer string then a stone tied to a string ?
15. State Stefan – Boltzmann law and write its expression.
16. List the factors affecting Brownian motion.
17. “ Soldiers are not allowed to march on a bridge ” . Give reason.
18. The surface tension of a soap solution is  $0.03 \text{ Nm}^{-1}$  How much work is done in producing soap bobble of radius  $0.05 \text{ m}$  ?
19. Distinguish between fundamental and derived quantities.
20. What is called frame of reference?
21. State newton's second law.
22. Define law of conservation of energy.
23. The average of frequencies at which human beings can hear sound waves varies from  $20 \text{ Hz}$  to  $20 \text{ kHz}$ . Calculate the wavelength of the sound wave in these limits. (Assume the speed of sound to be  $340 \text{ ms}^{-1}$ ).
24. Dose the moment of inertia depend upon the angular velocity of the body?
25. What are the various factors on which the value of  $g$  at any place on the earth depends?
26. Define one mole.
27. Why “no hydrogen in earth's atmosphere”?
28. What are called physical quantities?
29. What is called “point mass”? Give example.
30. Write the different ways “a force can change the velocity of a particle”.
31. Define energy and its unit.
32. Two point masses  $3 \text{ kg}$  and  $5 \text{ kg}$  are at  $4 \text{ m}$  and  $8 \text{ m}$  from the origin  $X$  axis. Locate the position of center of mass of the two point masses
  - (i) From the origin and
  - (ii) from  $3 \text{ kg}$  mass

33. What is called "retrograde motion" of planets?
34. What is called cohesive force?
35. Define molar specific heat capacity.
36. What are the factors affecting Brownian motion.
37. What are the types of motion?
38. Differentiate between kinetic energy and potential energy.
39. If a stone tied at the end of a string is whirled and the string breaks, why does the stone fly off tangentially?
40. What is called centripetal force?
41. Two resistors of resistances  $R_1 = 150 \pm 2$  ohm and  $R_2 = 220 \pm 6$  Ohm are connected in parallel combination. Calculate the equivalent resistance.
42. How will you prove that Earth itself is spinning?
43. Write down the expression for the elastic potential energy of a stretched wire?
44. Define latent heat capacity. Give its unit.
45. State Avogadro's law.
46. What are the advantages of SI system.
47. What is oscillatory motion? Give example.
48. State Newton's first law.
49. Establish the relation between momentum and kinetic energy.
50. Two vectors are given as  $\vec{r} = 2\hat{i} + 3\hat{j} + 5\hat{k}$  and  $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ . Find the resultant Vector  $\vec{t} = \vec{r} \times \vec{F}$ .
51. Which point is called fulcrum?
52. Why is there no lunar eclipse every month?
53. State Stefan – Boltzmann law.
54. Mention the different ways of increasing the number of molecular collision per unit time in a gas.
55. Define: 'Steradian'.
56. Write the different types of vector?
57. Why a person sitting at any position in an auditorium or a big hall can hear the sound without any disturbance?
58. Define Potential Energy.
59. If two objects of masses 2.5 kg and 100 kg experience the same force 5N, what is the acceleration experienced by each of them?
60. What is the difference between sliding and slipping?
61. State the law of floatation.
62. Define thermal conductivity.
63. List the factors affecting the mean free path.
64. Make a list of some commonly used practical units for measuring small distances.
65. Write a short note on vector product between two vectors.
66. A book of mass  $m$  is at rest on the table.
  - (i) What are the forces acting on the book?
  - (ii) What are the forces exerted by the book?
67. How can an object move with zero acceleration (constant velocity) when the external force is acting on the object?

68. A projectile of mass 5 kg, in its course of motion explodes on its own into two fragments. One fragment of mass 3 kg falls at three fourth of the range R of the projectile. Where will the other fragment fall?
69. What are geostationary and polar satellites?
70. What is Reynold's number?
71. What is the thermodynamics system? Give examples.
72. Deduce Avogadro's laws based on kinetic
73. Make a list of some commonly used practical units for measuring large distance.
74. Define displacement and distance.
75. Under what condition will a car skid on a levelled circular road?
76. Why should the object be moved at constant velocity when we define potential energy?
77. If the ratio of the orbital distance of two planets  $\frac{d_1}{d_2} = 2$ , what is the ratio of gravitational field experienced by these two planets?
78. What is the radius of gyration?
79. Define terminal velocity.
80. What is meant by state variable? Give example.
81. Deduce Boyle's law based on kinetic energy.
82. What is meant by significance figure?
83. Define average velocity.
84. There is a limit beyond which the polishing of a surface increases frictional resistance rather than decreasing it why?
85. Define Instantaneous Power.
86. A hot water cools from  $92^\circ\text{C}$  to  $84^\circ\text{C}$  in 3 minutes when the room temperature is  $27^\circ\text{C}$ . How long will it take for it to cool from  $65^\circ\text{C}$  to  $60^\circ\text{C}$ ?
87. Mention any two physical significances of moment of inertia?
88. What is meant by escape speed in the case of the earth?
89. Two streamlines cannot cross each other why?
90. What is an equation of state? Give an example.
91. Mention some applications of dimensional analysis.
92. Define momentum.
93. Why does a parachute descend slowly?
94. Define COR (coefficient of restitution).
95. A nurse measured the average heart beats of a patient and reported to the doctor in terms of time period as 0.8s. express the heart beat of the patient in terms of number of beats measured per minute.
96. State principle of moments.
97. What is the difference between gravitational potential and gravitational potential energy?
98. Define one calorie.
99. Define the terms degrees of freedom.
100. Define velocity and speed.
101. When a person walks on a surface, the frictional force exerted by the surface on the person is opposite to the direction of motion. True or False?
102. Define one watt.
103. Define couple.
104. From a point on the ground, the top of a tree is seen to have an angle of elevation  $60^\circ$ . The distance between the tree and a point is 50m. calculate the height of the tree?



105. Define gravitational potential.
106. What happens to the pressure inside a soap bubble when air is blown into it?
107. Can we measure the temperature of the object by touching it?
108. Write the expression for rms speed, average speed and most probable speed of a gas molecule.
109. State the principle of homogeneity of dimensions.
110. Define acceleration.
111. Can we predict the direction of motion of a body from the direction of force on it?
112. Write the difference between elastic collision and inelastic collision.
113. When a person breathes, his lungs can hold upto 5.5 litre of air at body temperature  $37^{\circ}\text{C}$  and atmospheric ( $1\text{ atm}=101\text{ kpa}$ ). This air contain 21% oxygen. Calculate the number of oxygen molecules in the lungs.
114. How do you distinguish between stable and unstable equilibrium?
115. Is potential energy the property of a single object? Justify.
116. What is an isotropic medium?
117. What is the microscopic origin of temperature?
118. Distinguish between dimensional and non-dimensional variables.
119. What is called retardation?
120. What are the forces acting on the cart?
121. What is collision? What are the types of collision?
122. Show that for a simple harmonic motion, the phase difference between
  - a) Displacement and velocity is  $\pi/2$  radian or  $90^{\circ}$ .
  - b) Velocity and acceleration is  $\pi/2$  radian or  $90^{\circ}$ .
  - c) Displacement and acceleration is  $\pi$  radian or  $180^{\circ}$ .
123. What is the relation between torque and angular momentum?
124. Define gravitational potential energy.
125. What is a deforming force?
126. What is PV diagram.
127. Distinguish between dimensional and non-dimensional constants.
128. Define angular displacement.
129. What is the relation between the average kinetic energy and pressure.
130. What is elastic potential energy?
131. The position vector of a particle is given by  $\vec{r} = 3t\hat{i} + 5t^2\hat{j} + 7\hat{k}$ . Find the direction in which the particle experience net force.
132. Give any two examples of torque in day-to-day life.
133. What is meant by superposition of gravitational field?
134. Define elastic limit.
135. Express the change in internal energy in terms of molar specific heat capacity.
136. Write the relation between radian, degree and minutes.
137. Two vector  $\vec{A}$  and  $\vec{B}$  of magnitude 5 units and 7 units make an angle  $90^{\circ}$  with each other. Find the magnitude of the difference vector  $\vec{A} - \vec{B}$  and its direction with respect to the vector  $\vec{A}$ .
138. State Lami's theorem?
139. What is known as path difference?

140. A man mass 50 kg is standing at one end of a boat of mass 300 kg floating on still water he walks towards the other end of the boat with a constant velocity of  $2\text{ms}^{-1}$  with respect to a stationary observer on land. What will be the velocity of the boat,
  - a) With respect to the stationary observer on land?
  - b) With respect to the man walking in the boat?
141. Explain the weightlessness in satellites.
142. Establish the relation between power and velocity.
143. Why is water not used in barometers?
144. Write the inferences on the refrigerator?
145. What is called system of units?
146. What is called centripetal acceleration?
147. When a cricket player catches the ball, he pulls his hands gradually in the direction of the ball's motion. Why?
148. What are the types of energy?
149. Calculate the energy of the (i). Moon orbiting the earth and (ii). Earth orbiting the sun.
150. Compute the position of an oscillating particle when its kinetic energy and potential energy are equal.
151. Define center of Mass.
152. A piece of iron sinks in water, but a ship made of iron floats in water. Why?
153. What is meant by a reversible and irreversible process?

### PART III

3 MARK

1. What are the limitations of dimensional analysis?
2. Find the maximum speed at which a car turn round a curve of 36 m radius on a level road. Given co-eff. Of friction between the tyre and road is 0.53
3. Give the difference between elastic and inelastic collision.
4. The position vector of a particle has length of 1 m makes an angle of  $30^\circ$  with a X axis. What are the lengths of x and y components of the position vector?
5. State Kepler's laws.
6. Explain any three factors affecting surface tension of a liquid.
7. Define degree of freedom. Give an example.
8. Explain any three applications of reflection of sound wave.
9. A child is playing on a sliding board. If he is sliding down:
  - a). Mention the forces acting on the child.
  - b). Draw FBD (Free Body Diagram)
  - c). Write the force equation.
10. What is the torque of the force  $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$  acting at a point  $\vec{r} = 2\hat{i} + 3\hat{j} + 5\hat{k}$  about the origin?
11. What are the various type of friction? Suggest few method to reduce friction.
12. A heavy body and a light body have same momentum. Which one of them has more kinetic energy and why?
13. Find the rotational kinetic energy of a ring mass 9 kg and radius 3 m rotating with 240 rpm about an axis passing through its center and perpendicular to its plane.
14. What do you mean by the term weightlessness? Explain the state of weightlessness of a freely falling body.

15. Derive an expression for the terminal velocity of a sphere falling through a viscous liquid.
16. Write down any six postulates of kinetic theory of gases.
17. Explain linear expansion of solid.
18. Two waves of wavelength 99 cm and 100 cm both travelling with the velocity of  $396 \text{ ms}^{-1}$  are made to interfere. Calculate the number of beats produced by them per sec.
19. How will you determine the distance of moon from earth using parallax method?
20. How is the area (irregular shape) found using integral calculus?
21. The velocity of a particle moving in a plane is given by the following diagram. Find out the direction of force acting on the particle.
22. Explain the different cases of zero work done.
23. Calculate the amplitude, angular frequency, time period and initial phase for the simple harmonic oscillation given below:
  - (a).  $y = 0.3 \sin (40\pi + 1.1)$
  - (b).  $y = 2 \cos (\pi t)$
  - (c).  $y = 3 \sin (2\pi t - 1.5)$
24. Calculate the volume of one mole of any gas at STP and room temperature (300K) with the same pressure 1 atm.
25. When a tree is cut, the cut is made on the side facing the direction in which the tree is required to fall. Why?
26. Distinguish between streamlined flow and turbulent flow.
27. Suppose unknowingly you wrote the universal gravitational constant value as  $G = 6.67 \times 10^{11}$  instead of the correct value  $G = 6.67 \times 10^{-11}$ , what is the acceleration due to gravity  $g'$  for this incorrect  $G$ ? According to this new acceleration due to gravity, what will be your weight  $W$ ?
28. How will you measure the diameter of the moon using parallax method?
29. Explain the three components of vector with diagram.
30. Explain the work done by a constant force with graph diagram.
31. Why does a porter bent forward while carrying sack of rice on his back?
32. Apply Newton's second law to a mango hanging from a tree. (mass of the mango is 400gm).
33. Explain what happens when the load on a metal wire suspended from a rigid support is gradually increased. Illustrate your answer with suitable stress-strain graph.
34. What is meant by maintained oscillation? Given an example.
35. Give some important characteristics of wave motion.
36. The moon orbits Jupiter once in 1.769 days. The orbital radius of the moon is 421700km calculate the mass of Jupiter?
37. What are the limitations of dimensional analysis?
38. How the co-ordinate system is used for addition and subtraction of two vectors?
39. Draw the graphical representation of constant force impulse and variable force.
40. Explain the work done by a variable force with graph diagram.
41. Two identical water bottles one empty and the other filled with water are allowed to roll down an inclined plane. Which one of them reaches the bottom first? Explain your answer.
42. Write short notes on two springs connected in parallel.
43. What are the limitations of the first law of thermodynamics?
44. What is viscosity? Explain the cause of viscosity.
45. Write about the formation of waves in tuning fork?



46. How can we classify variables and constants on the basis of dimension? Give examples of each type.
47. Distinguish between speed and velocity.
48. Explain static friction.
49. Discuss the force –displacement graph for a spring.
50. When a person breaths, his lungs can hold up to 5.5 liter of air at body temperature  $37^{\circ}\text{C}$  and atmospheric pressure ( $1\text{atm}=101\text{ kpa}$ ). This air contains 21% oxygen. Calculate the number of oxygen molecules in the lungs.
51. Why is it much easier to balance a meter scale on your finger tip then balancing on a match stick?
52. What will happen to the earth if there is no moon?
53. What are the energies possessed by a liquid? Write down their equations.
54. Explain resonance. Give an example.
55. How will you determine the significant figures in the sum, difference, multiplication and division of two number?
56. Distinguish between distance and displacement.
57. Using free body diagram, shown that it is easy to pull an object that to push it.
58. Discuss the potential energy – displacement graph for a spring.
59. A wire 10 m long has a crass sectional area  $1.25 \times 10^{-4}\text{m}^2$ . It is subjected to a load of 5kg. if young's modules of the material is  $4 \times 10^4\text{Nm}^{-2}$  calculate the elongation produced in the wire.
60. Three identical solid spheres move down through three inclined planes A, B, and C all same dimensions. A is without friction, B is undergoing pure rolling and C is rolling with slipping. Compare the kinetic energies  $E_A$ ,  $E_B$  and  $E_C$  at the bottom.
61. A student was asked a question 'why are there summer and winter for us? He replied as 'since earth is orbiting in an elliptical orbit, when the earth is very far away from the sun (aphelion) there will be winter, when the earth is nearer to the sun (perihelion) there will be winter'. Is this answer correct? If not, what is the correct explanation for the occurrence of summer and winder?
62. Show that a pressure difference exists between the two sides of a curved liquid surface.
63. Why is temperature less then absolute zero not possible?
64. State the rules for rounding off a measurement.
65. Discuss the motion under free fall. Write the equations of motion for a freely falling body.
66. Write the discussion on newton's law?
67. Distinguish the properties conservative and non conservative forces.
68. A person does 30 kj work on 2kg of water by stirring, around 5kcal of heat is released from water through is container to the surface and surrounding by thermal conduction and radiation. What is change in internal energy of the system?
69. Write the relation between angular momentum and rotational kinetic energy. For two objects of same angular momentum, compare the moment of inertia.
70. The following photographs are taken from the recent lunar eclipse which occurred on January 31, 2018. Is it possible to prove that earth is a sphere from these photographs?
71. Distinguish between cohesive and adhesive forces.
72. Explain the laws of simple pendulum with dependent and independent factors.
73. State the rules for counting significant figure.
74. Explain the projectile in horizontal projection.



75. When a bicycle moves in the forward direction, what is the direction of frictional force in the rear and front wheels?
76. Establish the relation between power and velocity.
77. Give the example to show that the following statement is false. 'any two forces acting on a body can be combined into single force that would have same effect'.
78. Why is the law of gravitation called the universal law?
79. A drop of oil placed on the surface of water spreads out. But a drop of water placed on oil contracts to a spherical shape. Why?
80. Describe the four parts of a car not engine?
81. What is the average velocity of the molecules of an ideal gas?
82. What is meant by (i) absolute Error (ii) mean absolute Error (iii) relative Error (iv) percentage Error.
83. Explain the different type of vectors.
84. Write the application of angle of repose?
85. Discuss the perfect inelastic collision.
86. Consider a simple pendulum of length ( $l$ ) = 0.9 m which is properly placed on a trolley down on a inclined plane which is at  $\theta = 45^\circ$  with fine horizontal assuming that the inclined plane is frictionless, calculate time period of oscillation of the simple pendulum.
87. Explain the motion of center of mass with differentiate the quantities.
88. When dropped from the same height a body reaches the ground quicker at poles than at equator. Why?
89. Write the application of Bernoulli's theory.
90. Explain Quasi-static process.
91. Distinguish between the terms precision and accuracy of a measurement.
92. Derive the equation of motion of a particle (a) falling velocity (b) projected vertically.
93. Explain the kinetic friction.
94. Explain the Centre of mass for uniform distribution of mass.
95. If an object of mass 2 kg is thrown up from the ground reaches a height of 5 m and falls back to the earth (neglect the air resistance). Calculate.
  - a) The work done by gravity when the object reaches 5 m height
  - b) The work done by gravity when the object comes back to earth.
  - c) Total the work done by gravity both in upward and downward motion and mention the physical significance of the result.
96. The moon has no atmosphere. Why?
97. Why is water not used in barometers?
98. What are the limitations of the first law of thermodynamics?
99. What is the simplest evidence in nature that you can think to suggest that atoms are not point particles?
100. Distinguish between Mass and Weight.
101. Derive the kinematic equations of motion for constant acceleration.
102. Show that impulse is the change of momentum.
103. Explain the types of collisions.
104. A ship in a sea sends SONAR waves straight down into the sea water from the bottom of the ship. The signal reflects from the deep bottom bet rock and returns to the ship after 3.5s. After the ship moves to 100 km it sends another signal which return back after 2s.

- Calculate the depth of the sea in each case and also compute the difference in height between two cases.
105. Establish the Relation between torque and angular acceleration.
  106. The earth has atmosphere. Why?
  107. We can cut vegetables easily with a sharp knife as compared to a blunt knife. Why?
  108. Explain the types of thermal expansion.
  109. Briefly describe a reflection method for estimating the distance of a nearby planet from the earth.
  110. Discuss the properties of vector products.
  111. Write the meaning of law of conservation of momentum.
  112. Comparison between elastic and inelastic collisions.
  113. A wire of length 2m with the area of cross – section  $10^{-6} m^2$  is used to suspend a load of 980N. Calculate (i) the stress developed in the wire (ii) the strain (iii) the energy stored. Given :  $Y = 12 \times 10^{10} Nm^{-2}$ .
  114. Establish the relation between the angular momentum and angular velocity.
  115. Why does the weight of a body become zero at the Centre of the earth?
  116. Why is it that the body cannot have 100% efficiency?
  117. Explain the factors depends on the pressure exerted by the molecules.
  118. Describe an indirect method to measure the height of an accessible tree or a tower.
  119. Discuss the properties of scalar products.
  120. Identify the internal and external forces acting on the following systems.
    - a) Earth alone as systems.
    - b) Earth and sun as a system.
    - c) Our body as a system while walking.
    - d) Our body + earth as a system.
  121. Explain the types of collision.
  122. How does the wave  $y = \sin(x - a)$  for  $a = 0$ ,  $a = \frac{\pi}{4}$ ,  $a = \frac{\pi}{2}$  and  $a = \pi$  look like? Sketch this wave.
  123. Explain the radius of gyration.
  124. Why is the weight of a body at the poles more then the weight at the equator?
  125. Why is it easier to swim in the sea water then in river water?
  126. Write the conditions for reversible process?
  127. Write the relation between astronomical unit, light year and parsec.
  128. Explain in details the triangle law of addition.
  129. Establish the relation between rotational kinetic energy and angular momentum.
  130. Explain the state of weightlessness.
  131. A baby is playing in a swing which is hanging with the help of two identical chains is at rest. Identify the force acting on the body. Apply Lami's theorem and find out the tension acting on the chain.
  132. Write the practical applications of Stoke's law?
  133. Explain why the specific heat capacity at constant pressure is greater then the specific heat capacity at constant volume.
  134. Give some applications of Doppler effect.
  135. When do the real gases obey more correctly the gas equation :  $PV = nRT$ ?
  136. Write the relation between radian, degree and minutes.

137. Two vectors  $\vec{A}$  and  $\vec{B}$  of magnitude 5 units and 7 units make an angle  $60^\circ$  with each other. Find the magnitude of the difference vector  $\vec{A} - \vec{B}$  and its direction with respect to the vector  $\vec{A}$ .
138. State Lami's theorem?
139. What is known as path difference?
140. A man of mass 50 kg is standing at one end of a boat of mass 300 kg floating on still water. He walks towards the other end of the boat with a constant velocity of  $2 \text{ ms}^{-1}$  with respect to a stationary observer on land. What will be the velocity of the board,  
 a) With respect to the stationary observer on land?  
 b) With respect to the man walking in the boat?
141. Explain the weightlessness in satellites.
142. Establish the relation between power and velocity.
143. Why is water not used in barometers?
144. Write the inferences on the refrigerator?
145. What are the different types of measurement system?
146. Explain Tangential acceleration.
147. Explain the concept of inertia. Write two examples each for inertia of motion, inertia of rest and inertia of direction.
148. A crane has an arm length of 2 m inclined at  $30^\circ$  with the vertical. It carries a container of mass of 2 ton suspended from the top end of the arm. Find the torque produced by the gravitational force on the container about the point where the arm is fixed to the crane. [Given : 1 ton = 1000 kg; neglect the weight of the arm.  $g = 10 \text{ ms}^{-2}$ ]
149. How is surface tension related to surface energy?
150. Derive an expression for the velocity of satellite.
151. Did joule convert mechanical energy to heat energy? Explain.
152. For an ideal gas, the internal energy can only be translational kinetic energy. Explain.
153. i) Calculate the velocity of the travelling pulse. The linear mass density of pulse is  $0.25 \text{ kg m}^{-1}$  further, compute the time taken by the travelling pulse to cover a distance of 30 cm on the string.  
 ii) Calculate the speed of sound in a steel rod whose Young's modulus  $y = 2 \times 10^{11} \text{ Nm}^{-2}$  and  $\rho = 7800 \text{ kg m}^{-3}$ .

## PART IV

5 MARK

1. a. Explain in detail the triangle law of addition.  
 (OR)  
 b. Discuss the four types of oscillation.
2. a. Explain the vertical motion of blocks connected by a string.  
 (OR)  
 b. What are the stationary waves? Write the characteristics of stationary waves.
3. a. Derive the expression of moment of inertia of rod about an axis passing through its center and perpendicular to the rod.

(OR)



b. State ideal gas laws. Derive equation of state for ideal gas.

4. a. Derive the expression of escape speed.

(OR)

b. Explain the different types of moduli of elasticity.

5. a. In a series of successive measurements in an experiment, the readings of period of rotation

of a wheel were found out to be 2.15 s, 2.25 s, 2.28s and 2.32s.

(ii) Will they have same kinetic energy?

(iii) Will they have same speed? Prove it.

(OR)

b. In a series of successive measurements in an experiments the reading of period of rotation of a wheel were found out to be 2.15s, 2.25s, 2.28s and 2.32s.

Calculate :

(i) Mean value of period of rotation

(ii) Absolute error in each measurement

(iii) Mean absolute error

(iv) Relative error and

(v) Percentage error. Express the result in proper.

6. a. Explain the principle of homogeneity of dimensions and derive an expression for the force  $F$  acting on a body moving in a circular path depending on the mass of the body ( $m$ ), velocity ( $v$ ) and radius ( $r$ ) of the circular path. Obtain the expression for the force by the dimensional analysis method (take the value  $k = 1$ ).

(OR)

b. State and prove Bernoulli's theorem for a flow of a incompressible non viscous and streamlined flow of liquid.

7. a. Prove the law of conservation of momentum. Use it to find the recoil velocity of a gun when a bullet of fired from it.

(OR)

b. State and prove parallel axes theorem.

8. a. What elastic collision? Derive an expression for final velocities of two bodies which undergo elastic collision in one dimension.

b. How will you determine the velocity of sound using resonance air column apparatus?

9. a. Derive Mayer's relation for an ideal gas..

(OR)

b. Explain the horizontal oscillation of spring.



10. a. i. Write down the equation of a freely falling body under gravity.  
ii. A ball is thrown vertically upward with the speed of  $19.6 \text{ ms}^{-1}$  from the top of a building and reaches the earth in 6 s. find the height of the building.

(OR)

- b. i. Define orbital velocity and establish an expression for it  
ii. Calculate the value of orbital velocity for an artificial satellite of earth orbiting at a height of 1000 km (Mass of the earth =  $6 \times 10^{24} \text{ kg}$ , radius of the earth = 6400 km).
11. a. i. The shadow of a pole standing on a level ground is found to be 45 m longer when the sun's altitude is  $30^\circ$  then when it was  $60^\circ$ . Determine the height of the pole. [ given  $\sqrt{3} = 1.73$  ]  
ii. The mass and volume of a body are found to be  $4 \pm 0.3$  and  $5 \pm 0.1 \text{ m}^3$  respectively. Then find the maximum possible percentage error in density.

(OR)

- b. Explain the type of motions with example.
12. a. Explain the two bodies in contact on a horizontal surface based Newton's law.

(OR)

- b. Explain the method to find the Centre of gravity of a irregularly shaped lamina.
13. a. Explain the kepler's law of planetary motion.

(OR)

- b. State Hooke's law and verify it with the help of an experiment.

14. a. Explain in detail the working of a refrigerator.

(OR)

- b. A room contains oxygen and hydrogen molecules in the ratio 3:1. The temperature of the room is  $27^\circ\text{C}$ . The molar mass of  $\text{O}_2$  is  $32 \text{ gmol}^{-1}$  and for  $\text{H}_2$  is  $2 \text{ gmol}^{-1}$ . The value of gas constant R is  $8.32 \text{ J mol}^{-1}\text{K}^{-1}$ .

- i) rms speed of oxygen and hydrogen molecules.  
ii) average kinetic energy per oxygen molecule and per hydrogen molecule.  
iii) Ratio of average kinetic energy of oxygen molecules and hydrogen molecule.
15. a. Derive an expression for the

- (i) Source in motion and observer at rest (a) source moves towards observer (b) source moves away from the observer.  
 (ii) Observer in motion and source at rest (a) observer moves towards sources (b) observer recedes away from the source.

(OR)

b. Arrive at an Expression for elastic collision in one dimension.

16. a. i) Check the correctness of equation  $\frac{1}{2}mv^2 = mgh$  using dimensional analysis method.

ii) State the number of significant figures in the following.

<u>Number</u>	<u>No. of Significant figures</u>
(i) 600800	-
(ii) 400	-
(iii) 0.007	-
(iv) 5213.0	-
(v) $2.65 \times 10^{24}$	-
(vi) 0.0006032	-

(OR)

b. Explain the particle moving in an inclined plane.

17. a. Explain the Motion Along one Dimension

(OR)

b. Explain why a cyclist bends while negotiating a curve road? Arrive at the expression for angle of bending for a given velocity.

18. a. Explain in details the geostationary and polar satellites.

(OR)

b. Derive the expression for a Carnot engine efficiency.

19. a. Derive an expression for the elastic energy stored per unit volume of wire.

(OR)

b. Derive the expression for mean free paths of the gas.

20. a. Expression the potential energy near the surface of the Earth.

(OR)

b. Briefly explain the difference between travelling waves and standing waves.

21. a. Obtain an expression for the time period T of a simple pendulum. The time period T depend upon (i) mass 'm' of the bob (ii) Length 'l' of the pendulum and (iii) Acceleration due to gravity g at the place where the pendulum is suspended. (Constant  $k = 2\pi$ )

(OR)

b. Explain the heat engine and obtain its efficiency.

22. a. Explain the Relative velocity in one and two Dimensional motions with special cases?

(OR)

b. State and prove Pascal's law fluids.

23. a. Explain the centrifugal force due to rotation of the earth.

(OR)

b. Derive the expression for moment of inertia of a uniform ring about an axis passing through the center and perpendicular to the plane.

24. a. Drive the expression for energy of satellite.

(OR)

b. Derive the ratio of two specific heat capacities of mono atomic, diatomic and tri atomic molecules.

25. a, Discuss how ripples formed in still water.

(OR)

b. Describe simple harmonic motion as a projection of uniform circular motion.

26. a. The force  $F$  acting on a body moving in a circular path depends on mass of the body ( $m$ ), velocity ( $v$ ) and radius ( $r$ ) of the circular path. Obtain the expression for the force by dimensional analysis method. (Take the value of  $k = 1$ )

(OR)

b. Derive Equations of uniformly accelerated motion by Calculus method.

27. a. Explain the forces acting on the vehicle on a levelled circular road.

(OR)

b. Discuss conservation of angular momentum with example.

28. a. Derive the time period of satellite orbiting the earth.

(OR)

b. Derive the expression for the terminal velocity of a sphere moving in a high viscous fluid using stokes forces.

29. a. Explain the isobaric process and derive the work done in this process.

(OR)

b. Explain in details the Maxwell Boltzmann speed distribution function.

30. a. Describe newton's formula for speed of sound waves in air and also discuss the Laplace's correction.

(OR)

b. Explain the motion in a vertical circle with diagram.

31. a. Using a Vernier calipers the length of a cylinder in different measurement is found to be 2.36 cm, 2.27 cm, 2.26 cm 2.28 cm, 2.31 cm, 2.28 cm and 2.29 cm. find the mean value, absolute error, the relative error and the percentage error of the cylinder.

(OR)

b. Write down the difference between simple harmonic motion and angular simple harmonic motion.

32. a. Derive Equations of motion under gravity.

- (i) A body falling from a height  $h$
- (ii) A body thrown vertically upwards.

(OR)

b. what are methods to reduce friction?

33. a. State and prove perpendicular axis theorem.

(OR)

b. Briefly explain the concept of superposition principle.

34. a. Explain the variation of  $g$  with depth from the earth's surface.

(OR)

b. Obtain an expression for the excess of pressure inside a (i) liquid drop (ii) liquid bubble (ii) air bubble.

35. a. Explain in details an Adiabatic process.

(OR)

b. Describe the Brownian motion.

36. a. Convert a velocity of  $72 \text{ kmh}^{-1}$  into  $\text{ms}^{-1}$  with the help of dimensional analysis.

(OR)

b. Explain the projectile under an angular projection (oblique projectile).

- (i) Maximum height
- (ii) Time of flight
- (iii) Horizontal range.

37. a. Explain the salient features of static and kinetic friction.

(OR)

b. Explain the Center of mass for distributed point masses.



38. a. Explain the variation of  $g$  with altitude  
(OR)  
b. Obtain an equation of continuity for a flow of fluid on the basis of conservation of mass.
39. a. Explain in details the isothermal process.  
(OR)  
b. Derive the ratio of two specific heat capacities of mono atomic and tri atomic molecules.
40. a. Explain the Elastic Potential Energy with example.  
(OR)  
b. What are the stationary waves? Explain the formation of stationary waves.
41. a. The parallax of a heavenly body measured from two points diametrically opposite on equator earth is  $2'$ . Calculate the distance of the heavenly body. [Given radius of the earth = 6400 km] [ $1'' = 4.85 \times 10^{-6}$  rad].  
(OR)  
b. Explain the projectile in horizontal projection with  
(i) Resultant velocity (velocity of projectile at any time)  
(ii) Speed of projectile when it hits the ground.
42. a. Calculate the centripetal acceleration of moon forwards of Earth.  
(OR)  
b. Explain the different types of equilibrium and their conditions.
43. a. Describe the construction and working of Venturimeter and obtain an equation for the volume of liquid flowing per second through a wider entry of the tube.  
(OR)  
b. Derive an expression for the work done in a volume change in a thermodynamic system.
44. a. Derive the expression for energy of satellite.  
(OR)  
b. Describe the vertical oscillation of a spring.
45. a. Explain the detail the Maxwell Boltzmann distribution function.  
(OR)  
b. Discuss the law of transverse vibrations in stretched strings.
46. a. Find the dimensions of  $a$  and  $b$  in the formula  $P + \frac{A}{V^2} [V - b] = RT$  where  $P$  is pressure and  $V$  is the volume of the gas.  
(OR)  
b. Explain briefly about the graphical representation of displacement, velocity and acceleration in SHM.

47. a. Write the expression for the velocity of longitudinal wave in an elastic medium.

(OR)

- b. How the magnitude of centripetal acceleration is constant for uniform circular motion. Explain?

48. a. Explain the need for banking of tracks.

(OR)

- b. How the velocity have different point in pure rolling?

49. a. Explain the variation of  $g$  with latitude.

(OR)

- b. State and prove Bernoulli's theorem for a flow of incompressible, non-viscous, and streamlined flow of fluid.

50. a. Discuss the (a) thermal equilibrium (b) mechanical equilibrium (c) chemical equilibrium (d) thermodynamic equilibrium.

(OR)

- b. Describe the total degrees of freedom for mono atomic molecule, diatomic molecule and tri atomic molecule.

51. a. The force  $F$  acting on a body moving in a circular path depends on mass of the body ( $m$ ) velocity ( $v$ ) and radius ( $r$ ) of the circular path. Obtain the expression for the force by dimensional analysis method. (Take the value of  $k=1$ ).

(OR)

- b. Discuss the various factors which affect the speed of sound in a gas.

52. a. Two vectors  $\vec{A}$  and  $\vec{B}$  are given in the component form as  $\vec{A} = 5\hat{i} + 7\hat{j} - 4\hat{k}$  and  $\vec{B} = 6\hat{i} + 3\hat{j} + 2\hat{k}$ . Find  $\vec{A} + \vec{B}$ ,  $\vec{B} + \vec{A}$ ,  $\vec{A} - \vec{B}$ ,  $\vec{B} - \vec{A}$ .

(OR)

- b. Explain acceleration in SHM and discuss special cases.

53. a. Briefly explain 'Rolling friction'.

(OR)

- b. Discuss the special cases for Elastic collision in one dimension.

54. a. Derive an expression for escape speed.

(OR)

- b. What is capillarity? Obtain an expression for the surface tension of a liquid by capillary rise method?

55. a. Discuss rolling on inclined plane and arrive at the expression for the acceleration.

(OR)

b. Explain in details newton's law of cooling.

56. a. Obtain an expression for the time period  $T$  of a simple pendulum. The time period  $T$  depend upon (i) mass 'm' of the bob (ii) length 'l' of the pendulum and (iii) acceleration due to gravity  $g$  at the place where the pendulum is suspended. (constant  $k = 2\pi$ ).

(OR)

b. (i) Two vector are given as  $\vec{r} = 2\hat{i} + 3\hat{j} + 5\hat{k}$  and  $\vec{F} = 3\hat{i} - 2\hat{j} + 4\hat{k}$ . Find the resultant vector  $\vec{\tau} = \vec{r} \times \vec{F}$ .

(ii) Find the derivative with respect to  $t$ , of the function  $x = A_0 + A_1t + A_2t^2$  where  $A_0, A_1$  and  $A_2$  are constants.

57. a. Briefly explain 'centripetal force' with suitable examples.

(OR)

b. Arrive at an expression for elastic collision in one dimension.

58. a. Derive an expression for kinetic energy in pure rolling with centre of mass and point of contact.

(OR)

b. explain in details the idea of weightlessness using lift as an example.

- 59 a. Derive Poiseuille's formula for the volume of a liquid flowing per second through a pipe under streamlined flow.

(OR)

b. Explain calorimeter and derive an expression for final temperature when two thermodynamic system are mixed?

60. a. Explain in detail the kinetic interpretation of temperature.

(OR)

b. Discuss the simple pendulum in detail.

61. a. If the value of universal gravitational constant in SI is  $6.6 \times 10^{-11} Nm^2 kg^{-2}$ , then find its value in CGS System.

(OR)

b. Explain the relative velocity in one and two dimensional motions with special cases.

62. a. Explain the similarities and difference of centrifugal forces.

(OR)

- b. Discuss the motion in vertical circle for the lowest and highest point at the case of minimum speed.

63. a. Write short notes on the oscillations of liquid column in U tube.

(OR)

- b. Discuss how the translational and Rotational motions are related in rolling.

64. a. Deduce expression for (a) particle velocity and (b) wave velocity. Discuss their phase relationship with displacement.

(OR)

- b. Prove that at points near the surface of the Earth, the gravitational potential energy of the objects is  $U=mgh$ .

65. a. state and prove Archimedes principle.

(OR)

- b. Explain in detail the thermal expansion.

66. a. Convert 76 cm of mercury pressure into  $Nm^{-2}$  using the method of dimensions.

(OR)

- b. Derive equations of uniformly accelerated motion by calculus method.

67. a. State Newton's three laws and discuss their significance.

(OR)

- b. Explain the motion in a vertical circle with diagram.

68. a. Discuss rolling on inclined plane and arrive at the expression for the acceleration.

(OR)

- b. Derive the expression for gravitational potential energy with special cases.

69. a. Derive an equation for the total pressure at a depth 'h' below the liquid surface.

(OR)

- b. Explain the meaning of heat and work with suitable examples.

70. a. Derive the expression of pressure exerted by the gas on the walls of the container.

(OR)

- b. Show that the velocity of a travelling wave produced in a string is  $v = \frac{\sqrt{T}}{\mu}$ .

71. a. In a series of successive measurement in an experiment, the readings of the period of oscillation of a simple pendulum were found to be 2.63s, 2.56s, 2.42s, 2.71s and 2.80s. calculate (i) The mean value of the period of oscillation (ii) The absolute error in each



measurement (iii) The mean absolute error (iv) The relative error (v) The percentage error. Express the result in proper form.

(OR)

b. Explain the motion along one dimension.

72. a. briefly explain the origin of friction. Show that in an inclined plane, angle of friction is equal to angle of repose.

(OR)

b. Explain the elastic potential energy with example.

73. a. Explain how the interference of waves is formed.

(OR)

b. State and prove parallel axis theorem.

74. a. Obtain an expression for the force in terms of mass of the earth and gravitational constant.

(OR)

b. Derive the expression of pressure exerted by the gas on the walls of the container.

75. a. Explain the difference types of moduli of elasticity.

(OR)

b. Explain Wien's law and why our eyes are sensitive only to visible eyes.

76. a. What is meant by parallax and Parallactic angle? How can we find the distance of the moon from earth by parallax method?

(OR)

b. Derive equation of motion under gravity.

(i) A body falling from a height  $h$

(ii) A body thrown vertically upwards.

77. a. A spring balance has a scale which ranges from 0 to 25kg and the length of the scale is 0.25m it is taken to an unknown planet  $x$  where the acceleration due to gravity is  $11.5\text{ms}^{-1}$ . Suppose a body of mass  $M$  kg is suspended in this spring and made to oscillate with a period of 0.50s. compute the gravitational force acting on the body.

(OR)

b. Explain the motion of blocks connected by a string in

(i) Vertical motion

(ii) Horizontal motion.

78. a. Explain the potential energy near the surface of the Earth.

(OR)

- b. Derive the expression for moment of inertia of a uniform disc about an axis passing through the center and perpendicular to the plane.

79. a. Explain how Newton arrived at his law of gravitation from Kepler's third law.

(OR)

- b. Mercury has an angle of contact equal to  $140^\circ$  with soda lime glass. A narrow tube of radius 2mm, made of this glass is dipped in a trough containing mercury. By what amount does the mercury dip down in the tube relative to the liquid surface outside? Surface tension of mercury  $T = 0.456 \text{ Nm}^{-1}$ ; Density of mercury  $\rho = 13.6 \times 10^3 \text{ kgm}^{-3}$ .

80. a. Derive Meyer's relation for an ideal gas.

(OR)

- b. Write down the postulates of kinetic theory of gases?

81. a. What do you mean by error in a measurement? Briefly explain the different types of errors and their causes.

(OR)

- b. Explain the projectile in horizontal projection with

- (i) Resultant velocity (velocity of projectile at any time)
- (ii) Speed of projectile when it hits the ground.

82. a. Prove the law of conservation of linear momentum. Use it to find the recoil velocity of a gun when a bullet is fired from it.

(OR)

- b. Explain work-kinetic energy theorem. Mention any three examples for it.

83. a. Explain the concepts of fundamental frequency, harmonics and overtones in detail.

(OR)

- b. Derive the expression for moment of inertia of a rod about its center and perpendicular to the rod.

84. a. Discuss the important features of the law of gravitation.

(OR)

- b. Describe the total degrees of freedom for mono atomic molecule, diatomic molecule and tri atomic molecule.

85. a. The reading of pressure meter attached with a closed pipe is  $5 \times 10^5 \text{ Nm}^{-2}$ . On opening the value of the pipe, the reading of the pressure meter is  $4.5 \times 10^5 \text{ Nm}^{-2}$ . Calculate the speed of the water flowing in the pipe.

(OR)

- b. Derive the work done in an isothermal process.

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