

- Class: XI
- 1) _____ have the same dimensional formula.
- a) Force and momentum b) Stress and Strain
c) Density and linear density d) Work and potential energy
- 2) The velocity of a body is expressed as $v = \frac{x}{t} + y/t$. The dimensional formula for x is
- a) ML^0T^0 b) M^0LT^0 c) ML^0T d) MLT^0
- 3) Which of the following sets have different dimensions?
- a) Pressure, Young's modulus, Stress b) E.M.F potential difference, electric potential
c) Heat, work done, energy d) Dipole moment, electric flux electric field
- 4) The number of significant digits in 0.0006032 is a) 8 b) 7 c) 4 d) 2
- 5) Percentage errors in the measurement of mass and speed are 2% and 3% respectively. The error in the estimate of kinetic energy obtained by measuring mass and speed will be
- a) 12% b) 10% c) 8% d) 2%
- 6) The displacement of particle is given by $x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$. What is its acceleration?
- a) $2a_2/3$ b) $-2a_2/3$ c) a_2 d) zero
- 7) A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is v, the total area around the fountain that gets wet is
- a) $\pi v^2/g$ b) $\pi v^4/g^2$ c) $\pi v^4/2g^2$ d) $\pi v^2/g^2$
- 8) A moving body is covering distances in proportion to the square of time along a straight line. The acceleration of the body is
- a) increasing b) decreasing c) zero d) constant
- 9) What is dot product of two vectors of magnitude 3 and 5, if angle between them is 60° ?
- a) 9.5 b) 8.4 c) 7.5 d) 5.2
- 10) Two bullets are fired at angle θ and $(90 - \theta)$ to the horizontal with same speed. The ratio of their time of flight is a) 1 : 1 b) $\tan\theta : 1$ c) 1 : $\tan\theta$ d) $\tan^2\theta : 1$
- 11) What force will change the velocity of a body 1 kg from 20 ms^{-1} to 30 ms^{-1} in 2 s?
- a) 25 N b) 10 N c) 5 N d) 2 N
- 12) The mass of a lift is 2000 kg. The tension in the supporting cable is 28000 N. Its acceleration is
- a) 30 m s^{-2} downwards b) 4 m s^{-2} upwards c) 4 m s^{-2} downwards d) 14 m s^{-2} upwards
- 13) Which of the following quantities has its unit as Newton-second?
- a) torque b) momentum c) energy d) Planck's constant
- 14) A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time
- a) $\frac{v}{g\mu}$ b) $\frac{g\mu}{v}$ c) $\frac{g}{v}$ d) $\frac{g^2}{v}$
- 15) A force F_1 of 500 N is required to push a car of mass 1000 kg slowly at constant speed on a level road if a force F_2 of 1000 N is applied, the acceleration of the car will be
- a) zero b) 1.5 ms^{-2} c) 1 ms^{-2} d) 0.5 ms^{-2}
- 16) A body of mass 100 g is rotating in a circular path of radius r with constant velocity. The work done in one complete revolution is a) $(r/100) \text{ J}$ b) $(100/r) \text{ J}$ c) $100 \pi \text{ J}$ d) zero
- 17) A force $\vec{F} = (5\hat{i} + 3\hat{j} + 2\hat{k}) \text{ N}$ is applied over a particle displaces it from its origin to the point $\vec{r} = (2\hat{i} - \hat{j}) \text{ m}$. The work done on the particle is a) -7 J b) $+7 \text{ J}$ c) $+10 \text{ J}$ d) $+13 \text{ J}$
- 18) If the new velocity of a body is twice of its previous velocity, then kinetic energy will become
- a) 2 times b) 0.5 times c) 4 times d) 6 times
- 19) A light and a heavier body have equal kinetic energy which one has greater momentum?
- a) The heavier body b) The light body
c) Both have equal momentum d) Data given is incomplete
- 20) In elastic collision 100% energy transfer takes place, when
- a) $m_1 = m_2$ b) $m_1 > m_2$ c) $m_1 < m_2$ d) $m_1 = 2m_2$
- 21) If flywheel makes 120 rev/min then its angular speed will be
- a) $8\pi \text{ rad/s}$ b) $6\pi \text{ rad/s}$ c) $4\pi \text{ rad/s}$ d) $2\pi \text{ rad/s}$
- 22) Relation between torque and angular momentum is similar to the relation between
- a) acceleration and velocity b) mass and moment of inertia
c) force and momentum d) energy and displacement
- 23) The angular speed of minute hand in a watch is
- a) $\frac{\pi}{21600} \text{ rad s}^{-1}$ b) $\frac{\pi}{12} \text{ rad s}^{-1}$ c) $\frac{\pi}{3600} \text{ rad s}^{-1}$ d) $\frac{\pi}{1800} \text{ rad s}^{-1}$
- 24) The moment of inertia of a body comes into play
- a) in linear motion b) in rotational motion c) in projectile motion d) in periodic motion
- 25) A particle of mass 1 kg is kept at (1m, 1m, 1m). The moment of inertia of this particle about Z-axis would be
- a) 1 kg m^2 b) 2 kg m^2 c) 3 kg m^2 d) None of these
- 26) The force of gravitation is a) repulsive b) electrostatic c) conservative d) non-conservative
- Let g_1 and g_2 denote acceleration due to gravity on the surface of the earth and on a planet, whose mass and radius are twice that of the earth. Then
- a) $g_1 = g_2$ b) $g_1 = 2g_2$ c) $g_2 = 2g_1$ d) $g_1 = 2g_2^2$

- 28) If v_e and v_o represent the escape velocity and orbital velocity of a satellite corresponding to a circular orbit of radius R (radius of earth), then
 a) $v_e = v_o$ b) $v_e = \sqrt{2} v_o$ c) $v_e = v_o / \sqrt{2}$ d) v_e and v_o are not related
- 29) The time period of a satellite in a circular orbit of radius R is T. The period of another satellite in a circular orbit of radius 4R is
 a) 4T b) T/4 c) 8T d) T/8
- 30) A missile is launched with a velocity less than the escape velocity. The sum of its kinetic and potential energies
 a) is positive b) is negative c) is zero
 d) may be positive or negative depending upon its initial velocity
- 31) The spherical shape of a rain drop is due to
 a) density of water b) surface tension c) atmospheric pressure d) gravity
- 32) Which of the following affects the elasticity of a substance?
 a) hammering and annealing b) change in temperature
 c) Impurity in the substance d) all of these
- 33) Two wires are made of the same material and have the same volume. However, wire 1 has cross-sectional area A and wire 2 has cross-sectional area 3A. If the length of wire 1 increased by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?
 a) F b) 4F c) 6F d) 9F
- 34) A sphere of mass M and radius a is falling in a viscous fluid. The terminal velocity attained by the falling object will be proportional to
 a) a^2 b) a c) $1/a$ d) $1/a^2$
- 35) The value of absolute zero on Celsius scale is
 a) 0°C b) -32°C c) -40°C d) -273.15°C
- 36) A black body is at temperature of 500 K. It emits energy at rate which is proportional to
 a) $(500)^4$ b) $(500)^3$ c) $(500)^2$ d) 500
- 37) A black body at 1227°C emits radiations with maximum intensity at a wavelength of 5000\AA . If the temperature of the body is increased by 1000°C the maximum intensity will be observed at
 a) 4000\AA b) 5000\AA c) 6000\AA d) 3000\AA
- 38) The property of the system that does not change during an adiabatic change is
 a) temperature b) volume c) pressure d) heat
- 39) The molar specific heats of an ideal gas at constant pressure and constant volume are denoted by C_p and C_v respectively. If $\gamma = C_p/C_v$ and R is a universal gas constant then C_v is
 a) $\frac{1+\gamma}{1-\gamma}$ b) $\frac{R}{\gamma-1}$ c) $\frac{\gamma-1}{R}$ d) γR
- 40) A pressure cooker reduces cooking time for food, because
 a) heat is more evenly distributed in the cooking space.
 b) cooking involves chemical changes helped by a rise in temperature.
 c) boiling point of water involved in cooking is increased.
 d) the higher pressure inside the cooker crushes the food.
- 41) When volume of an ideal gas is increased two times and temperature is decreased half of its temperature, then pressure becomes
 a) 2 times b) 4 times c) $1/4$ times d) $1/2$ times
- 42) The gases CO and N₂ at the same temperature have kinetic energies E_1 and E_2 respectively. Then
 a) $E_1 = E_2$ b) $E_1 > E_2$ c) $E_1 < E_2$ d) E_1 and E_2 cannot be compared
- 43) A particle is executing a simple harmonic motion. Its maximum acceleration is α and maximum velocity is β . Then its time period of vibration will be
 a) $\frac{2\pi\beta}{\alpha}$ b) $\frac{\beta^2}{\alpha^2}$ c) $\frac{\alpha}{\beta}$ d) $\frac{\beta^2}{\alpha}$
- 44) Two springs of spring constants k_1 and k_2 are joined in series. The effective spring constant of the combination is given by a) $\sqrt{k_1 k_2}$ b) $\frac{k_1 + k_2}{2}$ c) $k_1 + k_2$ d) $\frac{k_1 k_2}{k_1 + k_2}$
- 45) If the metal bob of a simple pendulum is replaced by a wooden bob, its time period will
 a) increase b) decrease c) remain the same d) first increases and then decreases
- 46) In SHM restoring force is $F = -kx$ where k is constant, x is displacement and a is amplitude of motion, then total energy depends upon
 a) k, a, m b) k, x, m c) k, a d) k, x
- 47) Which one of the following statements is true?
 a) Both light and sound waves in air are transverse
 b) The sound waves in air are longitudinal while the light waves are transverse
 c) Both light and sound waves in air are longitudinal
 d) Both light and sound waves can travel in vacuum
- 48) An organ pipe, open at both ends, produces
 a) longitudinal stationary waves b) longitudinal travelling waves
 c) transverse stationary waves d) transverse travelling waves
- 49) In a closed organ pipe, the fundamental frequency is ν . What will be the ratio of the frequency of the next three overtones? a) 2:3:4 b) 3:4:5 c) 3:7:11 d) 3:5:7
- 50) Two waves are said to be coherent, if they have
 a) same phase but different amplitude b) same frequency but different amplitude
 c) same frequency, phase and amplitude d) different frequency, phase and amplitude

XI - Public Discussion

- 1) $W \rightarrow ML^2 T^{-2}$, $PF \rightarrow ML^2 T^{-2}$, $F = MLT^{-2}$
 $P = MLT^{-1}$, Density $\Rightarrow ML^{-3}$
- 2) $V = \frac{x}{t} + yt$; $[LT^{-1}] = [x][T^{-1}] + [y][T]$
 $[x] = [L] \text{ or } [M^0 L T^0]$
- 3) a) $[ML^2 T^{-2}]$ b) $[ML^2 T^{-3} A^{-1}]$ (volt)
c) $[ML^2 T^{-2}]$ (joule) \Rightarrow
d) Displacement $\Rightarrow [M^0 L T A]$
Ele. flux $\Rightarrow [M^3 T^{-3} A^{-1}]$
Ele. field $\Rightarrow [MLT^{-3} A^{-1}]$
- 4) Number less than one, zero after decimal point insignificant
 $0.0006032 \Rightarrow 4$
- 5) $E = \frac{1}{2}mv^2$, $\frac{\Delta E}{E} \times 100 = \frac{\Delta m}{m} \times 100 + 2 \frac{\Delta v}{v} \times 100$
 $= 2\% + (2 \times 3\%) = 8\%$
- 6) $x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$ (in seconds)
 $\frac{dx}{dt} = \frac{a_1}{2} - \left(\frac{2a_2 t}{3} \right)$, $\frac{d^2 x}{dt^2} = -\frac{2a_2}{3}$
- 7) Total area $= \pi R_{\max}^2$ ($v = \sqrt{rg}$)
 $= \pi \left(\frac{v^2}{g}\right)^2 = \frac{\pi V^4}{g^2}$
- 8) $x \propto t^2$, $\frac{dx}{dt} \propto 2t$, $\frac{d^2 x}{dt^2} \propto 2 \propto \text{const}$
- 9) $\vec{A} \cdot \vec{B} = AB \cos \alpha = 3 \times 5 \times \cos 60^\circ = 15 \times \frac{1}{2} = 7.5$
- 10) $t_1 : t_2 = \frac{2u \sin \alpha}{g}, \frac{2u \sin(90^\circ - \alpha)}{g}$
 $\sin \alpha = \cos \theta$, $\frac{\sin \alpha}{\cos \theta} = 1$, $\tan \theta = 1$
- 11) $F = m \left(\frac{v-u}{t} \right) = 1 \times \left(\frac{30-20}{2} \right) = \frac{10}{2} = 5N$
- 12) $a = \frac{R-Mg}{M} = \frac{28000 - (2000 \times 10)}{2000} = \frac{8000}{2000}$
 $a = 4 \text{ m/s}^2$: upwards
- 13) torque $\Rightarrow \text{Nm}$, momentum $\Rightarrow \text{Ns}$
energy $\Rightarrow \text{J}$, Planck const $\Rightarrow \text{Js}$
- 14) Block comes to rest if,
applied force = frictional force
 $ma = \frac{mv}{t} = \mu mg$
 $t = \frac{v}{\mu g}$

- 15) $500N$ does not produce any motion.
Net force produce motion $= 1000 - 500$
 $= 500N$,
acceleration $= \frac{\text{Net force}}{\text{mass}} = \frac{500}{1000} = 0.5 \text{ m/s}^2$
- 16) Work done is zero since displacement is zero ($W = F \times d$)
- 17) $\vec{W} = \vec{F} \cdot \vec{s} = (5\hat{i} - 3\hat{j} + 2\hat{k}) (2\hat{i} - \hat{j})$
 $= 10 - 3 = +7J$
- 18) $E_1 = \frac{1}{2}mv^2$, $E_2 = \frac{1}{2}m(eV)^2$
 $E_2 = 4 \left(\frac{1}{2}mv^2 \right) = 4E_1$
- 19) $P = \sqrt{2mE}$ $P \propto \sqrt{m}$
- 20) $KE = \frac{1}{2}mv^2$
If ($m_1 = m_2$), then $v_1 = u_1$, $v_2 = u_2$
- 21) $\omega = 2\pi n = 2\pi \left(\frac{120}{60} \right) = 4\pi \text{ rad/s}$
- 22) $T = \frac{dL}{dt}$; $F = \frac{dp}{dt}$
- 23) $\omega = \frac{2\pi}{T} = \frac{2\pi}{60 \times 60} = \frac{\pi}{1800} \text{ rad/s}^{-1}$
- 24) Moment of inertia, $I = mr^2$
(r-radius)
- 25) $I = mr^2$, $I_z = \sum m(x^2 + y^2)$
 $I = I_1 + I_2 = 1(1^2 + 1^2) = 1(2) = 2 \text{ kg m}^2$
- 26) Gravitational force \Rightarrow attractive,
conservative (independent on path)
- 27) $g_1 = \frac{GM}{R^2}$, $g_2 = \frac{G(2M)}{(2R)^2} = \frac{g_1}{4}$
 $g_1 = 2g_2$
- 28) $V_e^2 = \frac{2GM_e}{R_e}$, $V_0^2 = \frac{GM_e}{R_e}$
 $V_e^2 = 2V_0^2$, $V_e = \sqrt{2} V_0$
- 29) Time Period, $T^2 \propto R^3$, $T \propto \sqrt{R^3}$
 $\frac{T}{T'} = \sqrt{\frac{R^3}{(4R)^3}} = \frac{1}{\sqrt{64}} = \frac{1}{8}$, $T' = 8T$
- 30) $U = -\frac{GMMe}{(R_e + h)}$, $K = \frac{1}{2} \frac{GMMe}{(R_e + h)}$
 $E = U + K = -\frac{GMMe}{2(R_e + h)}$
- 31) Surface tension

32 Elasticity affected by - hammering, annealing (heating), temperature, impurity

33 Two same material & Volume, from elastic energy (Young's modulus)

$$q = \frac{F\ell}{A \Delta x} = \frac{F_2 \cdot l_2}{(\lambda) \Delta x}, F\ell = \frac{F_2 \cdot l_2}{3}$$

$$\text{Volume } A\ell = 3A(l_2), \ell = 3l_2$$

$$F(3l_2) = \frac{F_2 l_2}{3}, F_2 = 9F$$

34 Terminal Velocity,

$$V = \frac{2a^2 (\rho - \sigma) g}{9\eta} \quad V \propto a^2$$

35 absolute zero = $-273.15^\circ\text{C} = 0\text{ K}$

36 Acc to Stefan's Boltzmann law, $E \propto T^4, E \propto (soo)^4$

37 Acc to Wien's law ($\lambda \propto \frac{1}{T}$)

$$\frac{\lambda_2}{\lambda_1} = \frac{T_1}{T_2} = \frac{1227 + 273}{2227 + 273}$$

$$\lambda_2 = \frac{1500}{2500} \times 5000 \text{ Å} = 3000 \text{ Å}$$

38 Heat

39 $y = \frac{C_p}{C_v}, C_V = \frac{C_p}{y}, C_p - C_V = R$

$$yC_V - C_V = R, C_V(y-1) = R$$

$$C_V = \frac{R}{y-1}$$

40 Boiling point of water increases with the increase in pressure

$$41 P_1 = \frac{RT_1}{V_1}, P_2 = \frac{RT_2}{V_2}$$

$$\frac{P_2}{P_1} = \frac{V_1}{V_2} \times \frac{T_2}{T_1} = \frac{V_1}{2V_1} \times \frac{T_1/2}{T_1} = \frac{1}{4}$$

$$P_2 = \frac{P_1}{4}$$

42 CO, N₂ are diatomic molecule. Both have equal KE, $E_1 = E_2$

13 In SHM, maximum acceleration, $a \omega^2 = \omega$

Velocity, $a \omega = \beta$

$$\frac{x}{P} = \omega = \frac{2\pi}{T}; T = \frac{2\pi}{\alpha}$$

14 Springs in series,

$$\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2}, K = \frac{K_1 K_2}{K_1 + K_2}$$

15 In simple pendulum,

$$T = 2\pi \sqrt{\frac{l}{g}}, \text{ independent of mass}$$

16 In SHM, $E = \frac{1}{2} m \omega^2 a^2$

$$a = \sqrt{\frac{2E}{m \omega^2}} = \sqrt{\frac{2E}{K}}$$

$$E = \frac{1}{2} K a^2$$

17 Sound - longitudinal wave
(compression and elongation)

Light - transverse
(crest and trough)

18 Open Organ pipe - both ends open - Antinodes are formed - longitudinal stationary waves

19 Closed Organ pipe

$$f_1 : f_2 : f_3 : f_4 = 1 : 3 : 5 : 7$$

fun { overtone }

Open Organ Pipe

$$f_1 : f_2 : f_3 : f_4 = 1 : 2 : 3 : 4 =$$

fun { overtone }

20 Two waves coherent : Condition

Same \Rightarrow freq, phase, amplitude.