## Answer Key

| Qn. No. | Sub Qns | Value points | Score | Total |
|---|---|---|---|---|
| 1 | | 1fermi | 1 | 1 |
| 2 | | a. Principle of homogeneity<br>b. Writing Dimenions<br>Substitution and simplification<br>c. The statement is not correct<br>Explanation with example (for eg:- work and torque have same dimension, but they have different nature) | 1<br>1<br>1<br>½<br>½ | 4 |
| 3 | | a) correct graph<br>b) $a=\frac{v_2-v_1}{t_2-t_1}=\frac{22-18}{2}=2m/s^2$<br>$x=v_0t+\frac{1}{2}at^2$<br>$x=18X20+\frac{1}{2}X2X20^2=760m$<br>c) in the case of an object moving with deceleration, acceleration and velocity are opposite | <br>½<br>½<br>1<br>1 | 4 |
| 4 | | a) horizontal component of velocity<br>b) Derivation of Time of flight<br>Derivation of maximum height<br>c) Correct derivation<br>Explanation | 1<br>1<br>1<br>1<br>1 | 5 |
| 5 | | a) First law of motion<br>b) If the resultant force acting on a body is zero, the body moves with constant velocity or remains at rest. Hence, the statement is wrong.<br>c) $F=(m_1+m_2)a$ , $a=\frac{F}{m_1+m_2}=\frac{200}{30+10}=5m/s^2$<br>Tension in the middle of the rope, $T=(m_1+\frac{m_2}{2})a$<br>$=(30+5)5=175N$ | 1<br>1<br>1<br>1<br>½ + ½ | 5 |

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|---|---|---|---|---|
| 6 | | a) Proof | 2 | |
| | | b) to find $v_0$ | 1 | |
| | | speed at B | ½ | 5 |
| | | speed at C | ½ | |
| | | ratio of KE | 1 | |
| 7. | | a) Derivation for rotational K:E | 3 | |
| | | L = Iω=constant | | |
| | | When he drops his hands to his side, I decreases and ω increases according to law of conservation of angular momentum. | 1 | 5 |
| | | The table rotaes with more and more angularvelocity | | |
| | | (b) (iii)rotates with more speed | 1 | |
| | | OR | | |
| | | a) Derivation of L = Iω | 3 | |
| | | $I_1\omega_1=I_2\omega_2$ | ½ | |
| | | $\frac{2}{5}MR^2X\frac{2\pi}{T}=\frac{2}{5}M(\frac{R}{3})^2X\frac{2\pi}{T_1}$ | | |
| | | $\frac{2}{5}MR^2X\frac{2\pi}{T}=\frac{2}{5}M\frac{R^2}{9}X\frac{2\pi}{T_1}$ | ½ | |
| | | $9T_1=T$ | | |
| | | $T_1=\frac{T}{9}=\frac{24}{9}=2.67$hours | | |
| | | b)(iv) infinity | 1 | |
| 8. | | a) $v=\sqrt{\frac{GM}{r}}$ | | |
| | | $=\sqrt{\frac{6.67X10^{-11}X6.4169X10^{23}}{300X10^3}}$ | 1+½ | |
| | | Result with proper unit | ½ | |
| | | $T=\frac{2\pi r}{v}$ | 1 | 5 |
| | | Result with proper unit | ½ | |
| | | $a_{radial}=\frac{v^2}{r}$ | 1 | |
| | | Result with proper unit | ½ | |

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| Qn. | Sub | Value points | Score | Total |
|---|---|---|---|---|
| | | b) (iv) sun, earth, natural and artificial satellites | 1 | |
| | | OR | | |
| | | Statement of gravitational P:E | 1 | |
| | | Derivation | | |
| | | $F = \frac{GM_E m}{r^3}$ | 1 | |
| | | Workdone in lifting a aprticle from $r = r_1$ to $r = r_2$ $(r_2 > r_1)$ along a vertical path, $W_{12} = \int_{r_1}^{r_2} \frac{GM_E m}{r^2} dr$ | ½ | |
| | | $= -GM_E m \left(\frac{1}{r_2} - \frac{1}{r_1}\right)$ | ½ | |
| | | Here $r_1 \to \infty$ and $r_2 = r$ | | |
| | | $W = \frac{-GM_E m}{r}$ | | |
| | | This workdone is stored as its P:E | | |
| | | $\therefore P:E = \frac{-GM_E m}{r}$ | ½ | |
| | | Definition of Gravitational Potential | | |
| | | $V = \frac{-GM_E}{r}$ | ½ | |
| | | b) (ii) positive | 1 | |
| 9. | | Yes | ½ | |
| | | $Y = \frac{Fl}{Al}$ | ½ | |
| | | If same force is appled on brass and rubber of same dimension, | | 2 |
| | | $Y \alpha \frac{1}{l}$ | ½ | |
| | | Here the change in length is less for brass | ½ | |
| | | $Y_B > Y_R$ | | |
| 10. | | a. Diagram | ½ | |
| | | explanation | ½ | |
| | | derivation | 3 | |
| | | b. water rises in the tube upto the neck and remains there | 1 | |
| | | here, rh is a constant | 1 | 7 |
| | | the radius of the meniscus portion increases to make rh, a constant | 1 | |

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| | | OR | | |
| | | (a) Bernoulli's theorem | | |
| | | Statement | 1 | |
| | | Proof | 3 | 7 |
| | | (b) Statement of Torricelli's theorem | 1 | |
| | | Proof | 2 | |
| 11. | | a. Explanation of Green House effect | 2 | |
| | | b. The statement is wrong. | | |
| | | Materials like silicon, selenium, cobalt, etc have negative expansion coefficients. (water have negative expansion coefficients in the range of $0^0$c to $4^0$c) | ½ ½ | 3 |
| 12. | | (a) Derivation of adiabatic workdone | 2 | |
| | | (b) Since flask is thermally insulated and the process is very fast, no heat is exchanged (adiabatic process) | ½ | |
| | | From the first law of thermodynamics (dQ = dU +dW), $0 = dU + dW$ And $dU = -dW$ | ½ | 4 |
| | | But, work is done on the system by shaking the flask externally. Then dU = - (-dW)= dW | ½ | |
| | | ie, internal energy increases | ½ | |
| 13. | | $TV^{\gamma-1} = T^1V^{1\gamma-1} = \frac{T}{2}(5.66V)^{\gamma-1}$ | ½ | |
| | | $(5.66)^{\gamma-1} = 2$ | | |
| | | $(\gamma - 1)\log 5.66 = \log 2$ | | |
| | | $\gamma\text{-}1 = \frac{\log 2}{\log 5.66} = \frac{0.3010}{0.7258} = 0.4$ | | 2 |
| | | $\gamma - 1.4$ | ½ | |
| | | But, $\gamma = 1 + \frac{2}{f}$ | ½ | |
| | | $1.4 = 1 + \frac{2}{f}$ | | |
| | | $f = 5$ | ½ | |
| 14. | | (a) Definition of SHM | 1 | |
| | | Derivation of differential equation | 1 | |
| | | (b) Time Period $T = 2\pi\sqrt{\frac{l}{g}}$ | 1 | 4 |
| | | As the water flows through the hole, water level decreses and centre of gravity lowers. Hence, l increases, period increases | ½ | |
| | | But, period returns to its initial value when the ball becomes empty | ½ | |

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| 15. | | (a)Transverse wave | 1 | |
| | | (b) $y = 4\sin\pi(2t-0.01x)$ | | |
| | | $= 4\sin(2\pi t-0.01\pi x)$ | | |
| | | $= -4\sin(0.01\pi x-2\pi t)$ | | |
| | | Comparing with the standard equation, $y = a\sin(kx-\omega t)$ | | |
| | | (i) Amplitude, A = 4m | ½ | |
| | | (ii) $kx = 0.01\pi x$, $2\pi x/\lambda = 0.01\pi x$, $\lambda = 200m$ | ½ | 4 |
| | | (iii) Initial Phase = 0 | ½ | |
| | | (iii) $\omega t = 2\pi t$ | | |
| | | $2\pi ft = 2\pi t$ | | |
| | | $f = 1Hz$ | ½ | |
| | | c) Sound in gases and liquids is always longitudinal, but in solids it can be transverse or longitudinal | 1 | |