FIRST YEAR HSE MODEL EXAMINATION - FEB-2020

PHYSICS

(1)(b) Nuclear force

(2)(b) Linear momentum

(3)(a) Energy

(4) ~~Equation of continuity~~ conservation of energy

(5) $C_p - C_v = R$

$(3 \times 1 = 3)$

(6)(a) $\frac{\Delta Z}{Z} = 4\frac{\Delta A}{A} + \frac{1}{3}\frac{\Delta B}{B} + \frac{\Delta C}{C} + \frac{3}{2}\frac{\Delta D}{D}$ (1)

(b) (1) 2 (2) 5 (1)

(7) Distance = Area

$= \frac{1}{2} \times b \times h$

$= \frac{1}{2} \times 10 \times 12$ (2)

$= 60\,m$

(8)(a) $f_s^{max} \propto R$ (1)

(b) Frictional force depends on area of contact. Area of contact is less in the case of rolling than in the case of sliding. (1)

(9)(a) Freezing (1)

(b) Amount of heat required to change the state without temp: change (1)

(10)(a) (ii) $\sqrt{\frac{3RT}{M}}$ (1)

(b) $\sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.31 \times 373}{32 \times 10^{-3}}} = 539.1\,m/s$ (1)

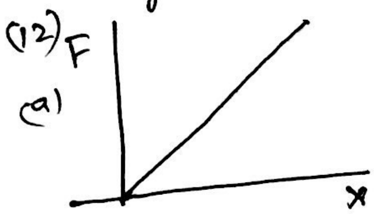
(11)(a) statement (OR) If $\tau_{ext} = 0 \Rightarrow L = \text{Constant}$

(b) $L = rP$

$= mvr$ (1)

As r decreases, L decreases with no change in direction.

(12)(a) (1)



(b) Area = Workdone = potential energy

(13)(a) $\Delta Q = \Delta U + \Delta W$ (1)

(b) $\Delta Q = 100\,J/s$

$\Delta W = 75\,J/s$

$\Delta U = \Delta Q - \Delta W$ (1)

$= 25\,J/s$

(14)(a) KE = PE

$\frac{1}{2}k(A^2 - y^2) = \frac{1}{2}ky^2$

$A^2 = 2y^2$

$y = A/\sqrt{2}$ (1)

(b) $V_{max} = \omega A$

$V = \omega\sqrt{A^2 - y^2} = \frac{V_{max}}{2}$

~~$\omega A = \omega_1$~~

$\omega\sqrt{A^2 - y^2} = \frac{\omega A}{2}$

$A^2 - y^2 = \frac{A^2}{4}$

$y^2 = A^2 - \frac{A^2}{4}$ (1)

$= \frac{3}{4}A^2$

$y = \frac{\sqrt{3}}{2}A$

(15)(a) Isothermal exp

Adiabatic "

Isothermal Compression (1)

Adiabatic "

(b) No

$\eta = 1 - \frac{Q_2}{Q_1}$ In heat engine Q_2 cannot be Zero. (1)

(16)(a) True, plane angle - radian, solid angle - steradian. (1)

(b) $[V^2] = (M^0 L T^{-1})^2 = [M^0 L^2 T^{-2}]$

$[V_0^2] = \text{"} = \text{"}$

$[2ax] = [M^0 L T^{-2} \times L] = [M^0 L^2 T^{-2}]$

dimensionally correct

17 (a) ~~Materials~~ Elastomers (1)

(b) $K = \frac{1}{B} = \frac{1}{2\times10^9} = 0.5\times10^{-9}\ m^2/N$ (1)

(c) Steel (1)

Steel regain the original condition than rubber when the deforming force is removed

18 (a) Derivation $V_o = \sqrt{\frac{GM}{R+h}} = \sqrt{\frac{gR^2}{R+h}}$ (2)

(b) V_o, V_o independant of mass of satellite (1)

19 (a) $AB\sin\theta = AB\cos\theta$

$\sin\theta = \cos\theta$ (1)

$\Rightarrow \theta = 45^\circ$

(b) $F = \sqrt{F_1^2+F_2^2+2F_1F_2\cos\theta}$

$= \sqrt{5^2+7^2+2\times5\times7\times\frac{1}{2}}$ (2)

$= \sqrt{25+49+35}$

$= \sqrt{109} = 10.44\ N$

20 (a) True

Rotation of earth about its own axis is periodic but not SHM. (1)

oscillation of a body under the action of a restoring force is SHM and is also periodic

(b) A pendulum with time period T = 2s (1)

(c) $T = 2\pi\sqrt{l/g} = 2\,sec$

If $l' = l/2$

$T' = 2\pi\sqrt{\frac{l}{2g}}$ (1)

$= \frac{1}{\sqrt{2}}T$

$= \frac{2}{\sqrt{2}}$

$= \sqrt{2}\ sec$

21 (a) Yes

At the topmost position of vertical motion under gravity

(OR) (1)

at extreme position of SHM.

(b) $R = 2\,km$

$T = 5\,min$

(i) Distance $= 2\pi R = 2\pi\times2 = 4\pi\,km$

Displacement $= 0$

$V_{av} = \frac{2\pi R}{T} = \frac{2\pi\times2000}{5\times60}$ (1)

$= 41.87\ m/s$

(ii) Distance $= \frac{2\pi R}{2} = \pi R$

$= 2\pi\ km$

Displacement = Diameter

$= 2R$

$= 4\,km$ (1)

$V_{av} = \frac{\pi R}{2.5\times60} = 41.87\ m/s$

22 (a) Statement of pascal's law (1)

(b) $P = h\rho g$

$= 10\times10^3\times9.8$ (2)

$= 9.8\times10^4\ N/m^2$

Total pressure $= P_{atm} + P$

23 (a) $T = \frac{2u\sin\theta}{g}$ derivation (2)

(b) At highest point, $V = u\cos\theta$

$KE = \frac{1}{2}mu^2\cos^2\theta$ (1)

24 (a) (i) (2)

(ii) (4)

(b) work done in isothermal process

$W = \mu RT\log_e\left(\frac{V_2}{V_1}\right)$

for $\mu = 1$ mole

$W = RT\log_e\left(\frac{V_2}{V_1}\right)$

25 (a) No. We have $g = \frac{GM}{R^2}$

since $R_{pole} < R_{equation}$

$g_{pole} > g_{equator}$ (1)

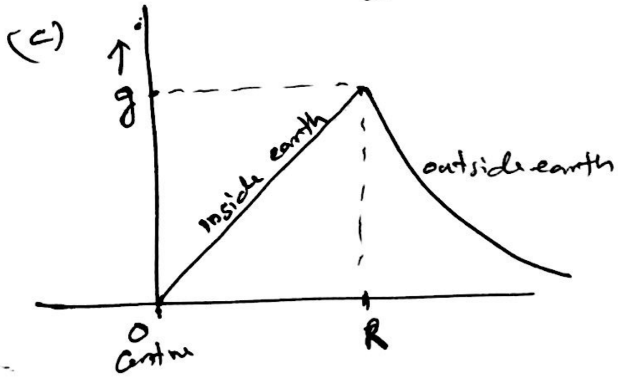
(b) $g_h = g_d$

$g\left(1 - \frac{2h}{R}\right) = g\left(1 - \frac{d}{R}\right)$

$2h = d$

$h = d/2 = 40km$ (2)

(c)



(1)

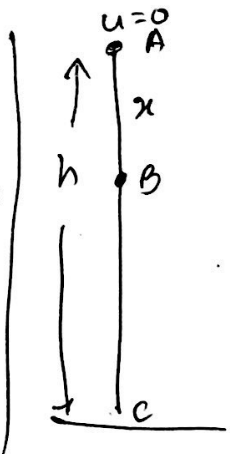
26 (a) Statement $W = \Delta KE$

(b) At A, $u = 0$

$KE_A = 0$

$PE_A = mgh$

$TE_A = KE + PE = mgh$



- At B, $h_B = h - x$

$V_B = \sqrt{2gx}$

$KE = \frac{1}{2} m V_B^2 = mgx$

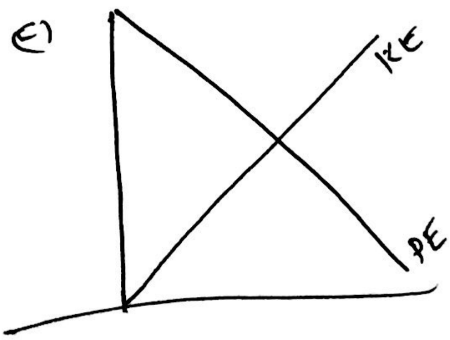
$PE = mg(h - x)$

$TE_B = mgh$

IIIly $TE_C = mgh$

$TE_A = TE_B = TE_C$

(c)



27 (a) Axis of rotation

(b) Distribution of mass around the axis

Mass of the body. (1)

(b) Statement of $\perp r$ axis theorem (1)

(c) $I_{ring} = MR^2$

$I_{disc} = \frac{MR^2}{2}$ (2)

$I_{ring} > I_{disc}$

---

28 $V = 18 km/hr$

$= 18 \times \frac{5}{18} = 5 m/s$

$R = 3m$

(a) Static friction.

(b) Derivation ~~$V_{max} = \sqrt{\mu Rg}$~~

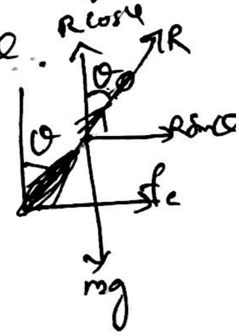
$V_{max} = \sqrt{rg\tan\theta}$

OR $V = \sqrt{\mu Rg}$

$f_c = \frac{mv^2}{R} = R\sin\theta$

$mg = R\cos\theta$

$\frac{V^2}{Rg} = \tan\theta$



(c) $V_{max} = \sqrt{\mu Rg}$

$= \sqrt{0.1 \times 3 \times 10}$

$= \sqrt{3}$

$= 1.73 m/s$ 1

$V > V_{max} \Rightarrow$ He will slip.

27 (a) mode 2 and mode 3 (1)

(b) mode 2

$L = 3\lambda/2$

$\lambda = \frac{2L}{3}$

$\nu_1 = \frac{V}{\lambda} = \frac{3V}{2L}$

Mode 3

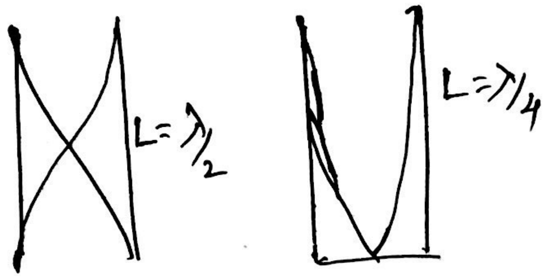
$$L = \frac{5\lambda}{2}$$

$$\lambda = \frac{2L}{5}$$

$$\nu_2 = \frac{V}{\lambda} = \frac{5V}{2L} \quad (2)$$

$$\frac{\nu_1}{\nu_2} = \frac{3}{5}$$

(c)



~~closed~~ open pipe, $L = \lambda/2$

$$\lambda = 2L$$

$$\nu_{open} = \frac{V}{\lambda} = \frac{V}{2L}$$

Closed pipe, $L = \lambda/4$

$$\lambda = 4L$$

$$\nu_{closed} = \frac{V}{\lambda} = \frac{V}{4L}$$

$$\frac{\nu_{open}}{\nu_{closed}} = \frac{V}{2L} \Big/ \frac{V}{4L} = 2$$

$$\nu_{open} = 2 \times \nu_{closed}$$

30 (a) Definition

(b) (ii) Derivation ; $h = \dfrac{2S\cos\theta}{r\rho g}$

(b) Surface tension of ~~sol~~ soap solution is less than normal water

$$h_{soap} < h_{water}$$

Lalan V.M
GMBHSS HARIPAD
9496520070