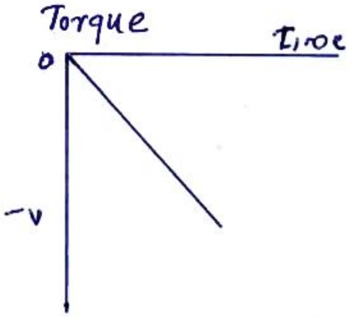
SECOND TERMINAL EXAM – DEC. 2024
PHYSICS
HSE - I

Any Five questions — 1 score

1. Ampere.
2. $4\,^{\circ}C$
3. Torque
4. 

5. $R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$
6. $3.6 \times 10^6\,J$ $(1000 \times 60 \times 60)$
7. zero.

Any 5 questions from 8 to 14. (2 score.)

8. (a) (i). 3
(ii). 5
(b) strain, Relative density.

9. (a) decreases
(b). Change from solid state to vapour state without passing through the liquid state. Solid to gas.
Example – Dry ice, Camphor.

10. If two vectors are represented in magnitude and direction by the two side of a triangle taken in order, then their resultant is given by the third side of the triangle taken in reverse order.
Picture.

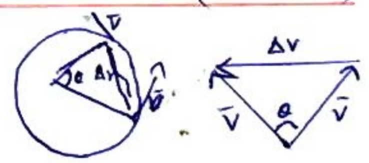
11. $P = P_a + \rho gh = 1.01 \times 10^5 + 1000 \times 9.8 \times 10$
$= 2.01 \times 10^5$ Pa.

12 (a). For a body to be in rotational equilibrium, the sum of the clockwise moments about any point must equal the sum of the anticlockwise moments about the same point. Sum of moments must be zero.
12 (b) net $F \propto \tau = 0$.
(b) net external force and torque acting on a body is zero

13. $KE = \frac{P^2}{2m}$ $\quad KE \propto \frac{1}{m}$ $\quad KE \uparrow\ m \downarrow$
Light body

14. $V_g = \frac{-M_B V_B}{M_g} = \frac{0.020 \times 80}{100} = 0.016$

Any 6 from 15 to 21 (Score 3)

15. 

$\frac{\Delta V}{\Delta r} = \frac{V}{r}$

$\Delta V = \frac{V}{r}\Delta r$

$\frac{\Delta V}{\Delta t} = \frac{V}{r}\frac{\Delta r}{\Delta t}$

$\lim_{\Delta t \to 0} \frac{\Delta V}{\Delta t} = \frac{V}{r} \cdot \lim_{\Delta t \to 0} \left(\frac{\Delta r}{\Delta t}\right)$

$a_c = \frac{V}{r} \times V = \frac{V^2}{r}$.

16. a. AB.
b. Area give displacement
Area of AB + Area of BC
$(10 \times 20) + (\frac{1}{2} \times 5 \times 20) = 250\,m$

17 (a) Every body continues in its state of rest or uniform motion along a straight line unless it is compelled by an external unbalanced forces to change that state.
(b). $F = mg = 0.1 \times 9.8 = 0.98\,N$
Vertically downwards.

18 (a) $\tau_{ext} = \frac{dL}{dt}$ $\quad \tau = 0$ $\quad L = $ a constant.
(b) $L = \bar{r} \times \bar{P}$
$\frac{dL}{dt} = \frac{d}{dt}(\bar{r} \times \bar{P})$
$\frac{dL}{dt} = r \times \frac{dP}{dt} + P \times \frac{dr}{dt} = r \times F + m(v \times v)$.
$\frac{dL}{dt} = r \times f = \tau$.

19. (a) $(PE + KE)_{at\ Surface} = (PE + KE)_{\infty}$
$-\frac{GMm}{R} + \frac{1}{2}mv^2 = 0$.
$v = \sqrt{\frac{2GM}{R}}$ $\quad v = \sqrt{2gR}$
(b). 2.3 km/s.

20. The amount of heat given to a system is equal to the sum of the increase in internal energy of a system and external work done $\quad dQ = du + dw$.

(b). $W = \mu RT \ln \frac{V_2}{V_1}$

$W = 8.3 \times 50 \times \left(\frac{40}{20}\right) \quad T = (50+273)\,K$

21. (a) Bulk modulus.

(b). The materials which can be elastically stretched to large value of strain are called elastomers.
Example: rubber, Elastic tissues of aorta.

22. (a) $F = At^2 + Bt$

$[F] = [At^2] = [Bt]$

$A = MLT^{-4} \qquad B = MLT^{-3}$.

(b). $P \propto K h^a \rho^b g^c$.

$ML^{-1}T^{-2} = L^a [ML^{-3}]^b [LT^{-2}]^c$

$ML^{-1}T^{-2} = L^a M^b L^{-3b} L^c T^{-2c}$

$M^1L^{-1}T^{-2} = M^b L^{a-3b-2c} T^{-2c}$

Eq. Power of M $\quad 1 = b$

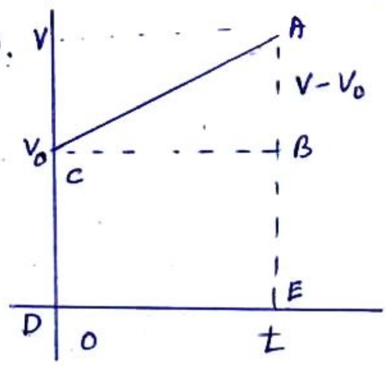
Eq. Power of L $\quad -1 = a-3b-2c$

Eq. Power of T $\quad -2 = -2c$

$a = 1,\ b = 1,\ c = 1$

$P = K h^1 \rho^1 g^1$

23. (a).



(b) slope $= \frac{AB}{BC}$

$a = \frac{V - V_0}{t}$

$V = V_0 + at$

Displacement = Area of □ + Area Δ.

$S = V_0 t + \frac{1}{2}(V - V_0)t$

$S = V_0 t + \frac{1}{2} at \cdot t$

$S = V_0 t + \frac{1}{2} at^2$.

24. (a) $dW = F \cdot dx$

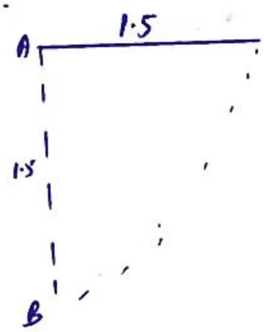
$W = \int F \cdot dx$

$W = \int -kx \cdot dx$

$W = -kx^2$

$U = \frac{1}{2} kx^2$

(b)



At A $\quad PE = mgh$
$KE = 0$
$TE = mgh$

At B $\quad PE = 0$
$KE = \frac{1}{2}mv^2$
$TE = \frac{1}{2}mv^2$.

The total energy at the lower most point is equal to 95% of the total energy at the horizontal point.

$\frac{1}{2}mv^2 = \frac{95}{100} mgh$

$V = \frac{2 \times 95 \times 1.5 \times 9.8}{100} = 5.28\ m/s$

25. (a) Freely falling Body.

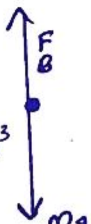
(b) $F + B = mg \qquad | m = \rho V$

$F = mg - B$

$6\pi\eta a V = \rho \frac{4}{3}\pi a^3 g - \frac{4}{3}\pi\sigma g a^3$

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

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



Questions 26 to 29 (5 score)
any three.

26. (a) Zero.

(b) $V^2 = u^2 + 2as$.

$0 = u^2\sin^2\theta - 2gH$

$H = \frac{u^2\sin^2\theta}{2g}$

| $V = 0$
| $a = -g$
| $S = H$
| $u = u\sin\theta$

$S = ut + \frac{1}{2}at^2$

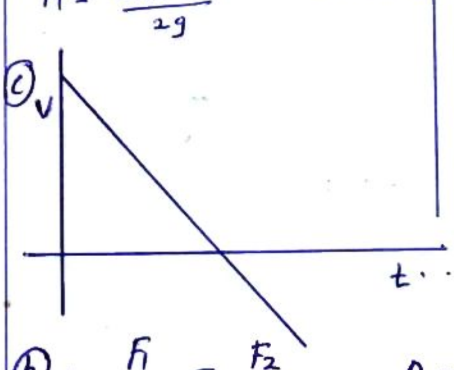
$0 = u\sin\theta T - \frac{1}{2}gT^2$

$u\sin\theta = \frac{1}{2}gT$

$T = \frac{2u\sin\theta}{g}$

| $S = 0$
| $a = -g$
| $u = u\sin$

(c)



27. (b). $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$A_1 = \pi r^2 = 3.14 \times (5 \times 10^{-2})^2$

$A_2 = \pi r^2 = 3.14 \times (15 \times 10^{-2})^2$

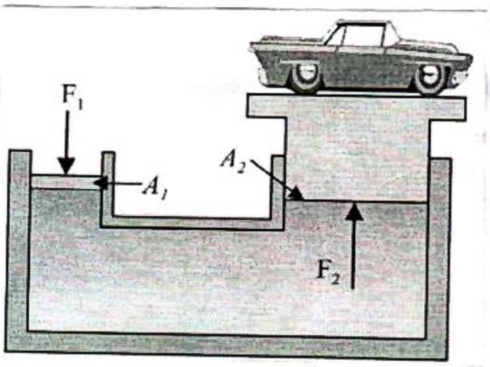
$F_1 = 150 \times g$.

$F_1 = 1500N$

$\frac{F_1}{0.25\pi} = \frac{1350 \times 10}{2.25\pi}$

$\frac{F_1}{0.25} = \frac{13500}{2.25}$

27 (a)



The pressure on smaller piston $P_1 = \frac{F_1}{A_1}$

This pressure is transmitted to the larger cylinder with a larger piston of area A_2, $P_2 = \frac{F_2}{A_2}$

According to pascal law $P_1 = P_2$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \qquad F_2 = F_1 \cdot \frac{A_2}{A_1}.$$

Thus the applied force has been increased by a factor of $\frac{A_2}{A_1}$. It is the mechanical advantage of the device.

28. (a) $g = \frac{GM}{R^2}$ —①

$$g_h = \frac{GM}{(R+h)^2} \quad —②$$

Dividing eq ① ÷ eq ②

$$\frac{g}{g_h} = \frac{GM}{R^2} \times \frac{(R+h)^2}{GM}$$

$$g_h = g/\left[1+\frac{h}{R}\right]^2$$

$$g_h = g\left[1+\frac{h}{R}\right]^{-2} \text{ using binomial theorem}$$

$$g_h = g\left[1-\frac{2h}{R}\right]$$

(b). $T^2 \propto R^3$

$$\frac{T_s^2}{T_e^2} = \frac{R_s^3}{R_e^3} \qquad \frac{T_s}{T_e} = 29.5$$

$$R_e = 1.58 \times 10^8 \text{ m}$$

29. mv a vechile moving over a level road. The two force acting on it are. ① weight = mg
② reaction N

The normal reaction can't produce sufficient centripetal force required for circular motion. The centripetal force for circular motion is provided by friction.

Centripetal force ≤ force of friction

$$\frac{mv^2}{R} \le \mu_s N$$

$$V^2 = \mu R g$$

$$V = \sqrt{\mu R g}.$$

(b) $V_0 = \sqrt{Rg\tan\theta}$. $\left(720 \text{ km/hr} = 200 \text{ m/s}\right)$

$$R = \frac{V^2}{g\tan\theta} = 14.93 \text{ km}$$

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