FIRST YEAR HSE SECOND TERMINAL EXAMINATION

DECEMBER 2023

FY 24

PHYSICS

1) (c) 3

2) True

3) a) Zero

4) d) ML^2T^{-3}

5) c) both translation and rotational motion.

6) b) $\frac{2S}{\gamma}$

7) Constant

8) Rate of change in velocity is called acceleration.

OR

$$a = \frac{\text{change in velocity}}{\text{time interval}}$$

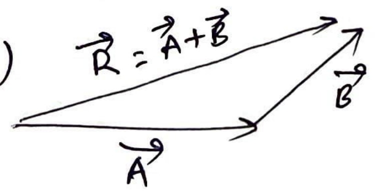
$$a = \frac{\Delta v}{\Delta t}$$

unit → m/s^2

dimension → $[M^0LT^{-2}]$

9) statement of Δ law.

(OR) (1)



10) It is the amount of motion contained in a body.

(OR)

It is defined as the product of its mass and velocity.

$p = mv$

It is a vector quantity

(11) $KE = \frac{1}{2} mv^2$

m → mass

v → velocity.

$PE = mgh$

m → mass

g = acc^n due to gravity

h → height

(OR)

$$PE = -\frac{Gm_1m_2}{r}$$

m_1, m_2 → masses

r → distance of separation

G → gravitational constant

(12) Definition or statement. (2)

(OR) $F \propto \frac{m_1m_2}{r^2}$ (1)

OR

(OR) $F = \frac{Gm_1m_2}{r^2}$ (1)

(13) within the elastic limit / proportional limit, stress is directly proportional to strain

(OR)

stress ∝ strain (1)

(14) Thermodynamic process under constant temperature.

PV = constant

(OR)

$P_1V_1 = P_2V_2$

(15) (1) Dimensional analysis can be used to check the dimensional consistency / to check the correctness of an equation.

If the dimension on both sides of an equation are same, the equation is dimensionally correct.

2) It is used to deduce relation among physical quantities.

If we know the dependance of physical quantity on other quantities, we may deduce the relation among them.

(16) $u = 28\,m/s$

$\theta = 30^\circ$

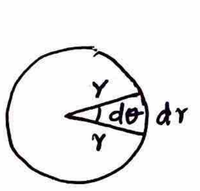
$$H = \frac{u^2 \sin^2\theta}{2g} = \frac{28^2 \times \left(\frac{1}{2}\right)^2}{2 \times 9.8}$$

$$= \frac{196}{19.6}$$

$$= 10\,m$$

17) a) It is the angular displacement in unit time.

$$\omega = \frac{\theta}{t}$$



b) Angle, $d\theta = \frac{dr}{r}$

$dr = r\,d\theta$

$$\frac{dr}{dt} = r\frac{d\theta}{dt}$$

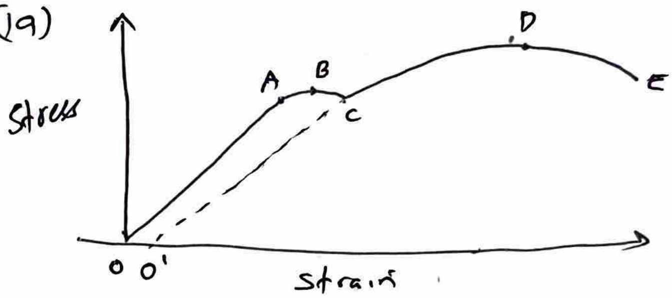
$v = r\omega$

(18) Statement of law

(OR)

If $\tau = 0$; angular momentum, L = constant.

(19)



A → proportional limit

B → elastic limit / yield point

OO' → permanent set / residual strain

D → ultimate point / ultimate stress

E → Fracture point / breaking point

(20) Statement of pascal's law

According to pascal's law,

$P_1 = P_2$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

Then, $\boxed{F_2 = \frac{A_2}{A_1} F_1}$

(21) Thermal conductivity is the ability to conduct heat from one end to another of a material. unit → W/m/K (OR) J/s/m/K

(OR) dimension → $[MLT^{-3}K^{-1}]$

Rate of heat flow is proportional to temperature difference $(T_C - T_D)$ and area of cross section (A) and inversily proportional to Length (L)

$$H = K\frac{A(T_C - T_D)}{L}$$

The proportionality constant K is called thermal conductivity.

(22) a) Newton's 2^{nd} law.

(OR)

Any two laws of motion

b) From 2^{nd} law,

$$F \propto \frac{dp}{dt}$$

$$F = k\frac{d}{dt}(mv)$$

$$= km\frac{dv}{dt}$$

$$= kma$$

put $k = 1$

$$\boxed{F = ma}$$

(23) a) work is calculated as the product of component of force in the direction of displacement and magnitude of displacement.

(OR)

$$W = F\cos\theta \times d$$

$$= \vec{F}\cdot\vec{d}$$

* positive work → If θ is in between 0 and 90°
* Negative work → If θ is in between 90 and 180°
* Zero work → If $\theta = 90°$.

b) Statement

Work done = change in KE

$$W = \Delta KE$$

(24) (a) Streamline flow → In streamline flow, the velocity of a particle at some point is same as that of the predecessor.

(OR)

It is the steady flow of liquid with velocity less than critical velocity.

Turbulent flow → If the velocity of particles at some point is different from the velocity of predecessor.

(OR)

In turbulent flow, the velocity of flow is greater than the critical velocity.

b) For a continuous flow of incompressible liquid through a pipe, the product,

area × velocity = constant.

$$av = \text{Constant}$$

$$a_1 v_1 = a_2 v_2$$

(25) a) Statement of I law of thermodynamics.

(OR)

$$\Delta Q = \Delta U + \Delta W$$

(OR)

$$\Delta Q = \Delta U + P\Delta V$$

b) PV diagrams of carnot cycle/carnot engine

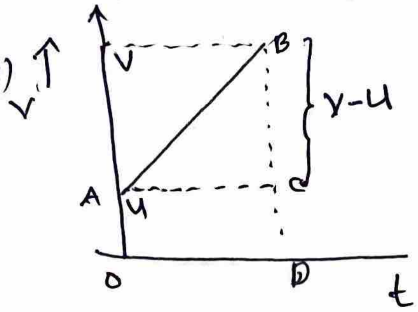
AB → Isothermal expansion

BC → Adiabatic "

CD → Isothermal Compression

DA → Adiabatic Compression

(26) a)



b) Displacement = Area OABD.

S = Area OACD + Area ABC

$= (OA \times OD) + \frac{1}{2} \times AC \times BC$

$= ut + \frac{1}{2} \times t \times (v-u)$

$= ut + \frac{1}{2} t \times at$

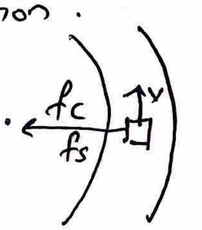
$S = ut + \frac{1}{2}at^2$

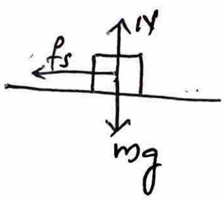
(27) Friction → It is the opposing force comes into play between two surfaces in contact, when there is relative motion or when there is no relative motion on application of force.

Static friction → Frictional force where there is no actual relative motion

Kinetic friction → Frictional force when there is actual relative motion.

(b)





At equilibrium,

$mg = N$ — ①

$\frac{mv^2}{r} = f_{ms} = \cancel{\mu N}$ — ②

$\frac{②}{①} \Rightarrow \frac{v^2}{rg} = \frac{f_{ms}}{N} = \mu$

$v^2 = \mu rg$

$v = \sqrt{\mu rg}$ //

(28) a) It is the accn of a freely falling body.

b) (i) depth

$g = \frac{GM}{R^2} = \frac{G \times \frac{4}{3}\pi R^3 \rho}{R^2}$

$= G \times \frac{4}{3}\pi R \rho$ — ①

At a depth d, $g_d = G \times \frac{4}{3}\pi (R-d)\rho$

$= G \times \frac{4}{3}\pi R\left(1-\frac{d}{R}\right)\rho$

$\boxed{g_d = g\left(1-\frac{d}{R}\right)}$

(ii) Height

$g = \frac{GM}{R^2}$

At a height, h, $g_h = \frac{GM}{(R+h)^2}$

$= \frac{GM}{R^2\left(1+\frac{h}{R}\right)^2}$

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

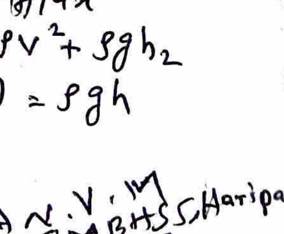
$= g\left(1-\frac{2h}{R}\right)$

(29) a) Law of conservation of energy.

b) Statement OR

$P + \frac{1}{2}\rho v^2 + \rho g h = \text{constant}$

c) Torricelli's law – The speed of efflux from the orifice of an open tank is equal to the velocity of a freely falling body



$TE_A = TE_B$

$P_A + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_B + \frac{1}{2}\rho v_2^2 + \rho g h_2$ — ①

$P_A = P_B = P_a$, atmospheric pressure

$v_1 = 0$; $v_2 = v$, velocity of efflux

① ⇒ $P_a + 0 + \rho g h_1 = P_a + \frac{1}{2}\rho v^2 + \rho g h_2$

$\frac{1}{2}\rho v^2 = \rho g (h_1 - h_2) = \rho g h$

$v^2 = 2gh$

$v = \sqrt{2gh}$ //

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