PRACTICE PAPER 01 FOR G.C.E A/L STUDENTS – 2024

CONDUCTED BY TAMIL STUDENTS OF FACULTY OF ENGINEERING
UNIVERSITY OF MORATUWA

01 – PHYSICS

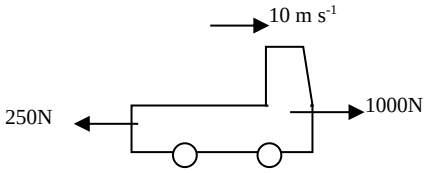
ANSWERS (MARKING SCHEME)

01 - Physics

Q.No.	Ans. No.	Q.No.	Ans. No.	Q.No.	Ans. No.	Q.No.	Ans. No.	Q.No.	Ans. No.
01.	**3**	06.	**3**	11.	**2**	16.	**3**	21.	**2**
02.	**5**	07.	**5**	12.	**3**	17.	**1**	22.	**5**
03.	**1**	08.	**4**	13.	**3**	18.	**4**	23.	**4**
04.	**5**	09.	**5**	14.	**1**	19.	**4**	24.	**4**
05.	**4**	10.	**3**	15.	**1**	20.	**3**	25.	**3**

MCQ Explanations

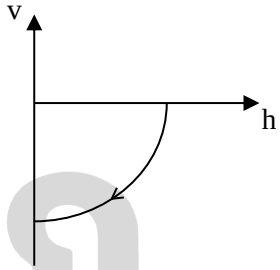
1. $P = F \times V$



$10000 = F \times 10$
$F = 1000$ N
P- constant
When $v \to vx$, $F \to \frac{F}{x}$
To find maximum velocity
Air resistance force = exerting force
$250x = \frac{1000}{x}$
$x = 2$
maximum velocity= 20 m s^{-1}

Answer- 3

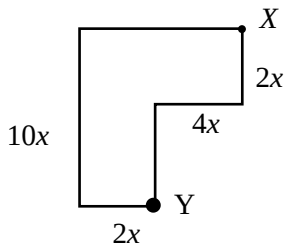
2. When releasing the ball, height=h , velocity= 0



Velocity increases when height decreases
$\frac{1}{2}mv^2 = mgh$ $v^2 \propto h$
Therefore,
As it rebounces to $\frac{2h}{3} (< h)$ height only, its velocity decreases after it collides with ground.
Then velocity decreases when height increases. Velocity will become 0 when h= $\frac{2h}{3}$

Answer- 5

3. total area=$28x^2$

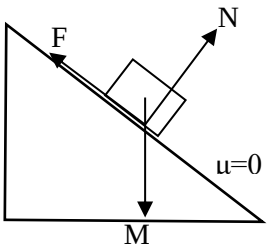


total mass=7m
$20x^2$=5m
$8x^2$=2m
The normal reaction given by the floor can be moved only up to Y to maintain the equilibrium.
Take moment about Y

$$5m \times x = 2m \times 2x + M \times 4x$$
$$M = {}^{m}/_{4}$$

Answer- 1

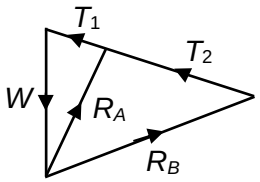
4. Resultants of F&N would be vertically upwards, if block is at rest or travels with uniform velocity.



As block moves with acceleration along the inclined plane, enough force F to maintain equilibrium isn't obtained. Therefore, line of reaction will be in β angle with vertical.

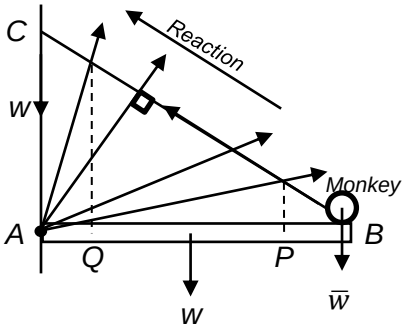
Answer- 5

5. (A)When monkey moves from B to A, C.M of monkey (approximately) will move from P to Q.



Reaction given by wall to A will goes through intersection point of resultant weight and string.

Reaction will decrease and increase

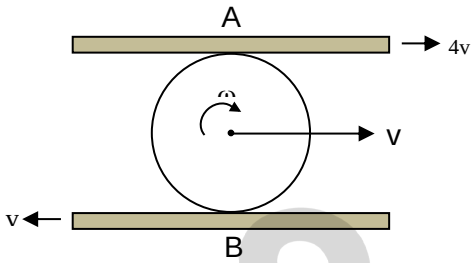


(B) When monkey is at A&B,Therefore, tension in the string is high when monkey is at B. So, high possibility of string to break.

(C) True statement.

Answer- 4

6. Let the linear velocity= u & angular velocity = ω



At A, 4v=u+rω

At B, v=rω-u

5v=2rω

$\omega = \frac{5v}{2r}$

Answer- 3

7. Maximum force can be given to 2kg block= 0.5 × 20 = 10N

Maximum acceleration of 2kg = $\frac{10N}{2kg}$ = 5ms^{-2}

To move 2kg&5kg blocks to move without slipping, 5kg block also should move with 5ms^{-2} acceleration.

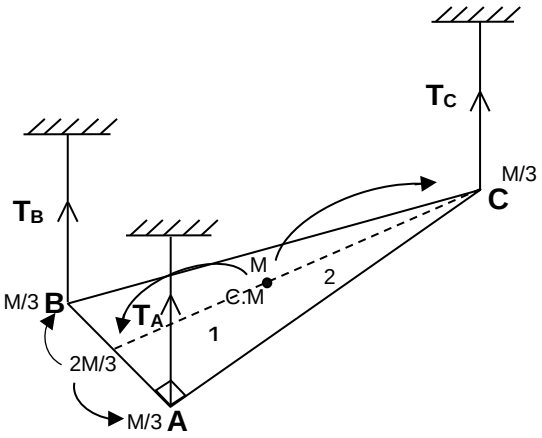
For system, F = ma

F = 7kg × 5ms^{-2} = 35N

Answer- 5

8. As point mass is placed in centre of mass, tension acts on all 3 strings are same.

(mass on CM can be divided equally tovertices of triangle)



Answer- 4

9. Statement A:
the angular velocities of four wheels are not same because the three small wheels will rotate in opposite direction of the big wheel. ∴ Angular velocity is not same.

Statement B:
the linear speeds at contact points will be same (because the radius of three small wheels are same) ∴ the contact points will leave from the contact points with same linear speeds. ∴ Linear speeds are same.

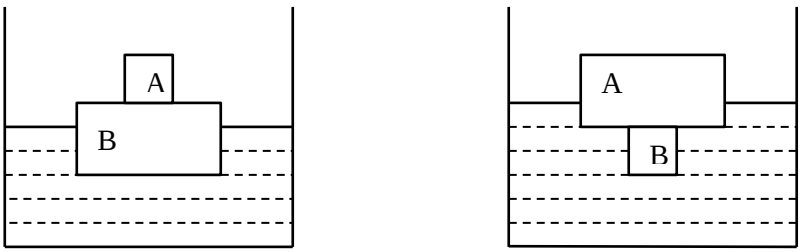
Statement C:
the rotational frequency will not be same because the big wheel won't perform one full rotation when small wheels complete their one full rotation. ∴ Rotational frequency is not same.

Answer-5

10. (1) Velocity increases as vehicle accelerates in t_0-t_1 and t_3-t_5 time intervals.
(2)Velocity doesn't increase uniformly as vehicle accelerates with various acceleration in t_2-t_3 time interval.
(3)Velocity increases as vehicle involves to constant acceleration in t_1-t_2 time interval.
(4)Velocity is maximum at $t=t_6$ as vehicle accelerates from t_0-t_6
(5)Velocity of vehicle increases non-uniformly in t_3-t_5 time interval as acceleration changes.

Answer-3

11.



Let the volume of water displaced by cuboid B be V_B

Let the volume of cuboid A be V
In both above instances the up thrust exerted by the water is same
(Mass is same in both instances)
So

$$V_B \rho w\, g + V_1 \rho w\, g = (V_B - V_2) \rho w\, g + V \rho w\, g$$
$$V_1 = -V_2 + V$$
$$V = V_1 + V_2$$

Answer - 2

12. Force that have to be applied to mass *m* in unit time in order to give *v* velocity ; F = *mv*
According to Newton's third law, the force exerted on firecracker when it is fired is *mv*.

∴ Torque about axis $\tau = mv \times r$

Apply $\tau = I\alpha$

$mv \times r = \frac{1}{2} Mr^2 \times \alpha$

$\alpha = \frac{2mv}{Mr}$

Answer - 3

13. According to Archimedis principle,

upthrust = weight of fluid displaced

$h\rho g \times 2rl - F = \frac{\pi r^2}{2} \times l\rho g$

$\frac{15}{100} \times 1000 \times 10 \times 2 \times \frac{10}{100} \times \frac{30}{100} - F = \frac{3}{2} \times \left(\frac{10}{100}\right)^2 \times \frac{30}{100} \times 1000 \times 10$

F = 45N ↓ Answer-3

14. (A) As fluid is at rest,

Pressure at P = Pressure at Q

$\pi + h_1\rho g = \pi + h_2\rho g$

$\therefore \quad h_1 = h_2$

∴ Liquid will found upto level Z in tube Q

(B) If R is opened,

Z level > Liquid level > X level

as liquid rise only due to static pressure when liquid has a velocity at Q

(C) Eventhough Q is shape, liquid rise only due to static pressure.

Therefore, liquid level in tube P > liquid level in tube Q Answer- 1

15. (A)True for any value of e

(B)Statement is false. There is a possibility for A to become rest after the collision.

(C)The magnitude of impulse act on A and B during collision will always be same.

(momentum should be conserved)

Answer-1

16. Volume of metal block = V

Let volume of air bubble= v
According to Arichimedis principle,

Upthrust = Weight

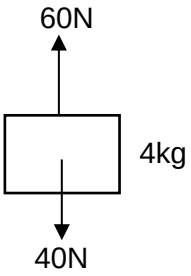
$$\frac{V}{2}\rho_{Water}\,g + \frac{V}{2}\rho_{Oil}\,g = (V\text{-}v)\,\rho_{Metal}\,g$$

$$\frac{V}{2} \times 1000 \times g + \frac{V}{2} \times 800 \times g = (V\text{-}v) \times 2400 \times g$$

$$\frac{v}{V} = \frac{5}{8}$$

Answer- 3

17. Tension in the string should be 60N in order to have 6kg at rest. As pulley is light & frictionless tension in both ends of string are same.



4kg mass $\uparrow a = \frac{F}{m} = \frac{20}{4} = 5ms^{-2}$
Therefore, pulley should accelerates with 2.5ms^{-2} upwardly.
∴ Pulley should be moved upwardly.
Reading = 60N + 60N = 120N (pulley is light)

Answer- 1

18. Let the velocity of vehicle be v when ball is thrown.

Apply v=u+at for ball upwards
-5=5+ (-10)t
t=1 sec
It will take 1s to reach the vehicle again. Ball will have v horizontal velocity until it reaches the vehicle again.
Horizontal distance travelled by ball in 1sec= v×1
Horizontal distance should be travelled by vehicle in that 1s= v+20
Apply s=ut+$\frac{1}{2}$ at^2 for vehicle

v+20= v×1 + $\frac{1}{2}$ a1^2
a = 40ms^{-2}

Answer- 4

19. As rod is in horizontal equilibrium,

Moment of mass of right side = Moment of mass of left side
about point of contact of rod with spring balance
But, perpendicular distance from point of contact of spring balance with rod to masses on both sides are same.
∴mass on right side = mass on left side
∴ Reading of spring balance= 2(m_2+M_2) + M_1

Answer- 4

20. A→ B

$\nearrow \quad v = u + at$

$0 = u - g\sin\theta \times t$

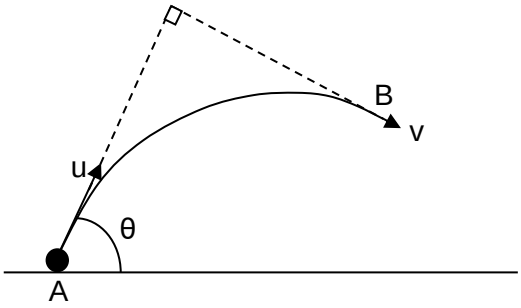
$t = \dfrac{u}{g\sin\theta}$

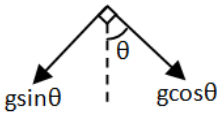
$\searrow \quad v = u + at$

$v = 0 + g\cos\theta \times t$

$v = g\cos\theta \times \dfrac{u}{g\sin\theta}$

$= \dfrac{u}{\tan\theta}$



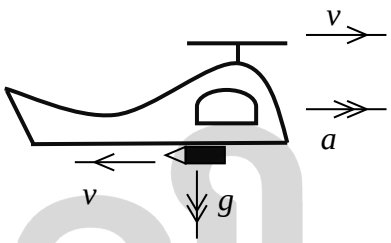


Kinetic energy of particle at B = $\frac{1}{2}m\left(\frac{u}{\tan\theta}\right)^2$

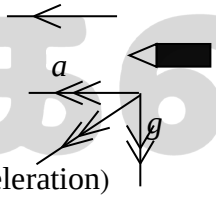
$= \dfrac{mu^2}{2(\tan\theta)^2}$

Answer-3

21. If bullet is fired, V_2>0Motion of bullet relative to helicopter,



v_2 (Resultant Velocity)



(Resultant Acceleration)

Answer- 2

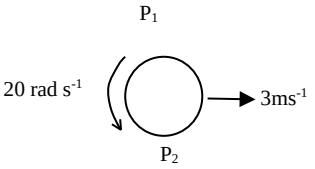
22. According to Bernouli's principle, a resultant pressure acts in ball.

$P_1 - P_2 = \dfrac{1}{2} \times 1.2[(3ms^{-1} + 0.05 \times 20rads^{-1})^2 - (3ms^{-1} - 0.05 \times 20rads^{-1})^2]$

$=0.6\times 12Pa$

Force acts on ball $=0.6\times 12Pa \times \pi r^2$

$=0.6\times 12Pa \times 3 \times 0.05^2$



To ball $F = ma$

$a = \dfrac{0.6\times12\times3\times25\times10^{-4}}{0.3}$

$=18\times 10^{-2}ms^{-2}$

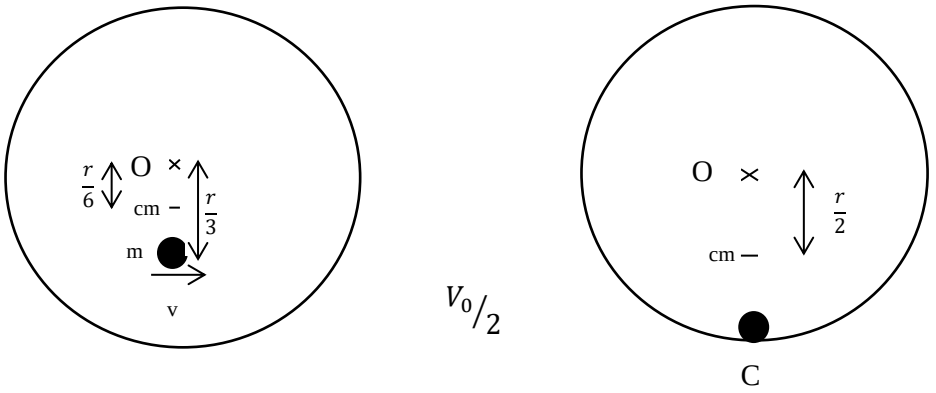
Time taken by ball to reach wall = $\dfrac{30m}{3ms^{-1}} = 10\ sec$

Apply $s = ut + \frac{1}{2}at^2$ in the accelerating direction

$s = 0 + \frac{1}{2} \times 18 \times 10^{-2}ms^{-2} \times 100s^2 = 9m$

Answer- 5

23.



The total momentum of disk and ring = momentum of disk

= m × v

= mv

The mass of the total system = mass of disc + mass of ring

= m+m

= 2m

= mv/2m

= v/2

The displacement attained by the system = velocity × time

= v/2 ×t

Let the center of mass of the system= C.M

Displacement of the ring = OO'

$$= \sqrt{\left(\frac{vt}{2}\right)^2 + \left(\frac{r}{2} - \frac{r}{6}\right)^2} \qquad = \sqrt{\frac{(vt)^2}{4} + \frac{r^2}{9}}$$

Answer-4

24. The total mechanical energy is same at initial instance and at the time where X leaves A

V-velocities of X , Y when X leaves

ω =angular velocity of the plank

Initial energy=final energy

$$2mgl\sin 30^0 = mgl\sin 30^0 + \frac{1}{2}I\omega^2 + \frac{1}{2}mv^2 + \frac{1}{2}(2m)v^2$$

$$mgl = \frac{mgl}{2} + \frac{1}{2}\frac{ml^2}{12}\left(\frac{v}{l/2}\right)^2 + \frac{1}{2}mv^2 + mv^2$$

$$gl = \frac{gl}{2} + \frac{1}{6}v^2 + \frac{1}{2}v^2 + v^2$$

$$\frac{10v^2}{6} = \frac{gl}{2}$$

$$v^2 = \frac{3gl}{10}$$

$$v = \sqrt{\frac{3gl}{10}}$$

Answer-4

25. Let the time taken to collide with wall be ;Δt

$$F = \frac{m\Delta v}{\Delta t}$$

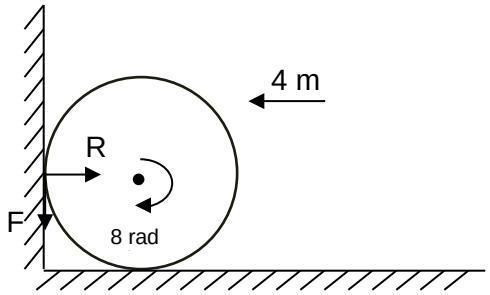
R=$\frac{2kg(4-(-4))}{\Delta t}$

R=$\frac{16}{\Delta t}$

(after the collision) $\tau = Fr = \frac{I\Delta\omega}{\Delta t}$

$$F\times 1m = \frac{\frac{1}{2}\times 2kg\times 1m^2(8-4rads^{-1})}{\Delta t}$$

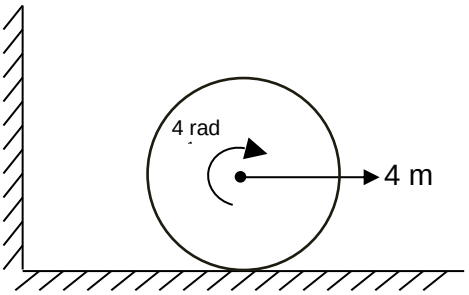
F=$\frac{4}{\Delta t}$



Angular velocity should be possessed to roll without slipping

$$;v = r\omega$$

$\omega = \frac{4ms^{-1}}{1m}$ =4rads^{-1}



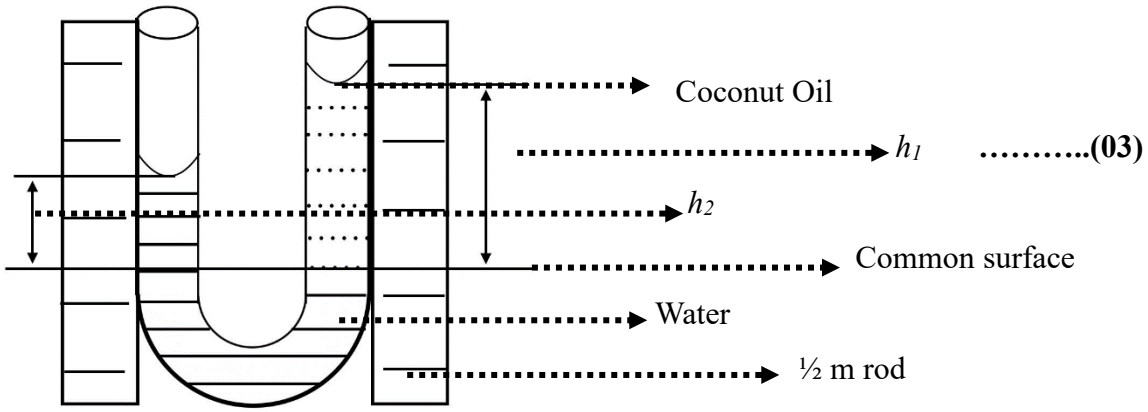
Apply $F = \mu R$

$\mu = \frac{F}{R} = \frac{\frac{4}{\Delta t}}{\frac{16}{\Delta t}}$=$\frac{1}{4}$

Answer-3

Part A - Structured Essay

1. (a) (i)



……..(03)

(ii) Setsquare. **……..……...…….(01)**

(iii) Since fixed on a board both arms of U-tube will have same slant or both will be parallel. **……..….. (01)**
Hence it can be neglected in calculations.

(iv) First rinse the U-tube with sodium hydroxide (NaOH). **……..……(01)**
Then with diluted hydrochloric acid (HCl).
Then with distilled water.
Then dry it.

(b) (i) $P_o + h_1d_1g = P_o + h_2d_2g$ **……..…….……..…… (01)**
$h_1d_1 = h_2d_2$
$d_1 = \left(\frac{h_2}{h_1}\right) d_2$

(ii) No, **……..……..(01)**
Since, the common surface only rises, the heights of free surfaces from common surface does not changes. **…….....… (01)**

(iii) $d_1 = \left(\frac{h_2}{h_1}\right) d_2$ **……...……. (01)**
$d_1 = 0.91 \times 1000$ kg m^{-3}
$d_1 = 910$ kg m^{-3}

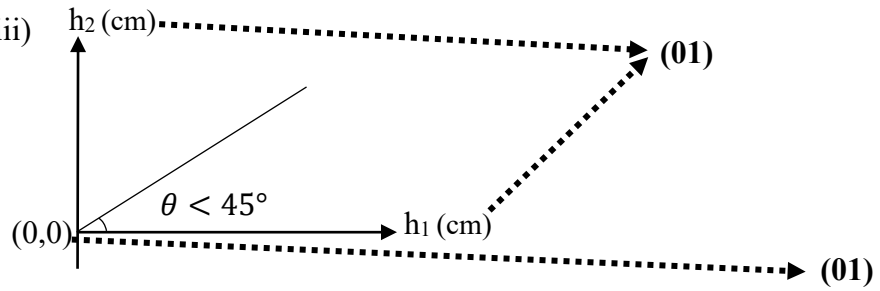
(c) (i) Immiscible with each other. **……..…. (01)**

(ii) A third liquid immiscible with these two liquids and having higher density should be added first into the tube.
Then the two liquids can be added in either arm and experiment can be conducted. **(01)**

(d) (i) Water / Liquid with higher density.
To prevent coconut oil / liquid with lower density splitting into two parts. **……... (02)**

(ii) Height of free surface of mercury from common surface can be very small hence; fractional error will be high
OR
Height of coconut oil column will be high hence; it is hard to handle such a long tube.
(02)

(iii)



(iv) Densities of two liquids have to be nearly equal. ..... **(01)**

2. (a) (i) $F = ke$ ..... **(01)**

(ii) Energy $= \frac{1}{2}ke^2$ ..... **(01)**

(b) $\frac{1}{2}mV_B^2 = \frac{1}{2}kc^2$ ..... **(02)**

$V_B^2 = \frac{kc^2}{m}$

$V_B = c\sqrt{\frac{k}{m}}$ ..... **(01)**

(c) $F = \mu R$

$F_1 = \mu mg$ ..... **(02)**

(d) (i) $\overrightarrow{F = ma}$

$-\mu mg = ma_1$

$a_1 = -\mu g$ ..... **(02)**

(ii) $V^2 = U^2 + 2aS$

$V_D^2 = \frac{kc^2}{m} - 2\mu g(b-a)$

$V_D = \sqrt{\frac{kc^2}{m} - 2\mu g(b-a)}$ ..... **(03)**

(e) (i) Loss of kinetic energy = Gain in potential energy

$\frac{1}{2}mV^2 = mg \times 2R$ ..... **(02)**

$V^2 = 4gR$

$V = 2\sqrt{gR}$ ..... **(01)**

(ii) $4gR = \frac{kc^2}{m} - 2\mu g(b-a)$ ..... **(02)**

(f) $\downarrow S = ut + \frac{1}{2}at^2$

$2R = 0 + \frac{1}{2}gt^2$

$t^2 = \frac{4R}{g}$

$t = 2\sqrt{\frac{R}{g}}$ ..... **(02)**

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

$b = V_E \times 2\sqrt{\frac{R}{g}} + 0$

$V_E = \frac{b}{2}\sqrt{\frac{g}{R}}$ ..... **(01)**

Part B - Essay

3. (a) (i) Dimensions of pressure = [N m^{-2}]
= [M L T^{-2} L^{-2}]
= M L^{-1} T^{-2} ……**(01)**
Dimension of *hdg* = [kg m^{-1} s^{-2}]
= M L^{-1} T^{-2} ……**(01)**
So, dimension of pressure = Dimension of *hdg*
(ii) Incompressible ……**(01)**
Non-Viscose ……**(01)**

(b) (i) $P = P_o + h\rho g$ ……**(02)**
(ii) Atmosphere air will get inside via the tube A. ……**(02)**
(iii) Let density = ρ
Velocity of liquid at cross section $A_1 = \bar{V}$
$P_B = P_o + h_1 \rho g$ …… (1) ……**(01)**
$P_C = P_o + h_2 \rho g$ …… (2) ……**(01)**

$P_C = P_B + \frac{1}{2} \rho \bar{V}^2$ ……**(01)**
$P_C - P_B = \frac{1}{2} \rho \bar{V}^2$ …… (3) ……**(01)**

(2) – (1) ➡ $P_C - P_B = (h_1 - h_2) \rho g$ …… (4) ……**(01)**
(3) – (4) ➡ $\frac{1}{2} \rho \bar{V}^2 = (h_1 - h_2) \rho g$ ……**(01)**
$\bar{V}^2 = 2(h_1 - h_2) g$
$\bar{V} = \sqrt{2(h_1 - h_2)g}$ ……**(01)**
According to the equation of continuity, ……**(01)**
$A_1 \bar{V} = A_2 V$ ……**(01)**
$V = \frac{A_1}{A_2} \bar{V}$
$V = \frac{A_1}{A_2} \sqrt{2(h_1 - h_2)g}$ ……**(01)**

(c) (i) $P + \frac{1}{2} dv^2$ = constant ……**(02)**
(ii) The man gets dragged towards the train. ……**(01)**
When the train swifts near the man the air column near the train / between man and train also move fast. Hence, according to Bernoulli's equation the dynamic pressure increases **<u>resulting a low static pressure. An unbalanced force</u>** act on man due to the **<u>pressure difference pushes him towards the train</u>**. ……**(03)**

(iii) Pressure difference = 1× 10^5 Pa - 5× 10^4 Pa ……**(01)**
= 5× 10^4 Pa ……**(01)**
Unbalanced force acting on man = 5× 10^4 Pa × 1 m^2 ……**(01)**
= 5× 10^4 N ……**(01)**
Applying $F = ma$ for man horizontally,.
$F = ma$ ……**(01)**
5× 10^4 N = 50 kg × a
a = 1000 ms^{-2} ……**(01)**