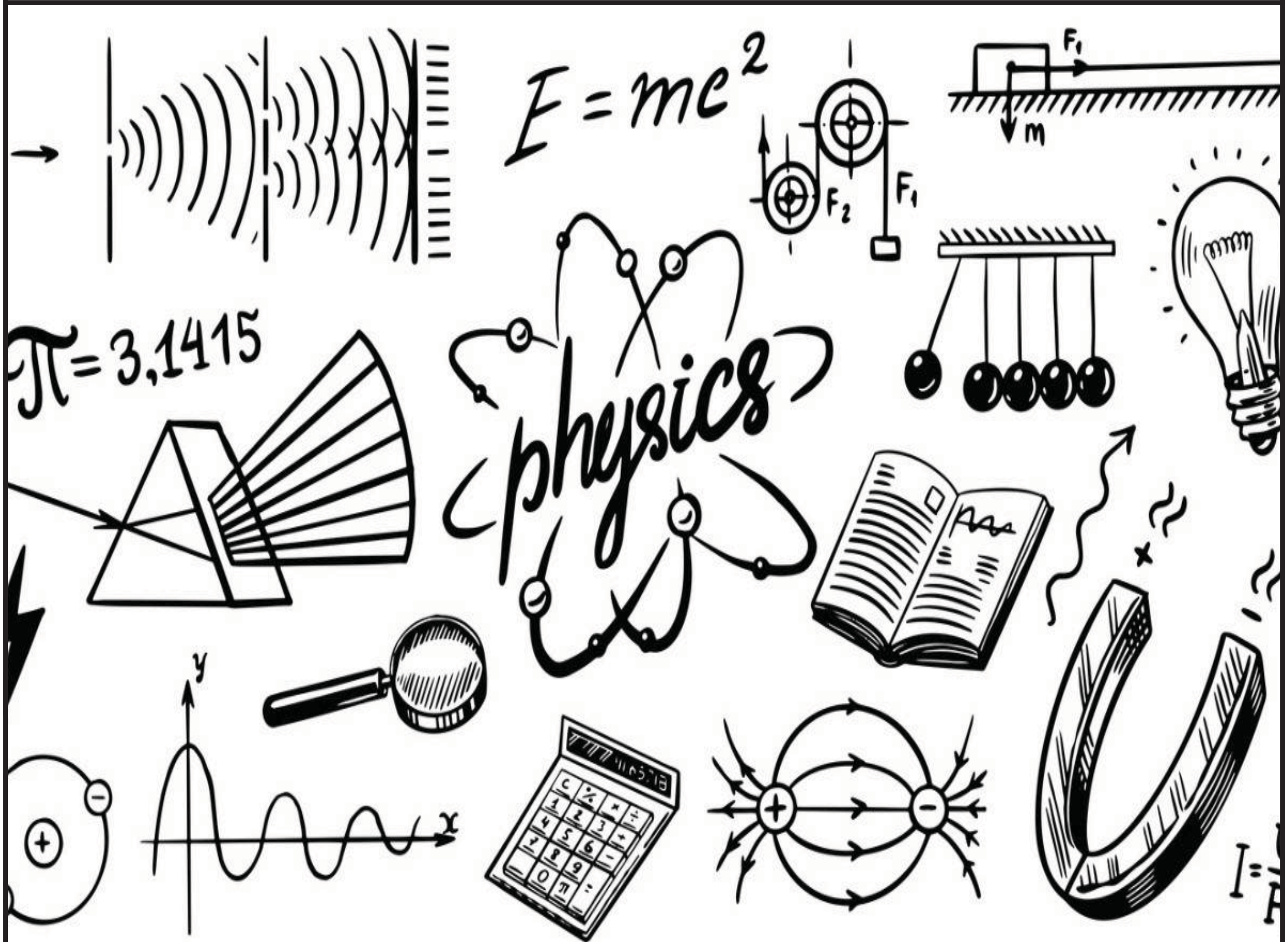
தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு

முதலாம் தவணைப் பரீட்சை - 2023

National Field Work Centre, Thondaimanaru.

1st Term Examination - 2023

Grade - 12 (2024) physics Marking Scheme



பகுதி I

01) 4	06) 5	11) 1	16) 3	21) 4
02) 3	07) 4	12) 3	17) 1	22) 1
03) 2	08) 4	13) 1	18) 5	23) 5
04) 5	09) 2	14) 4	19) 2	24) 3
05) 2	10) 1	15) 5	20) 5	25) 5

PART - II A

01/

a) To maintain vertical equillibrium in a horizontal plane —— ①

b) Located in the vertex of an equilateral triangle —— ②

C/

1/ By adjusting the screw just to touch the image —— ②
formed in the glass block

11/

—— ①

1/ adjust the screw to touch the curved surface —— ②

111/ 1/ 0.03 mm —— ①
2.70 mm —— ②

2/ 3.00 mm —— ①

1V/

1/ Vernier calliper —— ①
internal jaw —— ①

2/ Press the sphcrometer on a white sheet and measure the distance between the legs using the internal jaws —— ②.

3/ $R = \frac{\cancel{30}^{5} \times \cancel{30}^{10}}{\cancel{6} \times 3} + \frac{3}{2}$ = 50 + 1.5 —— ①
= 51.5 mm —— ①.

d/ measuring the radius of large sphere —— ②

20

02/

a/

i/ A — Vertical fine adjustment knob — to adjust vertically

B — Focusing knob — to focus the object on the cross wire.

C — levelling screw — to adjust the plane horizontally

E — horizontal fine adjustment knob — to adjust horizontally

G — stage — to keep the objects to be observed — 5

b/ adjust the eyepiece until the cross wire is clearly seen — 2

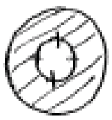
c/ screw F is not tightly fixed — 2.

d/ i/ 0·01 mm — 1

ii/ 38·65 mm — 2.

e/ Yes — 1.

to obtain circular image of the end through microscope — 1.

f/  — 2.

g/ No — 1

here only the diameter of the end is measured — 1

h/ measuring the diameter of the soap bubble.

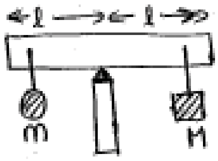
Measuring the diameter of the thin rubber tube — 2.

20

03)

a) To determine the centre of gravity point / to avoid the mass of the metre ruler in the measurement — ②

b) i) 50g — ①
length measurements are approximately equal — ②

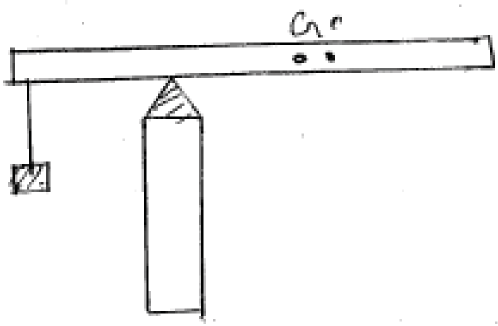
ii)  — ④

iii) $mgl = MgL$ — ①
$ml = ML \rightarrow m = \frac{ML}{l}$ — ①

iv) Fractional error of length measurement / To reduce the percentage error — ②

c) To avoid other forces contributing in the moment of metre ruler — ②

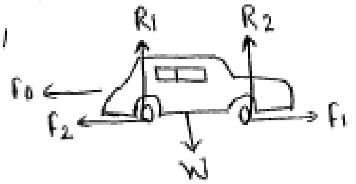
~~$12 \times M_0 g = 35 \times 50 g$~~ ~~— ①~~
~~$M_0 = 145.8 g$~~ ~~— ①~~

d) i)  — ③

ii) $12 \times m_0 g = 35 \times 50 g$ — ①
$m_0 = 145.8 g$ — ①

20

04) a)



If all are correct — 3
If any 5 are correct — 2
If any 4 are correct — 1

R_1, R_2 - Reaction given by the floor
f_1 - by rotating the engine wheel
f_2 - by rolling the wheel
f_0 - resistive force given by air / Drag force
W - gravitational force.

All — 3
Any 4 — 2
Any 3 — 1

b) i) 160 N — 1

ii) $P = F \times V$
$= 160 \times 20$ — 2
$= 3200 W$

iii) 1) $3.2 + 1.8 = 5 kW$ — 1.

2) A) energy used to rotate the wheel $= \frac{20}{100} \times 4 \times 10^7$
$= 8 \times 10^6 J/l$ — 1.

Power used to rotate the wheel in $20 ms^{-1}$ $= 5 \times 10^3 J/s$

∴ time duration for 1l $= \frac{8 \times 10^6}{5 \times 10^3} = \frac{8000}{5}$
$= 1600$ sec — 1.

distance travelled in 1600 sec $= 1600 \times 20$
$= 32000$ m

fuel efficiency $= 32 km/l$ — 1

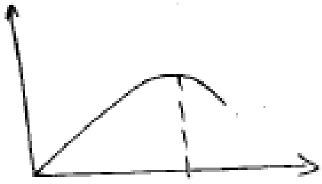
B) Increase the frictional force of front wheel — 2
decreasing the air resistive force / Reduce the Area

iv) $F = KAPV^2$
$160 = k \times 2 \times 1.2 \times 20^2$ — 1.
$k = 0.17$ — 1

c)

— ①.

d)



— ②

PART-II B

05) Acceleration - gradient of the graph. —— (1)

Displacement - area of the graph. —— (1)

a) i) Rate of change of velocity (a) $= \frac{0-40}{4} = -\frac{40}{4} = -10\,ms^{-2}$ —— (1)

(1)

(ii) $a = \frac{-V-0}{3}$

$-10 = -V/3$

$V = 30\,ms^{-1}$ —— (1)

(iii) At 4th sec

Velocity of car A $= \overrightarrow{40\,ms^{-1}}$ (V_{AE})

Velocity of car B $= \overleftarrow{30\,ms^{-1}}$ (V_{BE})

$V_{BA} = V_{B,E} + V_{E,A}$

$= \overleftarrow{30} + \overleftarrow{40}$ —— (1) + (1)

$= \overleftarrow{70}\,ms^{-1}$ —— (1)

(iv) Till 12 sec

Area of graph of car A $= \frac{1}{2} \times (12+8) \times 40$

$= 400\,m$ (Right) —— (1)

Graph area of car B $= \frac{1}{2} \times (6+12) \times 30$

$= 270\,m$ (Left) —— (1)

Total distance between car A and car B $= 400\,m + 270\,m$

$= 670\,m$. —— (1)

(v) Magnitude of desceleration of car B

$\frac{30-0}{12-6} = \frac{25-0}{T-12}$ —— (1)

$\frac{30}{6} = \frac{25}{T-12}$

$5 = \frac{25}{T-12}$ —— (1)

$T - 12 = 5$

$T = 17\,sec$ —— (1)

2

(vi) Distance travelled at 12 sec = 400m

$\therefore 400\,m = \frac{1}{2} \times [(t-12)+(t-15)] \times 30$ —— 1

$2t - 27 = \frac{400 \times 2}{30} = \frac{80}{3}$

$2t = \frac{80}{3} + 27$

$2t = \frac{80+81}{3}$

$t = 161/6$ —— 1 $t = 26.83\,sec$ —— 1

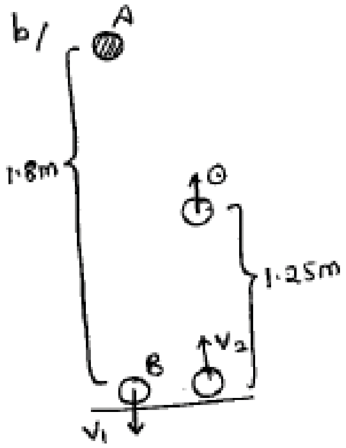
Car B.

Distance travelled $= -270 + 1/2 \times (14.83 + 9.83) \times 25$ —— 1

$= -270 + 308.25$

$= 38.25\,m$ (Right) —— 1

b/



(i) Applying $\downarrow$ $v^2 = u^2 + 2as$

$V_1^2 = 0 + 2 \times 10 \times 1.8$ —— 1

$V_1^2 = 36$

$V_1 = 6\,ms^{-1}$ —— 1

(ii) Applying $\uparrow$ $v^2 = u^2 + 2as$

$0 = V_2^2 - 2 \times 10 \times 1.25$ —— 1

$V_2^2 = 25$

$V_2 = 5\,ms^{-1}$ —— 1

(iii) $\uparrow$ $s = ut + 1/2\,at^2$

$0 = 5 \times t - 1/2 \times 10t^2$ —— 1

$5t = 5t^2$

$t = 1\,sec$ —— 1

Time taken for $A \rightarrow B$

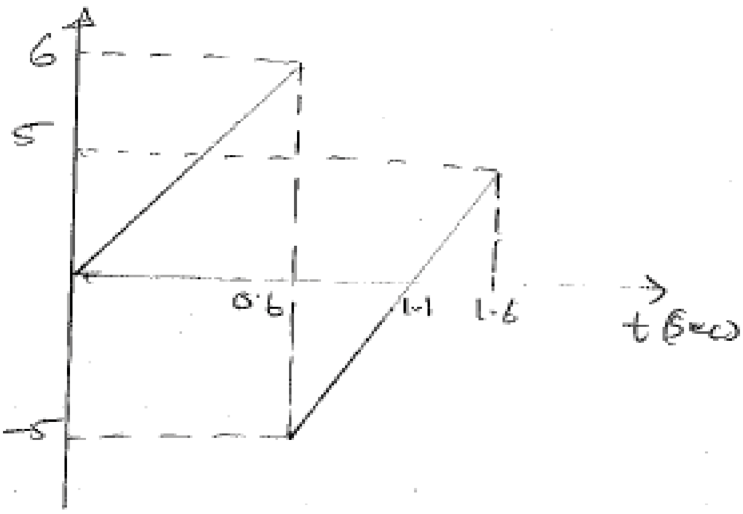
Applying $\downarrow$ $V_1 = u + at$

$6 = 10 \times t$ —— 1

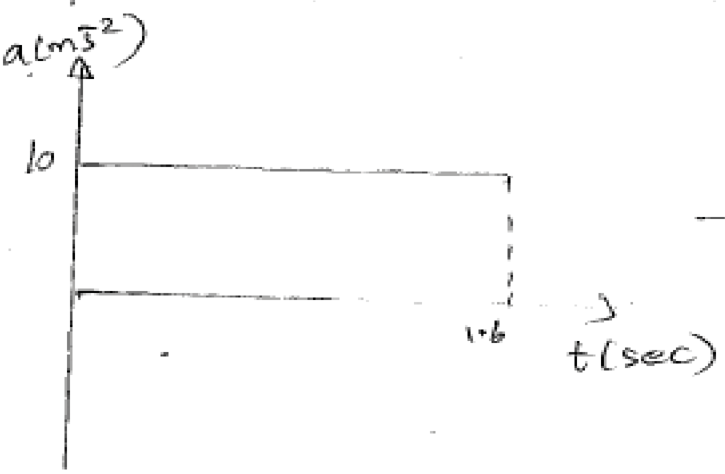
$t = 0.6\,sec$ —— 1

Total time taken for 2nd collision $= 1\,sec + 0.6\,sec$

$= 1.6\,sec$ —— 1

(iv) 

—— (1)

(v) 

—— (1)

30

06/ a/

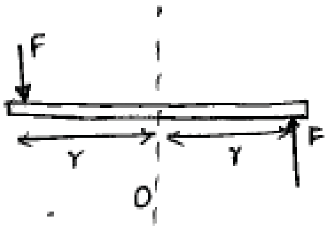
(i) If two forces acting on a point can be represented in magnitude and direction by two adjacent sides of a parallelogram, then the resultant of the two forces will be represented in magnitude and direction by the diagonal of the parallelogram passing through that angular point. — 2

(ii) 1/ The net external force on the system must be zero. — 1

2/ The net torque on the system must be zero. — 1

(iii) Stable Unstable Neutral — 3

b/ (i)



Couple of forces = F x d — 1

Net moment about the axis O is

$= F \times r + F \times r$ (anticlockwise) — 1

$= 2Fr$

$= F \times 2r$; $d = 2r$

$= F \times d$.

∴ Net moment = couple of forces.

(ii) $R^2 = P^2 + Q^2 + 2PQ\cos\theta$ — 2

(iii) $R = R_{max}$ when $\theta = 0$; $\cos\theta = 1$ — 1

∴ $R^2_{max} = P^2 + Q^2 + 2PQ$

$R^2_{max} = (P+Q)^2$

$R_{max} = P+Q$ — 1

$R = R_{min}$ when $\theta = 180$; $\cos\theta = -1$ — 1

∴ $R^2_{min} = P^2 + Q^2 - 2PQ$

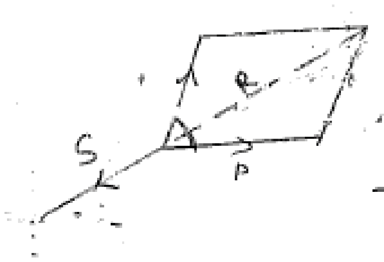
$R^2_{min} = (P-Q)^2$

∴ $R_{min} = P - Q$ — 1

(IV) If $\theta = 90^\circ$; $\cos 90 = 0$

$$R^2 = P^2 + Q^2 + 2PQ \times 0$$
$$R^2 = P^2 + Q^2$$
$$R = \sqrt{P^2 + Q^2} \quad —— ①$$

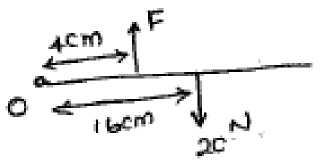
(V)



$$S = \sqrt{P^2 + Q^2 + 2PQ\cos\theta} \quad —— ②$$

—— ①

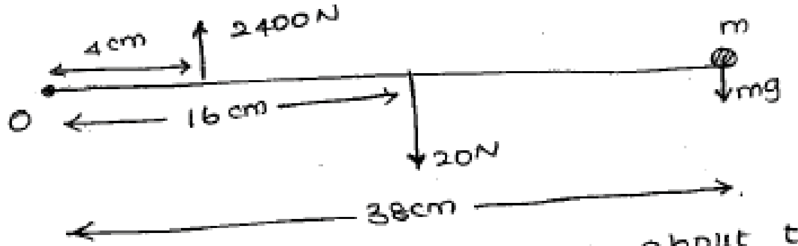
C/ (I)



for equillibrium net moment about the axis O is zero.

$$F \times 4 \times 10^{-2} - 20 \times 16 \times 10^{-2} = 0 \quad —— ②$$
$$F \times 4 = 20 \times 16$$
$$F = 80N \quad —— ①$$

(II)



For equillibrium Net moment about the axis O is zero.

$$2400 \times 4 \times 10^{-2} = 20 \times 16 \times 10^{-2} + mg \times 38 \times 10^{-2} \quad —— ③$$
$$9600 - 320 = mg \times 38$$
$$mg = 9280/38$$
$$m = 244.2/10 = 24.4kg \quad —— ①$$

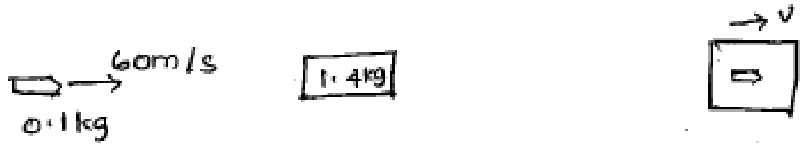
(III) $F \sin 60 \times 4 = 20 \times 16 \sin 60 + 100 \times \sin 60 \times 38$ —— ③

$$F \times 2 = 320 + 1900$$
$$F = \frac{2060}{2}$$
$$= 1030\ N \quad —— ①$$

30

07/ Conservation of momentum states that the total momentum of an isolated system remains the same in the absence of an external force. —(2)

a



(I) using conservation of momentum.

Initial momentum = final momentum. —(1)

$60 \times 0.1 + 0 = 1.5 \times v$

$v = \frac{6}{1.5} = 4\,ms^{-1}$ —(1)

(II) Initial Energy $E_1 = \frac{1}{2} \times 0.1 \times 60^2 = \frac{60 \times 60 \times 0.1}{2}$ —(1)

$= 180\,J$ —(1)

Final Energy $E_2 = \frac{1}{2} \times 1.5 \times 4^2 = 12\,J$ —(1)

(1)

Percentage of energy loss $= \frac{\text{loss of energy}}{\text{initial energy}} \times 100\%$ —(1)

$= \frac{180 - 12}{180} \times 100\%$ —(1)

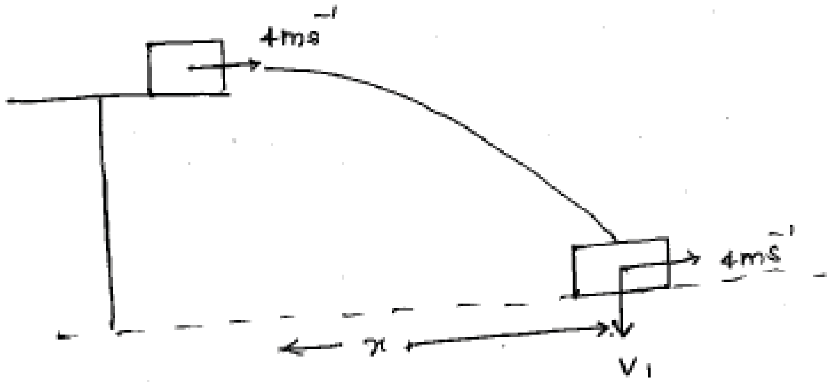
$= \frac{168}{180} \times 100\%$

$= 93.3\%$ —(1)

(1)

No, Energy is lost in other forms such as sound, heat. —(1)

(III)



For Block

Applying $\downarrow s = ut + \frac{1}{2}at^2$

$0.8 = 0 + \frac{1}{2} + 10 \times t^2$ — (1)

$t^2 = 0.16$

$t = 0.4\,sec.$ — (1)

Applying $\rightarrow s = ut + \frac{1}{2}at^2$

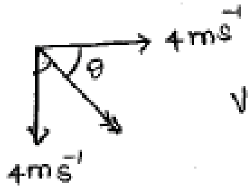
$x = 4 \times \frac{4}{10} + 0$ — (1)

$= 1.6\,m.$ — (1)

iv/ Applying $\downarrow v = u + at$

$V_1 = 0 + 10 \times 0.4$

$V_1 = 4\,ms^{-1}$ — (1)

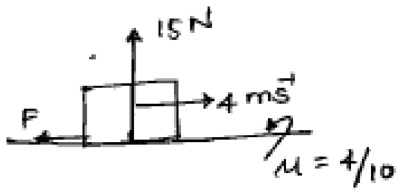


$V_1 = \sqrt{4^2 + 4^2} = \sqrt{32} = 4\sqrt{2}\,ms^{-1} = 6.5\,ms^{-1}$ — (1)

$\tan\theta = 4/4 = 1$

$\theta = 45^\circ.$ — (1)

b/



(i) $F = \mu R = 4/10 \times 15 = 6\,N$ — (1)

(1)

(ii) loss of K.E = Friction force × distance

$= 6 \times 1.5$ — (1)

$= 9J$ — (1)

(iii) Assume the final velocity is V.

Final K.E = Initial K.E − loss of K.E

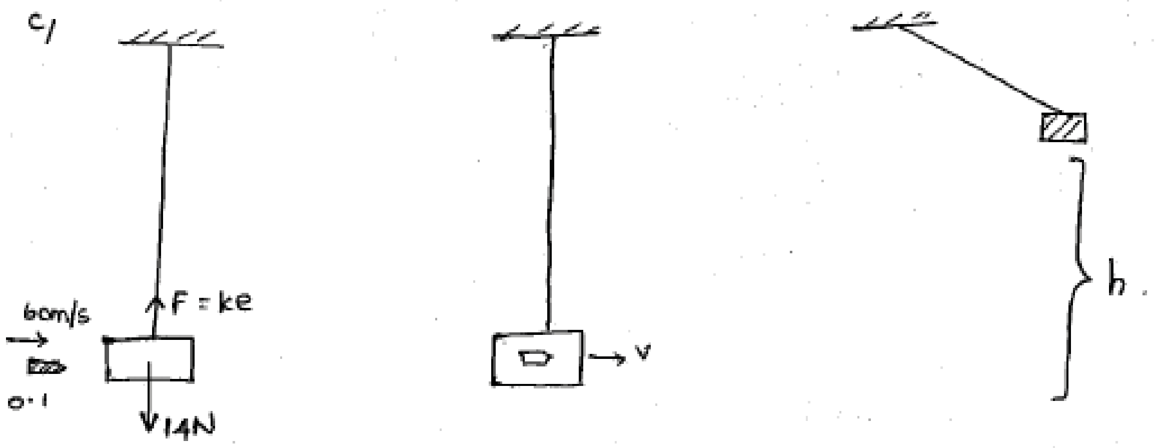
$\frac{1}{2}mv^2 = \frac{1}{2}mu^2 - 9$ — (1)

$\frac{1}{2} \times 1.5 \times v^2 = \frac{1}{2} \times 1.5 \times 4^2 - 9$

$v^2 = \frac{3 \times 2}{1.5} = 4$

$v = 2\,ms^{-1}$ — (1)

c)



(i) For equillibrium — ①

$14 = ke$

$14 = k \times 2/10$

$k = 70\,Nm^{-1}$ — ①

(ii) $V = 4\,ms^{-1}$ — ①
(from a (i))

(iii) Using conservation of Energy,

Initial Energy = Final Energy.

$\frac{1}{2} \times 1.5 \times 4^2 + \frac{1}{2} \times 70 \times \left(\frac{2}{10}\right)^2 = 1.5 \times 10 \times h + \frac{1}{2} \times 70 \times \left(\frac{1}{10}\right)^2$ — ①

$12 + 1.4 = 15h + 0.35$

$15h = 13.05$

$h = 0.87\,m$. — ①

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