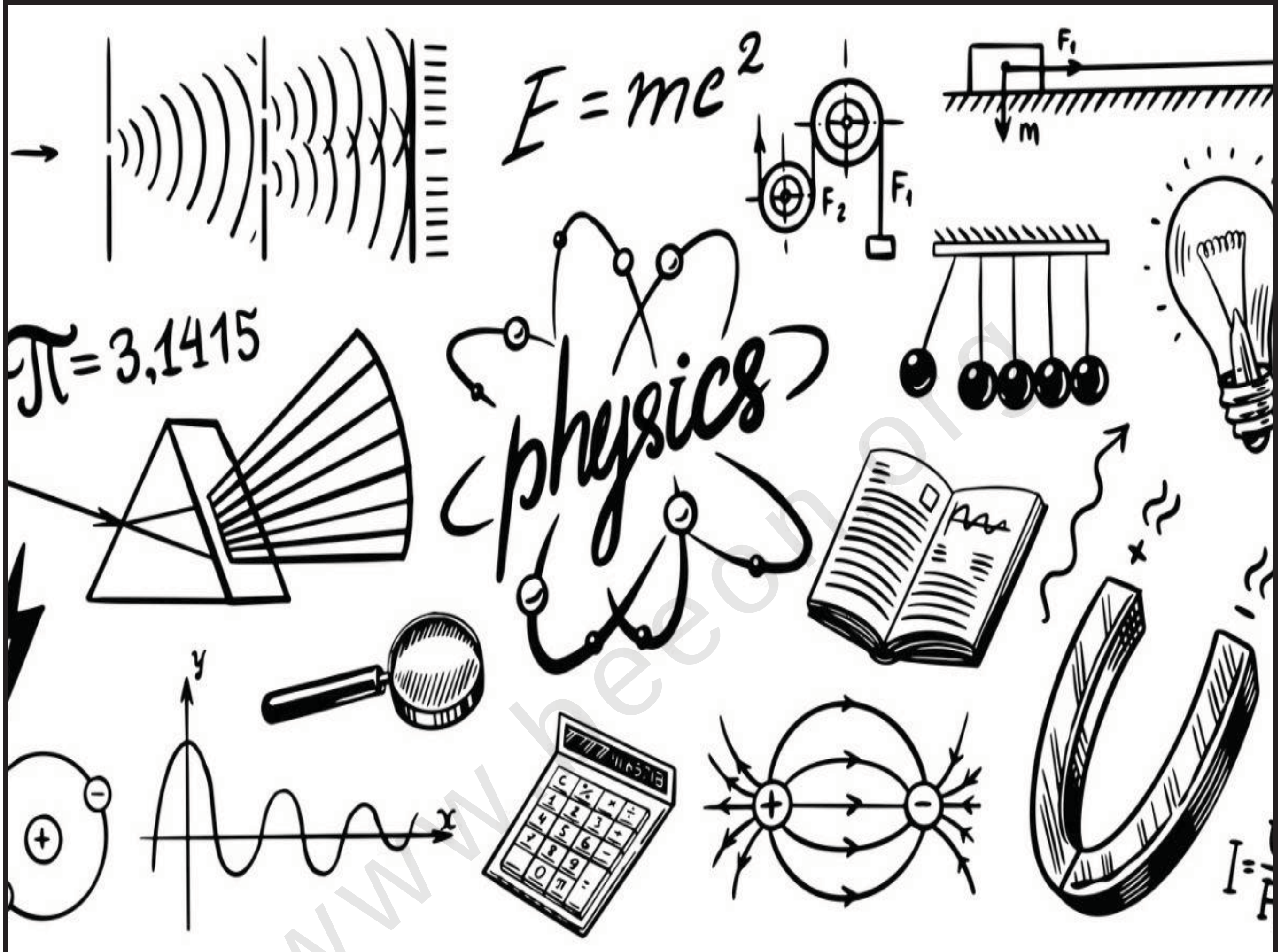
தேசிய வெளிக்கள நிலையம் தொண்டைமானாறு

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/

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

ii/

i, adjust the screw to touch the curved surface —— ②

iii/ 1/ 0.03 mm —— ①
2.70 mm —— ②

2/ 3.00 mm —— ①

iv/

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

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

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

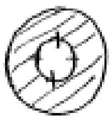
c/ screw F is not tightly fixed — (2).

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).

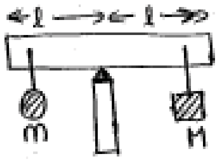
20

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, $mg\ell = MgL$ — (1)

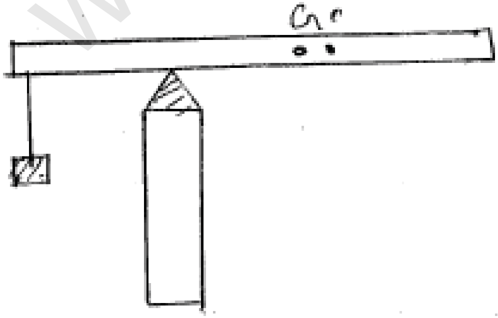
$m\ell = ML \rightarrow m = \frac{ML}{\ell}$ — (1).

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

v, to avoid other forces contributing in the moment of metre ruler — (2).

~~$12 \times m_0 g = 35 \times 50g$ — (1)~~

~~$m_0 = 145.8g$ — (2).~~

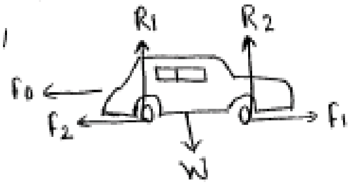
d, i,  — (3)

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

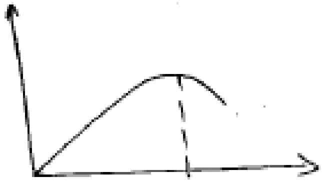
B) Increase the frictional force of front wheel —— 2
decreasing the air resistive force / Reduce the Area

iv) $F = KA\rho V^2$
$160 = k \times 2 \times 1.2 \times 20^2$ —— 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 = $\frac{1}{2} \times (12+8) \times 40$

= 400m (Right) —— 1

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

= 270m (Left) —— 1

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

= 670m. —— 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

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

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

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

$$2t = \frac{80+81}{3} \quad — 1$$

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

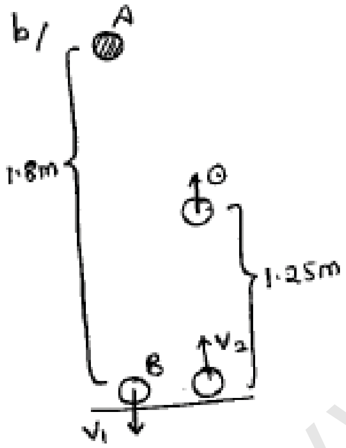
Car B.

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

$$= -270 + 308.25$$

$$= 38.25\,m \text{ (Right)} \quad — 1$$

b/



(i) Applying ↓ $v^2 = u^2 + 2as$

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

$$V_1^2 = 36$$

$$V_1 = 6\,ms^{-1} \quad — 1$$

(ii) Applying ↑ $v^2 = u^2 + 2as$

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

$$V_2^2 = 25$$

$$V_2 = 5\,ms^{-1} \quad — 1$$

(iii) ↑ $S = ut + 1/2\,at^2$

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

$$5t = 5t^2$$

$$t = 1\,sec \quad — 1$$

Time taken for $A \rightarrow B$

Applying ↓ $V_1 = u + at$

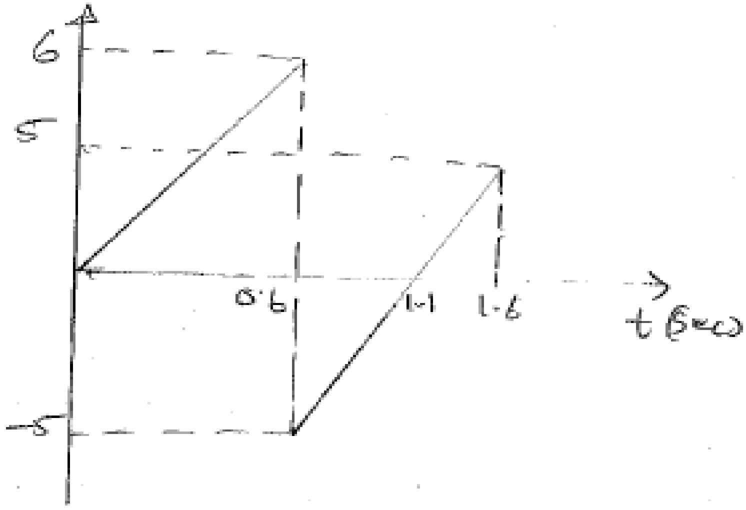
$$6 = 10 \times t \quad — 1$$

$$t = 0.6\,sec \quad — 1$$

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

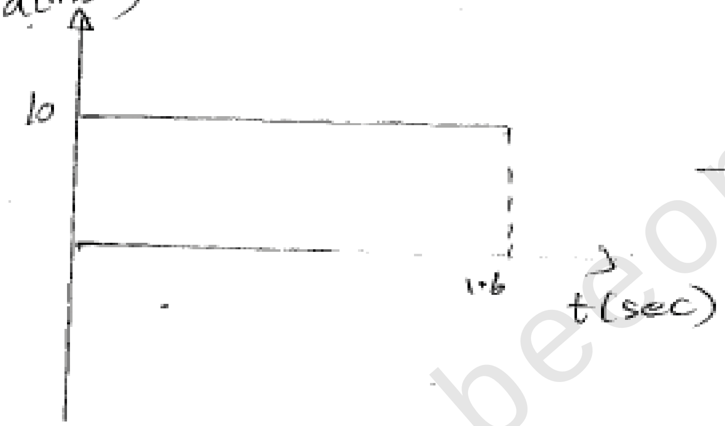
$$= 1.6\,sec \quad — 1$$

(iv) v(ms⁻¹)



—— ①

(v) a(ms⁻²)



—— 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

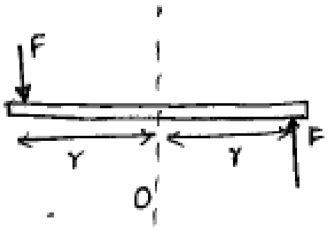
(ii) 1/ The net external force on the system must be zero. — 1

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

(iii) Stable Unstable Neutral

— 3

b/ (i)



Couple of forces $= F \times d$ — 1

Net moment about the axis O is

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

$= 2Fr$

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

$= F \times d$.

$\therefore$ 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

$\therefore R^2_{max} = P^2 + Q^2 + 2PQ$

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

$R_{max} = P + Q$ — 1

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

$\therefore R^2_{min} = P^2 + Q^2 - 2PQ$

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

$R_{min} = P - Q$ — 1

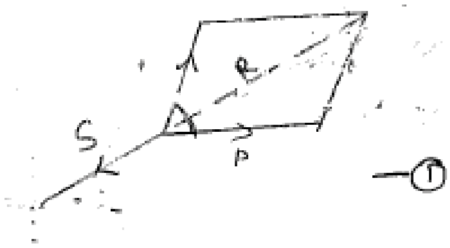
(IV) If $\theta = 90^\circ$: $\cos 90 = 0$

$$R^2 = P^2 + Q^2 + 2PQ \times 0$$

$$R^2 = P^2 + Q^2$$

$$R = \sqrt{P^2 + Q^2} \quad \text{—— } 1$$

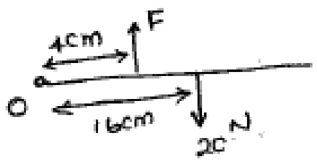
(V)



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

—— 1

C/ (I)



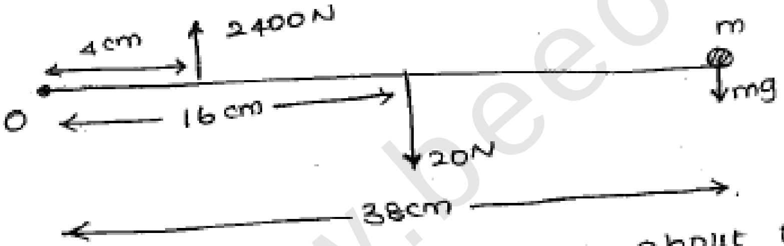
for equillibrium net moment about the axis O is zero.

$$F \times 4\times10^{-2} - 20\times16\times10^{-2} = 0 \quad \text{—— } 2$$

$$F \times 4 = 20\times16$$

$$F = 80N \quad \text{—— } 1$$

(II)



For equillibrium Net moment about the axis O is zero.

$$2400\times4\times10^{-2} = 20\times16\times10^{-2} + mg\times38\times10^{-2} \quad \text{—— } 3$$

$$9600 - 320 = mg\times38$$

$$mg = 9280/38$$

$$m = 244.2/10 = 24.4\,kg \quad \text{—— } 1$$

(III) $F \sin60 \times 4 = 20\times16 \overset{\sin60}{+} 100\times\sin60\times38$ —— 3

$$F\times2 = 320 + 1900$$

$$F = \frac{2060}{2}$$

$$= 1030\ N \quad \text{—— } 1$$

130

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 60m/s 0.1kg 1.4kg v

(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)

$= 180J$ — (1)

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

(1)

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

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

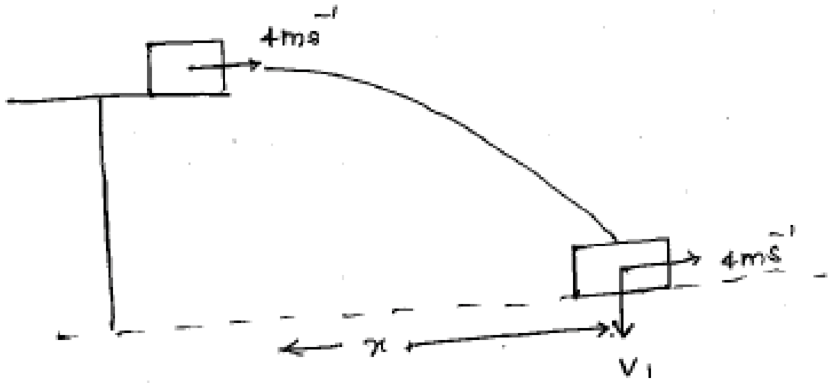
$= \frac{168}{180} \times 100\%$

$= 93.3\%$ — (1)

(1)

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

(iii)



For Block

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

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

$t^2 = 0.16$

$t = 0.4\ \text{sec}$ — (1)

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

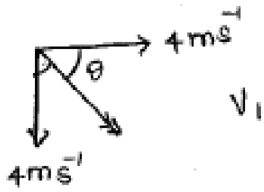
$x = 4 \times \frac{4}{10} + 0$ — (1)

$= 1.6\,\text{m}$ — (1)

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

$V_1 = 0 + 10 \times 0.4$

$V_1 = 4\,\text{ms}^{-1}$ — (1)

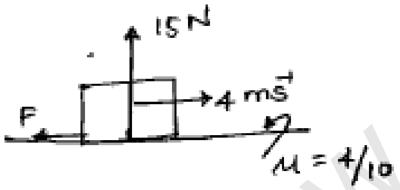


$V_1 = \sqrt{4^2 + 4^2} = \sqrt{32} = 4\sqrt{2}\,\text{ms}^{-1} = 6.5\,\text{ms}^{-1}$ — (1)

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

$\theta = 45^\circ$ — (1)

b/



(i) $F = \mu R = \frac{4}{10} \times 15 = 6\,N$ — (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

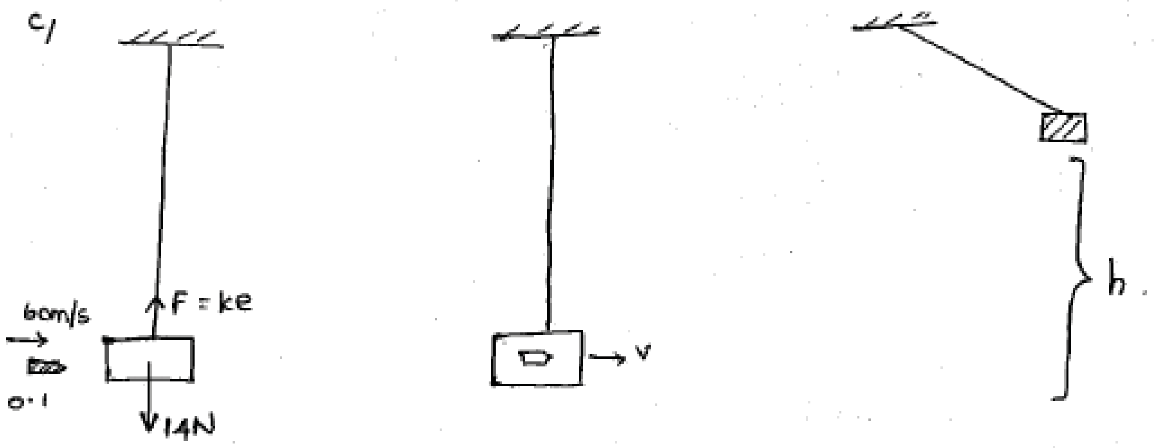
$\frac{1}{2}mv^2 = \frac{1}{2}mu^2 - 9$ — (1)

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

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

$v = 2\,\text{ms}^{-1}$ — (1)

c/



(I) For equillibrium

$$14 = ke$$

$$14 = k \times 2/10$$

$$k = 70 Nm^{-1}$$ — (1)

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

(III) Using conservation of Energy,
Initial Energy = Final Energy.

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

$$12 + 1.4 = 15h + 0.35$$

$$15h = 13.05$$

$$h = 0.87m.$$ — (1)

30