Part - I
பகுதி I

1) 4	11) 1	21) 4	31) 5	41) 2
2) 3	12) 4	22) 5	32) 1	42) 4
3) 1	13) 3	23) 2	33) 2	43) 4
4) 2	14) 1	24) 2	34) 3	44) 5
5) 2	15) 4	25) 2	35) 5	45) 4
6) 1	16) 4	26) 2	36) 5	46) 5
7) 1	17) 1	27) 2	37) 2/4	47) 2
8) 3	18) 3	28) 4	38) 3	48) 2
9) 4	19) 2	29) 1	39) 1	49) 1
10) 2	20) 4	30) 3	40) 3	50) 5

Part - II (A)

01.) a.) Pressure $= \frac{Force}{Area} = \frac{mg}{A} = \frac{Ah\rho g}{A}$ — ①

$= h\rho g$ — ①.

b.) The 76cm Hg column creats a pressure equal to the atmospheric pressure — ①.

c.)

I.) The relative density of liquids can be mixed with water can be measured — ②

II.) Suck air by mouth and then close the clip. — ②

III.) It is difficult to observe the meniscus in the beaker due to light refraction on the glass surface — ②.

IV.) $P_x = P + h_l \rho_l g$ — ①.

$P_y = P + h_w \rho_w g$ — ①.

V.) $P_x = P_y$.

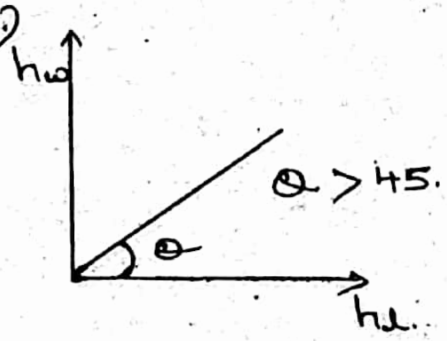
$P + h_l \rho_l g = P + h_w \rho_w g$

$h_l \rho_l = h_w \rho_w$ — ①

VI.) $h_w = \frac{\rho_l}{\rho_w} \cdot h_l$ — ①

$y = m \cdot x$

VII.)



Gradient = relative Density. — ①

— ①

VIII.) Yes —— (1)

Beaker Levels are not necessary because the pressures are balanced with atmospheric pressure. —— (1)

IX.) No. —— (1).

The rise of the liquid does not depend on the cross sectional area —— (1)

20

02.) a.)

I.) String of violin - standing Transverse wave —— (1)

wave moving towards the ear - longitudinal wave —— (1)

II.) The standing wave does not transmit energy (1)

The longitudinal wave transmit energy (1)

III.) standing transverse wave (2)

b.) I.) $\lambda/2 = l$ —— (1)

$\lambda = 2l$.

$V = F\lambda$.

$V = 2lf$ —— (1)

II.) $l = \frac{V}{2} \cdot \frac{1}{f}$ —— (2)

$y = mx$

III.) Very small tuning fork —— (2)

IV.) Vibration amplitude is very high in the Fundamental Vibration —— (2)

V.) can do the experiment quickly or may confirm Fundamental resonance —— (2)

VI.) Points (55, 43), (30, 23) —— ①
(No marks for other points.)

$$m = \frac{(55-30)\times10^{-2}}{(43-23)\times10^{-4}} = 125 \text{ —— ①}$$

Gradient = $V/2$ —— ①

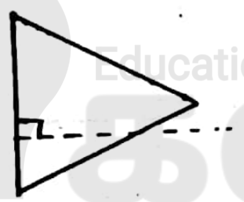
$V = 2m$

$= 2\times 125 = 250\ ms^{-1}$. —— ①

20

03.) a) Telescope, collimator, prism table. —— ③

b)



—— ①

c) Turn the telescope to see the light reflected on the prism surface and adjust two screws to see the slit image symmetrically. —— ②

d) yes —— ①
No horizontal level is required here,
The prism table should be adjusted to the telescope and collimater's plane —— ①

e) P = cross wire of the telescope
Q = slit of the collimater.
R = Prism table.
S = collimater.
} ④

f.) The mean of the two values of a obtained from the two scales should be considered as the final result. —— (1)

g.) The rays will have total internal reflection on the second surface for the smallest incident angle on the first surface —— (2)

h.) $D = 183^\circ 15' - 143^\circ 29' = 39^\circ 46'$ —— (1)

i.) $n = \dfrac{\sin\left(\frac{D+A}{2}\right)}{\sin\left(A/2\right)}$ —— (2)

j.) $n = \dfrac{\sin\left(\frac{60 + 39^\circ 46'}{2}\right)}{\sin 60/2} = \dfrac{\sin 49^\circ 53'}{\sin 30}$ —— (1)

$= \dfrac{0.765}{0.5} = 1.52$ —— (1)

20

4.) a.) The amount of energy that must be added to a liquid substance to transform a quantity of that substance in to a gas in boiling temperature —— (1)

b.) i) Balance (Electronics | triple beam balance) —— (1)

ii) 0 - 50 °c —— (1).
small least count / can be measured accurately / Error reduction in measurement —— (1)

iii) To keep the hot water pressure at atmospheric pressure —— (1).
To prevent interfering by hot water exiting through that pipe —— (1).

c.) i.) To reduce heat transfer with the environment — ①.

ii.) The steam should be supplied until the temperature rises to the same amount as the lower temperature taken. — ①

iii.) To prevent the spread of heat to the calorimeter by radiation.

d.) i.) Mass of Empty Calorimeter + mass of stirrer — x_1
Mass of water + calorimeter + stirrer — x_2.
Initial temperature of the system — x_3 } ③

ii.) Initial temperature = 28 – 29 — ①.
Final temperature = 32 – 31 — ①.

iii.) Maximum temperature of the mixure — x_4 — ①.

Final mass of the system — x_5. — ①.

iv.) $(x_5 - x_2)L + (x_5 - x_2)S(100 - x_4)$.
$= [(x_2 - x_1)S + c](x_4 - x_3)$ — ①.

e.) To allow steam only
(To prevent the flow of condensed water.) — ①

f.) To mix the dry steam, avoiding water stagnation in the vertical pipe. — ①.

20.

Part II B Essay

1\. (a) Drag Force $\propto$ Velocity

$R_o \propto V$

$R_o = KV$ (1)

The Vehicle can achieve high velocity V'

$\therefore P = FV'$ (1) But $F = KV'$ (1)

$KV' = \frac{P}{V'}$

$V'^2 = \frac{P}{K}$ (1)

$= \frac{PV}{R_o}$

$V' = \sqrt{\frac{PV}{R_o}}$ (1)

(b)(i) Cross section area of the car - A say.

The volume of air that strikes on area A in 1 sec = AV V - velocity of car

The mass " " = $AV\rho$ ρ - density of air

$= 1 \times 20 \times 1.2$ (1)
$= 24\ kg$ (1) } (2)

(ii) rate of change of momentum of the air $= AV\rho(V - 0)$ (1)

$F = 24 \times 20 = 480N$ (1)

Force acts on the surface = 480N (1) } (3)

(iii) $W = F \times S$ (1)

$= 480 \times 100 \times 10^3$ (1)

$= 48\ MJ$ (1) } (3)

(iv) $P = FV$ (1)

$= 480 \times 20$ (1)

$= 9.6\ kW$ (1) } (3)

(V) out put energy used to overcome the air resistance consuming 1 lit. petrol $= \frac{40 \times 15}{100} = 6\ MJ$ (1)

$\therefore$ The amount of petrol used to work 48 MJ $= \frac{48}{6} = 8$ lit (1)

(VI) Power required to maintain the speed $30\ ms^{-1} = AV^2\rho V$

$P = AV^3\rho$ (1)

$P = 1 \times 30^3 \times 1.2 = 32.4 \text{ kW}$ (1) (1)

$\therefore$ Additional Power $= 32.4 - 9.6 = 22.8 \text{ kW}$ (1)

(VII) Energy required to cover 100 km distance at constant speed 30 ms^{-1} $= F \times s = AV^2\rho \times s$ (1)

$= 1 \times 30^2 \times 1.2 \times 10^5$ (1)

$= 108 \text{ MJ}$ (1)

The amount of Petrol required to obtain 108 MJ energy $= \frac{108}{6} = 18 \ \ell$ (1)

(viii) initial fuel efficiency $= \frac{100}{8} \text{ km } \ell^{-1}$ (1)

current fuel efficiency $= \frac{100}{18} \text{ km } \ell^{-1}$ (1)

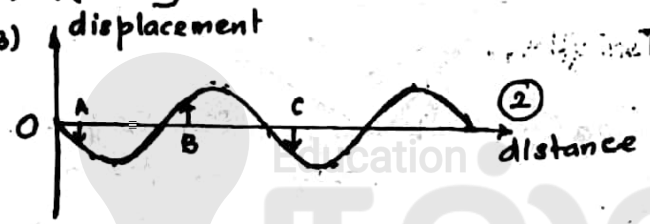
decrease of the fuel efficiency $= \left(\frac{100}{8} - \frac{100}{18}\right) \text{ km } \ell^{-1}$ (1)

$\simeq 7 \text{ km } \ell^{-1}$ (1)

2: (a) (i) → or ← (1)

(ii) (α) A - Negative, B - Positive, C - Negative (3)

(β)



(2) To indicate A, B and C positions (1)

(γ) decrease (1) In $V = f\lambda$, V-constant, f-increase therefore λ decrease (1)

(iii) $f = \frac{20}{5} = 4 \text{ Hz}$ (1) $\lambda = 1.2 \text{m}$ $V = f\lambda = 4 \times 1.2 = 4.8 \text{ ms}^{-1}$ (1) (1)

(iv) return as compression (2)

(b) (i) Simple Harmonic motion (2)

(ii) $A = 2.5 \text{ cm}$ (1)

(iii) $f = \frac{1}{15} = 0.067 \text{ Hz}$ (1)

(iv) $V = A\omega$ (1)

$= \frac{2.5}{100} \times 0.4$

$V = 0.01 \text{ ms}^{-1}$ (1)

$\omega = 2\pi f$ (1)

$= 2 \times 3 \times \frac{1}{15}$

$\omega = 0.4 \text{ rad s}^{-1}$ (1)

(v)

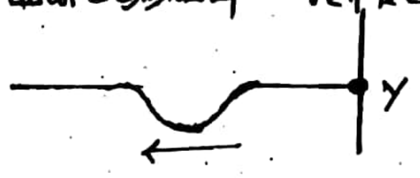
(2)

(vi) $V = f\lambda = \frac{1}{15} \times 0.3$ (1)

$= 0.02 \text{ ms}^{-1}$ (1)

(c) (i) வன்தெறிப்பு reflection at fixed end (Hard reflection) (2)

(ii)



(2)

3\. a)

Adjusting the astronomical telescope to appear the final image at infinity is called normal adjustment. (2)

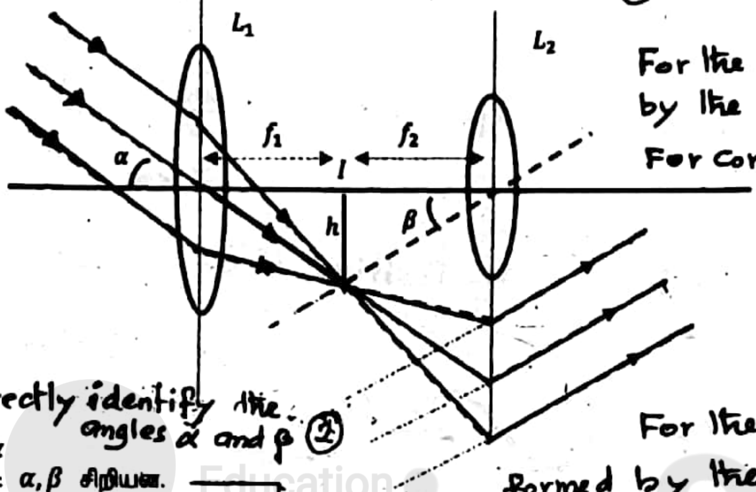
I. வானியல் தொலைகாட்டியின் இறுதிவிம்பம் முடிவிலியில் அமையுமாறு செப்பஞ் செய்தல் இயல்பான செப்பம் செய்கை எனப்படும்.

II. $M = \beta/\alpha$ (கோணத்தின் குறியீடுகள் அவசியமில்லை) (1)

β – இறுதிவிம்பம் கண்ணில் எதிரமைக்கும் கோணம். (Angle subtended at the eye by the final image) (1)

α – பொருள் கண்ணில் எதிரமைக்கும் கோணம்.

III. Angle subtended at the eye by the object (1)



For the first image formed by the objective. (1)

For correct labeling of hand I (1)

For the final image formed by the eye piece at infinity (1)

IV. For correctly identify the angles α and β (2)

V. $M = \beta/\alpha$

எடுகோள்: α, β சிறியன. → Assumption :- α, β small angles (1)

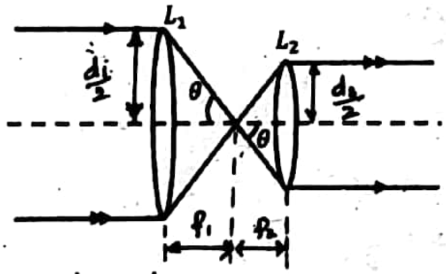
ஆகவே $M = \tan\beta/\tan\alpha$ (1)

$M = \dfrac{h/f_2}{h/f_1}$ (1)

$M = f_1/f_2$ (1)

VI.

1\.



(2)

2\. $\tan\theta = \dfrac{d_1/2}{f_1} = \dfrac{d_2/2}{f_2}$ (1)

$f_1/f_2 = d_1/d_2$ (1)

3. $M = f_1/f_2 = d_1/d_2$ ①

$\therefore 1500/f_2 = 180/15$ ①

$f_2 = 125\,mm$ ①

கருவியின் நீளம் $= f_1 + f_2$

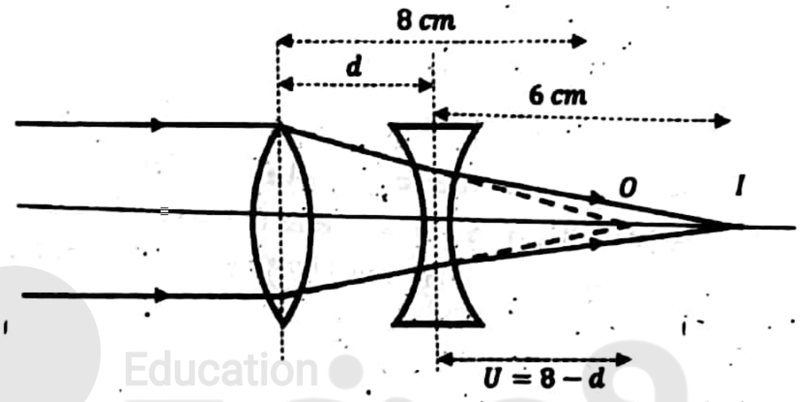
Length of the instrument $= 1500 + 125 = 1625\,mm = 1.625\,m$ ①

$M = f_1/f_2 = d_1/d_2$

கோணப்பெருக்கம் Angular magnification $M = 1500/125 = 12$ OR $M = 180/15 = 12$ ①

b)

I)



③

குழிவுவில்லைக்கு வில்லைச் சூத்திரத்தைப் பிரயோகிக்க. Using lens formula for concave lens

$\frac{1}{V} - \frac{1}{U} = \frac{1}{f}$ ①

குறிவழக்குடன் பிரதியிட

$-\frac{1}{6} + \frac{1}{8-d} = \frac{1}{10}$ ②

$\frac{d+6-8}{6(8-d)} = \frac{1}{10}$

$10(d-2) = 6(8-d)$

$16d = 68$

$d = 4.25\,cm$ ①

4. a) Heat capacity (Def^n) ②

Specific heat capacity (Def^n) ②

b)(i) $H = ms\Delta\theta$ ①

$= 0.5 \times 4200\,(100 - 30)$ ①

$= 2100 \times 70$

$= 147000\,J$

$= 147\,kJ$ ①

(ii) $P \cdot t = H$ (1)

$2\times10^3 \times t = 147\times10^3$

$t = 73.5\ s$ (1)

(iii) Always submerge the entire coil in water and transfer all the heat generated by the coil to the water (2)

(iv) When there is water in the kettle, the maximum temperature at which the coil reaches the boiling point of water (100 °C). Therefore the temperature of the coil does not reach its melting point so the coil does not damage. (1)

when there is no water, rate of heat produced by the coil is grater than rate of heat lost, it causes the temperature of the coil can reach melting point, therefore coil is melt (2)

(v) 1. 135 s (1)

2. Heat lost to the environment. (1)

The kettle receives heat (1)

3. $H = Pt$ (1)

$= 2000 \times 135$

$= 2.7\times10^5\ J$ (1)

4. Eefficiency $= \dfrac{\text{out put energy}}{\text{input energy}} \times 100\ \%$ (1)

$= \dfrac{147\times10^3}{2.7\times10^5}\times100\ \%$ (1)

$= 54.4\ \%$ (1)

5. To reduce heat transfer by radiation. (1)

6. The temperature gradient decreases in both regions. because as the temperature increases, the excess temperature of the kettle increase thus increasing the heat loss rate, therefore - decreasing the rate (1)

at which the water heats up, so decreasing the temperature gradient. (2)

7. Advantage :- 1) low heat lost to the environment
2) Heat capacity of the kettle negligible/ Heat absorbed by the kettle " " (2)
3. The electric shock doesn't occur.

(any two)

disadvantage:- 1) Plastic damage easily at high temperature.
2) when a plastic kettle containing water is heated the water becomes harmful to the body. (2)

(Any other relevant answer)

5. a) (i) For the circular motion of the satellite.

$$\frac{GMm}{(R_E+h_1)^2} = \frac{mV_0}{(R_E+h_1)}$$ (2)

$$V_0 = \sqrt{\frac{GM}{R_E+h_1}}$$ (1)

(ii) $V_0 = r\omega$ $\quad \omega = \frac{2\pi}{T}$

$$(R_E+h_1)\frac{2\pi}{T} = \sqrt{\frac{GM}{R_E+h_1}}$$ (2)

$$T = 2\pi(R_E+h_1)\sqrt{\frac{R_E+h_1}{GM}}$$ (1)

(iii) $$T = \frac{2\times 3\left[(6400+400)\times 10^3\right]^{3/2}}{(4\times 10^{14})^{1/2}}$$ (1)

$$T = 5.32 \times 10^3 \ s$$ (1)

b) (i) The gravitational potential at a point in a gravitational field is the work done to move an unit mass from infinity to the point. (2)

SI unit $J\,kg^{-1}$ (1)

(ii) $\Delta E = -\frac{GMm}{(R_E+h_2)} - \left(-\frac{GMm}{R_E}\right)$ (2)

$= GMm\left[\frac{1}{R_E} - \frac{1}{R_E+h_2}\right]$ $\qquad g = \frac{GM}{R_E^2}$ (1)

$= \frac{mgR_Eh_2}{(R_E+h_2)}$ (1)

(iii) Minimum work = Gravitational Potential energy + Kinetic energy

$= \frac{mgR_Eh_2}{(R_E+h_2)} + \frac{1}{2}m\frac{GM}{(R_E+h_2)}$ (2)

$= \frac{mgR_E}{R_E+h_2}\left[h_2 + \frac{R_E}{2}\right]$

$= \frac{4\times10^5\times10\times6400\times10^3}{6808\times10^3}\left[408 + \frac{6400}{2}\right]\times10^3$ (1)

$= 1.3567\times10^{13}$

$= 1.36\times10^{13}\,J$ (1)

c (i) $V_{rms} = \sqrt{\frac{3RT}{M}}$ (1) Where R is the universal gas constant
T is the Temperature in kelvin of gas
M is the molar mass of gas (1)

(ii) $V_{rms} = \sqrt{\frac{3\times8.3\times300}{32\times10^{-3}}}$ (1)

$= 4.83\times10^2\,ms^{-2}$ (1)

(iii) $V_e = \sqrt{\frac{2GM}{R}}$ (1)

$g = \frac{GM}{R^2}$ (1)

$V_e = \sqrt{2gR}$ (1)

(iv) $V_e = \sqrt{2 \times 10 \times 6400 \times 10}$

$V_e = 11.31\ kms^{-1}$ (1)

(v) $V_{rms} = 4.83 \times 10^2\ ms^{-1}$

$\therefore 6\ V_{rms} = 2.9 \times 10^3\ ms^{-1}$ (1)

$= 2.9\ kms^{-1}$

ஆனால் $V_e = 11.31\ kms^{-1}$

$\therefore 6\ V_{rms} < V_e$ (1)

$\therefore$ oxygen (O_2) is present in the earth's atmosphere (1)

6. a) (i) $E = \frac{\sigma}{\epsilon_0}$ (2)

(ii) $\sigma \propto 1/R$ (2) R - radius of curved surface

(iii) Molecules in the atmosphere (air) are ionized by the high electric field caused by lightning, and the resulting ions (Positive/negative) travel in the direction of the electric field / opposite and reach (opposite charge for the charge on) the Conductor. (2)

Doesn't occur in a vacuum (1)

(iv) In the case of ions formed by the ionization of air the charges with the sign of the charge in the cloud are discharged through lightning Conductor to the earth quickly.

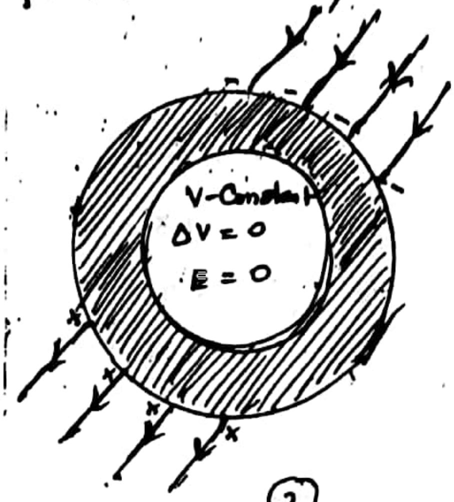
To reduce the effective electrical resistance of the conductor compaired to buildings and trees. (3)

To prevent buildings from being damaged by - lightning

-8-

(v) Lines of electric field don't go into the closed conductor so the electric field intensity inside the car is zero. (2)

(vi) Lines of electric field don't go inside the conductor, therefore the electricfield intensity in the conductor and inside the conductor is zero thus the electric potential difference is zero so the current inside conductor is zero which is electrostatic shielding.



(2)

b)

(i) $C = \frac{A\epsilon_0}{d}$ (2)

(ii) $U = \frac{1}{2}CV^2$

$V = \frac{(Q/2)}{C}$

$U = \frac{1}{2} \times \frac{Q^2}{4C}$

$U = \frac{Q^2 d}{8A\epsilon_0}$ (2)

+Q charge in both side of the plate so charge remains one side of the plate is +Q/2

(iii) $V = \frac{Q/2}{C}$

$= \frac{Qd}{2A\epsilon_0}$ (2)

(iv) $E = \frac{V}{d} = \frac{Q}{2A\epsilon_0}$ (1)

If some students assume that one side of the plate contains charge Q, then award follow the marks

(ii) $U = \frac{Q^2 d}{2A\epsilon_0}$ (1)

(iii) $V = \frac{Qd}{A\epsilon_0}$ (1)

(iv) $E = \frac{Q}{A\epsilon_0}$ (1)

c)

(i) $V = \frac{80 \times 500}{3000 \times 2000 \times 8.85 \times 10^{-12}}$ (1)

$= 7.53 \times 10^{8}$ V (1)

(ii) $E = \frac{V}{d} = \frac{7.53 \times 10^{8}}{500}$ (1)

$\simeq 1.51 \times 10^{6}\ V m^{-1}$ (1)

$\therefore E < 3 \times 10^{6}\ V m^{-1}$ So the lightning strike will not occur. (1)

(iii) 1. The distance between the clouds and the top of the tower/building decrease so the value of electric field can also increase more than $3 \times 10^6 \, V m^{-1}$. ①

2. The top of the tower can act as a sharp edge, therefore increasing the surface charge density can also increase the value of electric field more than $3 \times 10^6 \, V m^{-1}$. ①

(iv) $U = \frac{Q^2}{2C} = \frac{80^2 \times 500}{2 \times 6 \times 10^6 \times 8.85 \times 10^{-12}}$ ①

$U = 3.01 \times 10^{10} \, J$ ①

7. (a) (i) $F = BIl \sin\theta$ ②

$F_{AB} = NBIa$ ②

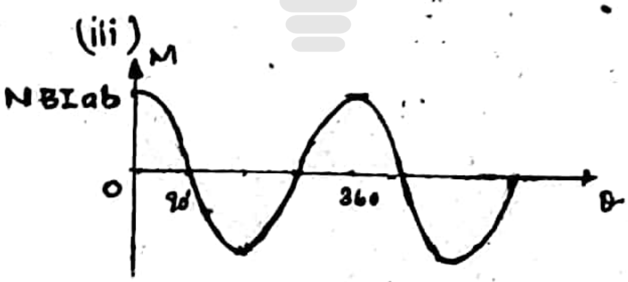
$F_{BC} = NBIb \sin\theta$ ②

(ii) $M = \text{Force} \times \perp^r \text{distance}$ ①+① for each term.

$= F_{AB} \times b \cos\theta$

$= NBIab \cos\theta$ ②

(iii)



Shape ②

max^m value ①

b) (i) $M = NBIab$ ②

(ii) $M = \tau$

$NBIab = C\theta$ ①

$\theta = \left(\frac{NBab}{C}\right) I$ $\left[\frac{NBab}{C} \text{ constant}\right]$ ①

$\theta \propto I$ ①

(iii) A small resistance will be connected as a shunt resistance. ②

c) (i) upwards (2)

towards the scale (2)

(ii) Equating the moment

$mg\,\Delta x = NBIab$ (1)

$B = mg\Delta x / NIab$ (1)

(iii) 1. Δx will be doubled (2)

2. Δx will be doubled (2)

Part - I
பகுதி I

1) 4	11) 1	21) 4	31) 5	41) 2
2) 3	12) 4	22) 5	32) 1	42) 4
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9) 4	19) 2	29) 1	39) 1	49) 1
10) 2	20) 4	30) 3	40) 3	50) 5

எங்கள் குறிக்கோள்

எண்ணிம உலகத்தில் மாணவர்களிற்கென சிறந்ததொரு கற்றல் கட்டமைப்பை உருவாக்குதல்.

அனைத்தும் டிஜிட்டல் மயப்படுத்தப்பட்ட இந்த காலத்தில் பல்வேறு துறைகளும் கால ஓட்டத்துடன் இணைந்து டிஜிட்டல் தளத்தில் பல்கிப்பெருகி வருகின்றன. அந்த வகையில் கல்வித்துறையும் இதற்கு விதிவிலக்கல்ல. இணையவழி கல்வியின் மூலம் கலவித்துறை புதியதொரு பரிமாணத்தை எட்டியுள்ளது. குறிப்பாக கொரோனா பேரிடர் காலத்தில் நாடே முடக்கப்பட்டிருந்தது. இதனால் மாணவர்களிற்கும் பாடசாலை, கல்வி நிறுவனங்களிற்கு இடையிலான தொடர்பு துண்டிக்கப்பட்டது. அந்த இக்கட்டான சூழ்நிலையில் இணையவழி வகுப்புகள் மாணவர்களிற்கு வரப்பிரசாதமாக அமைந்தது என்பதே உண்மை.

இன்று தொழில்நுட்பம் மாணவர்களை தவறான பாதைக்கு இட்டு செல்வதாக ஓர் எண்ண ஓட்டம் மக்கள் மத்தியில் உள்ளது. தொழில்நுட்பம் என்பது ஒரு கருவி மட்டுமே அதை எவ்வாறு பயன்படுத்துகிறோம் என்பதில் அதன் ஆக்க மற்றும் அழிவு விளைவுகள் தீர்மானிக்கப்படுகிறது. உளியை கொண்டு சிலையை செதுக்க நினைத்தால் அவன் நிச்சயம் சிற்பி ஆகலாம். இங்கு பிரச்சினையாக காணப்படுவது மாணவர்களை வழிப்படுத்த தொழில்நுட்ப உலகில் ஓர் முறையான கட்டமைப்பு இல்லாமையே. அதை உருவாக்குவதே எங்கள் நோக்கம். அதை நோக்கியே எங்கள் பயணம் அமையும்.