



**வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
தொண்டைமாளாறு வெளிக்கள நிலையம் நடாத்தும்
தவணைப் பரீட்சை, மார்ச் - 2020**

**Conducted by Field Work Centre, Thondaimanaru
In Collaboration with Provincial Department of Education Northern Province
Term Examination, March - 2020**

தரம் :- 13 (2020)

பெளதிகவியல்

புள்ளித்திட்டம்

பகுதி I

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



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Physics

Marking Scheme

01. a) i) When a body is partly or fully immersed in a fluid at rest, the apparent loss in weight experienced by the body is equal to the weight of the fluid displaced by it. (02)

ii) Floating of big ships / submarines
- Determination of relative density of substances.
- Determining the purity of gold.
- Hot-air-balloon
- Hydrometer
- Swim bladder in fish
} For any two applications (02)

c) $W_1 = 321.2 \text{ g}$ (02)

d) $W_2 = 256.4 \text{ g}$ (02)

e) $\frac{P_{\text{stone}}}{P_{\text{water}}} = \frac{W_1}{W_1 - W_2}$ (02)

f) $\frac{P_{\text{stone}}}{P_{\text{water}}} = \frac{321.2}{321.2 - 256.4} = \frac{321.2}{64.8} = 4.95 \approx 5$ (02)

g) $W_3 = 272.2 \text{ g}$ (02)

h) $\frac{P_{\text{liquid}}}{P_{\text{water}}} = \frac{W_1 - W_3}{W_1 - W_2}$ (02)

i) $\frac{P_{\text{liquid}}}{P_{\text{water}}} = \frac{321.2 - 272.2}{321.2 - 256.4} = \frac{49.0}{64.8} = 0.756 \approx 0.76$ (02)

j) The errors due to: (i) weight of the thread.
(ii) absorption of water by the stone will change the reading. (02)

TOTAL MARKS (20)

02. a) Mass of air (0)
Temperature of air (0) (02)

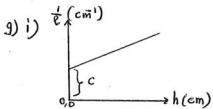
b) Slowly (0)
To maintain the temperature at constant value. (0) (02)

c) $V = aL$ ① → (02)
 $P = (H + x \frac{h}{L}) \rho g$ ① →

d) Steadily change the inclination of the tube, and measure the values of h and l ①

e) $(H + x \frac{h}{L}) \rho g \cdot aL = k$, where k is a constant. ①

f) $\frac{1}{l} = (\frac{x \rho g a}{kL}) \cdot h + (\frac{H \rho g a}{k})$ ②
 $\downarrow y = \downarrow m \quad \downarrow x + \downarrow c$



For straight line graph ① (02)
 Labelling of axes with units ①

ii) Atmospheric pressure can be obtained by dividing the intercept by the gradient and by substituting the values of x and L ②

iii) $H = \frac{c \cdot x}{m \cdot L}$ ①
 $= \frac{0.05}{1.64 \times 10^{-4}} \times \frac{10}{40}$ ①
 $= 76.25 \text{ cm Hg}$ ①

iv) When the tube is horizontal, $h = 0$
 $\therefore \frac{1}{l} = \text{Intercept}$ ①

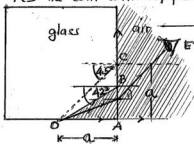
$\therefore l = \frac{1}{\text{Intercept}}$
 $= \frac{1}{0.05 \text{ cm}^{-1}}$
 $= 20 \text{ cm}$ ①

v) Not possible ①
 The pressure exerted by the mercury thread will be small. By changing the inclination of the tube, the readings obtained for the length of air column will not have wider range of values. ① (02)

TOTAL MARKS (20)

- Q3 a) • The ray of light must travel from optically denser medium to an optically less dense medium, and
 • that the angle of incidence must be greater than the critical angle.

b) i) Yes the coin will appear to him

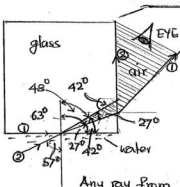


(For a detail diagram) 02

This is possible, because any ray of light from the coin D, reaching the section AB of the vertical face, will have angle of incidence less than 42° . Hence the ray will refract and emerge out into the air.

(For a detail diagram) 02

ii)



$$\frac{4}{3} \sin 90^\circ = \frac{3}{2} \sin c$$

$$\sin c = 0.8889$$

$$c \approx 63^\circ$$

$$\frac{4}{3} \sin i_w = \frac{3}{2} \sin 48^\circ$$

$$\sin i_w = \frac{9}{8} \times \sin 48^\circ$$

$$= 0.8360$$

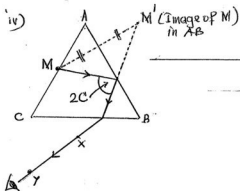
$$i_w \approx 57^\circ$$

Any ray from the coin within the film of water having an angle of incidence ranging from 57° to 90° will pass through the shaded area and finally into the air, hence the boy will be able to see the image of the coin.

c) i) To prevent the refraction of light at face AC, so that the image of M by the reflection at face AB can be located at equal distance. 02

ii) The bright image of M is expected to appear for some time and will either suddenly disappear or becomes extremely faint when reaching a certain position. 02

iii) Fix the two pins X and Y, one at a time, to be in a line with the image of M appearing inside face AB, at the moment the image of M disappearing as stated in c(ii). 02



02

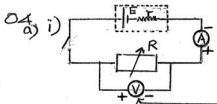
v) Twice the critical angle for glass is obtained ($= 2C$)

01

For marking the angle $2C$ in the above figure

01

TOTAL MARKS 20



For marking + and -

01

For marking + and -

01

ii) Rheostat (as its value is not needed)

01

iii) $E = 1.5V$
 $r = 0.5\Omega$

01

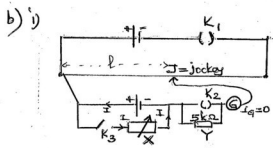
01

iv) Potentiometer doesn't draw current from the circuit as it measures potential drop using null deflection method.

01

Sensitivity can be increased by decreasing the potential drop per unit length of the potentiometer.

01



For marking X

01

For marking Y

01

For completing the circuit

02

ii) X = resistance box, because its values to be known. (01)

iii)
$$\left. \begin{aligned} E &= k l_0 \\ IR &= k l \\ I &= \frac{E}{R+l} \end{aligned} \right\} \Rightarrow l_0 R = l(R+l) \quad \text{One mark for each equation} \quad (04)$$

iv)
$$\frac{1}{P} = \frac{Y}{l_0} \cdot \frac{1}{R} + \frac{1}{l_0} \quad (02)$$

$$\downarrow \quad \quad \quad \downarrow \quad \quad \quad \downarrow \quad \quad \quad \downarrow$$

$$y = \frac{1}{m} = \frac{1}{x} + \frac{1}{c}$$

- v) (1) ✓ (01)
(2) ✓ (01)
(3) —
(4) —

TOTAL MARKS

20

PHYSICS II B

05. a) i) Time taken = $\frac{4.8 \times 10^3 \text{ m}}{16 \text{ m s}^{-1}} = 3 \times 10^2 \text{ s} \quad (1 + 1) \quad (2)$

ii) Work against gravity = $1.2 \times 10^4 \text{ N} \times 0.3 \times 10^3 \text{ m} \quad (1)$
 $= 3.6 \times 10^6 \text{ J} \quad (1)$

iii) Work against friction = $5.0 \times 10^2 \text{ N} \times 4.8 \times 10^3 \text{ m} \quad (1)$
 $= 2.4 \times 10^6 \text{ J} \quad (1)$

Minimum power = $\frac{\text{total work done}}{\text{time taken}} \quad (1)$
 $= \frac{3.6 \times 10^6 + 2.4 \times 10^6}{3 \times 10^2} \quad (1)$
 $= 2.0 \times 10^3 \text{ W} \quad (1)$

b) i) Resultant force down the plane = $1.2 \times 10^4 \times \frac{0.3}{6.4} - 5.0 \times 10^2 \quad (2)$
 $= 62.5 \text{ N} \quad (1)$

Acceleration = $\frac{62.5}{1.2 \times 10^3} \quad (2)$
 $\approx 5.2 \times 10^{-2} \text{ m s}^{-2} \quad (1)$

ii) $v^2 = u^2 + 2as \quad (1)$
 $= 0 + 2 \times 5.2 \times 10^{-2} \times 6.4 \times 10^3 \quad (1)$
 $= 665.6 \text{ (m s}^{-1}\text{)}^2 \quad (1)$

$v = \sqrt{665.6} \approx 25.8 \text{ m s}^{-1} \quad (1)$

iii) Frictional force = weight component down the plane (1)
 $= 1.2 \times 10^4 \times \frac{0.3}{6.4} \quad (1)$
 $= 562.5 \text{ N} \quad (1)$

d) $\Delta f = (51.25 - 50.80) \text{ kHz}$
 $= 0.45 \text{ kHz} = 450 \text{ Hz}$ _____ (01)

$v = \frac{c \cdot \Delta f}{2 \cdot f}$
 $= \frac{340 \times 450}{2 \times 50.80}$
 $= 1506 \text{ m s}^{-1}$ _____ (01)

ii) The reflection of wave occurs only when the wavelength is smaller or almost same size as the object. _____ (01)

e) i) $f = \frac{1}{T}$ _____ (01)
 $= \frac{1}{0.50}$
 $= 2 \text{ Hz}$ _____ (01)

ii) The amplitude of the oscillation decreases with time. _____ (01)

iii) Force on each wheel spring = $\frac{7500 \text{ N}}{4}$
 $= 1875 \text{ N}$ _____ (01)

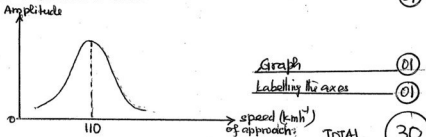
$k = \frac{F}{x}$ _____ (01)
 $= \frac{1875 \text{ N}}{12 \times 10^{-2} \text{ m}}$
 $= 15625 \text{ N m}^{-1}$ _____ (01)

iv) The frequency of the periodical driving force must be equal to the natural frequency of vibrating object. _____ (01)

v) $110 \text{ km h}^{-1} = \frac{110 \times 10^3 \text{ m}}{60 \times 60 \text{ s}}$ _____ (01)
 $= 30.56 \text{ m s}^{-1}$ _____ (01)

$v = f \lambda$ _____ (01)
 $\lambda = \frac{v}{f}$
 $= \frac{30.56 \text{ m s}^{-1}}{2 \text{ s}^{-1}}$
 $= 15.28 \text{ m}$ _____ (01)

\therefore Distance between crests = 15.28 m _____ (01)



TOTAL MARKS

30

07 a) A = proportional limit } (2) each. (06)
 B = elastic limit }
 C = breaking point. }

Distinguishing A & B. (02)

b) i) Young's modulus of steel, $Y_s = \frac{3 \times 10^8}{1.5 \times 10^{-3}} = 2 \times 10^{11} \text{ Nm}^{-2}$ (02)

Young's modulus of copper $Y_c = \frac{2 \times 10^8}{2 \times 10^{-3}} = 1 \times 10^{11} \text{ Nm}^{-2}$ (02)

ii) Max. load for steel wire = stress \times area of cross-section (without exceeding proportion limit) $= 3 \times 10^8 \times 0.8 \times 10^{-6} = 240 \text{ N}$ (02)

Max. load for copper wire $= 2 \times 10^8 \times 0.8 \times 10^{-6} = 160 \text{ N}$ (02)

iii) Max. load on composite wire $= 160 \text{ N}$ (01)

c) Force on a wire $F = \frac{AYe}{l}$ (01)

Each wire extends by 1mm - award marks for identifying this
 $F = \frac{0.8 \times 10^{-6} \times 2 \times 10^{11} \times 1 \times 10^{-3}}{2} = 80 \text{ N}$ (01)

Weight to be placed at the centre $= 80 \text{ N} \times 4 = 320 \text{ N}$ (02)

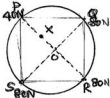
\therefore The mass to be placed at the centre $= 32 \text{ kg}$. (01)

d) i) Force required to extend Cu wire 1mm be F_{Cu} .
 $F_{Cu} = \frac{0.8 \times 10^{-6} \times 1 \times 10^{11} \times 1 \times 10^{-3}}{2} = 40 \text{ N}$ (02)

Force on steel wire $F_s = 80 \text{ N}$ [from section (c)]

$\frac{F_{Cu}}{F_s} = \frac{40 \text{ N}}{80 \text{ N}} = \frac{1}{2}$
 $F_{Cu} : F_s = 1 : 2$ (01)

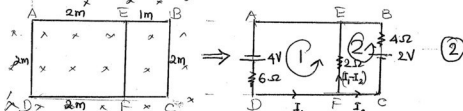
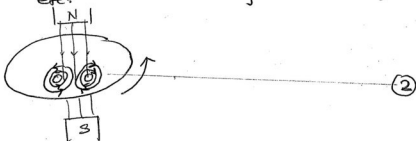
ii) Load required $= 3 \times 80 \text{ N} + 40 \text{ N} = 280 \text{ N}$ or 28 kg (01)

iii)  By symmetry the resultant of the 4 forces will pass through the point X on diagonal PR. (01)

Taking moments about point P.
 $280 \times PX = 80 \times PR + 2 \times 80 \times \frac{1}{2} PR$
 $280 \times PX = 80 \times 15 + 2 \times 80 \times \frac{15}{2}$
 $PX = 8.57 \text{ cm}$ (02)

- 8 i) Faradays law of electromagnetic induction (statement) — (2)
- ii) Lenz's law (statement) — (2)
- iii) Total number of magnetic flux lines passing through a given area at right-angle to its surface. — (2)
- iv) Normal ^{magnetic} flux per unit area. — (2)
- v. (a) Magnetic flux density
 (b) The speed of the conductor
 (c) The number of turns } One mark each — (3)
- vi) When a conductor passes through a magnetic field or when it is kept in a varying magnetic field, there will be induced cyclic currents in the conductor. These currents are called eddy currents. — (2)

- VI. — Vehicle's speedometer
 — Magnetic levitation trains
 — Brake system
 — Electric saw/drill for emergency shut-off
 — Cancer treatment.
 — Induction welding etc. } For any two from this or any other two (one mark each) — (2)



Induced e.m.f. in closed circuit ① = $2 \times 2 \times 1 = 4V$
 " " " " " ② = $2 \times 1 \times 1 = 2V$ } One mark each — (2)

$$\Sigma E = \Sigma IR \text{ for closed circuit (1)}$$

$$4 = 6I_1 + 2(I_1 - I_2)$$

$$2 = 4I_1 - I_2 \quad \text{--- (i)}$$

$$\Sigma E = \Sigma IR \text{ for closed circuit (2)}$$

$$2 = 4I_2 - 2(I_1 - I_2)$$

$$1 = -I_1 + 3I_2 \quad \text{--- (ii)}$$

$$(i) + 4(ii) \Rightarrow 6 = 11I_2$$

$$\therefore I_2 = \frac{6}{11} \text{ A Current in BE} \quad \text{--- (1)}$$

$$ii) \Rightarrow I_1 = 3I_2 - 1$$

$$= 3 \times \frac{6}{11} - 1$$

$$= \frac{7}{11} \text{ A Current in AE} \quad \text{--- (1)}$$

$$I_1 - I_2 = \frac{7}{11} - \frac{6}{11} = \frac{1}{11} \text{ A Current EF} \quad \text{--- (1)}$$

TOTAL MARKS

30

09 A a) i) $E = \frac{W}{q}$

$$= \frac{J}{C} \quad \text{--- (2)}$$

ii)

$$W = Eq$$

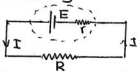
$$\frac{W}{t} = \frac{Eq}{t}$$

$$P = EI$$

① mark each

③

b)



$$I = \frac{E}{R+r} \quad \text{--- (1)}$$

Total energy dissipated in the circuit in time t = EIt --- (1)

$$= E \cdot \frac{E}{R+r} \cdot t$$

$$= \frac{E^2}{R+r} t \quad \text{--- (1)}$$

c) i) $P = VI$ --- (1)

$$I = \frac{10}{20} = 0.5 \text{ A} \quad \text{--- (1)}$$

2) For the cell, $V = E - Ir$ --- (1)

$$20 = 24 - 0.5r$$

$$r = 8 \Omega \quad \text{--- (1)}$$

3) $P = EI$ --- (1)

$$= 24 \times 0.5$$

$$= 12 \text{ W} \quad \text{--- (1)}$$

i) 1) $P = \frac{V^2}{R}$ _____ (1)

$\therefore R = \frac{V^2}{P} = \frac{(12)^2}{6} = 24 \Omega$ _____ (1)

2) $I = \frac{E}{R+r}$ _____ (1)

$= \frac{24}{24+24}$ _____ (1)

$= \frac{24}{48} = 0.5 \text{ A}$ _____ (1)

3) The power supplied to the circuit = Power supplied by the cell - Power dissipated in the cell _____ (1)

$= EI - I^2 r$ _____ (1)

$= 24 \times 0.5 - 0.36 \times 2$ _____ (1)

$= 14.4 - 2.88$ _____ (1)

$= 11.52 \text{ W}$ _____ (1)

iii) The current through L_1 (bulb) = $\frac{P}{V}$ _____ (1)

$= \frac{6}{12}$ _____ (1)

$= 0.5 \text{ A}$ _____ (2)

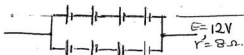
2) As the fan rotates, a back e.m.f. is induced in the fan's coil. Hence, the current is reduced. _____ (2)

3) $I = \frac{E - e}{r}$ $e = \text{back e.m.f.}$ _____ (1)

$0.5 = \frac{24 - e}{40}$ _____ (1)

$e = 4 \text{ V}$ _____ (1)

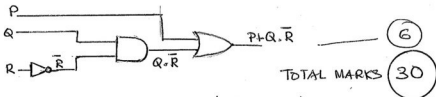
d) _____ (1)



8 cells _____ (1)

09 B

TOTAL MARKS (30)



- 10 a) i) By reducing the volume (increasing the pressure) } 0 mark each (03)
 By reducing the temperature
 By adding more liquid.

ii) Dew point is the temperature to which air must be cooled just to make it saturated (02)

iii) R.H = $\frac{\text{s.v. P of water at dew point}}{\text{s.v. P of water at room temperature}} \times 100\%$ (02)

- b) i) i) Let the partial pressure of water vapour in the cylinder at 20°C be = p
 $\frac{p}{1.75} \times 100 = 60$ (1)
 $p = \frac{6 \times 17.5}{10} \text{ mmHg}$
 $= 10.5 \text{ mmHg}$ (1)
 From the given tables, dew point = 15°C (1) } (03)

- ii) Applying $PV = nRT$ to the unsaturated water vapour
 $10.5 \times 10^{-3} \times 13600 \times 10 \times 1 = \frac{m}{18 \times 10^{-3}} \times 8.31 \times 293$ (1)
 $m = \frac{10.5 \times 136 \times 180 \times 10^3}{293 \times 8.31}$
 $= 10.557$
 $\approx 10.56 \text{ g}$
 \therefore Absolute Humidity = 10.56 g m^{-3} (1) } (2)

- 2 For the unsaturated vapour: $P_1 V_1 = P_2 V_2$
 $10.5 \times 1 = P_2 \times 0.6$ (1)
 $P_2 = \frac{10.5}{0.6}$
 $P_2 = 17.5 \text{ mmHg}$ (1)
 \therefore Absolute Humidity = 10.56 g m^{-3} (1)
 Relative humidity = 100% (1)
 Dew point = 20°C (1) } (5)

3) Let the mass of the water vapour now be = m_1

$$17.5 \times 10 \times 13660 \times 10 \times 0.25 = \frac{m_1}{18 \times 10^{-3}} \times 8.31 \times 293 \quad \text{--- (1)}$$

$$m_1 = \frac{17.5 \times 18 \times 136 \times 0.25 \times 10^{-3}}{8.31 \times 293}$$

$$= 4.299 \times 10^{-3} \text{ kg} \quad \text{--- (1)}$$

$$\approx 4.40 \text{ g} \quad \text{--- (1)}$$

\therefore The mass of water vapour condensed = $10.56 - 4.40$

$$= 6.16 \text{ g} \quad \text{--- (1)}$$

4) Let the mass of water vapour required to saturate the air at 20°C be = M

$$\therefore \frac{10.56 \times 100}{M} = 60 \quad \text{--- (1)}$$

$$M = \frac{10.56}{6} \times 10 \text{ g} \quad \text{--- (1)}$$

\therefore Present R.H = $\frac{m_1}{M} \times 100\%$

$$= \frac{4.4 \times 6}{10.56 \times 10} \times 100\% \quad \text{--- (2)}$$

$$= 25\% \quad \text{--- (1)}$$

OR.

Let the partial pressure of the water vapour at 20°C be = P

$$P \times 1 = \frac{4.4}{18} \times \frac{8.31 \times 293}{13660 \times 10 \times 10^{-3}} \quad \text{--- (2)}$$

$$P = 4.376 \text{ mmHg} \quad \text{--- (1)}$$

$$\therefore \text{Present R.H} = \frac{4.376}{17.5} \times 100\% \quad \text{--- (1)}$$

$$\approx 25\% \quad \text{--- (1)}$$

5) i) When the process is slowly carried out, the temperature of the system will remain constant.

$$\therefore \Delta U = 0 \quad \text{--- (2)}$$

ii) When the process is rapidly carried out, the process is called adiabatic process. Therefore $\Delta Q = 0$

When volume decreases $\Delta W < 0 \therefore \Delta U > 0$

Hence the temperature of the system will increase

TOTAL 30