வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
தொண்டைமானாறு 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

FWC

தரம் :- 13 (2020)	பௌதிகவியல்	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

வடமாகாணக் கல்வித் திணைக்களத்துடன் இணைந்து
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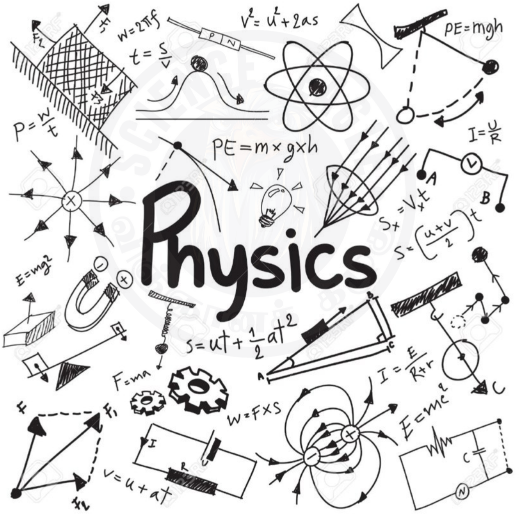
Grade - 13 (2020) **Physics** **Marking Scheme**



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 the. —— (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) $W_1 = 321.2\,g$ —— (02)

d) $W_2 = 256.4\,g$ —— (02)

(e) $\frac{\rho_{stone}}{\rho_{water}} = \frac{W_1}{W_1 - W_2}$ —— (02)

(f) $\frac{\rho_{stone}}{\rho_{water}} = \frac{321.2}{321.2 - 256.4} = \frac{321.2}{64.8} = 4.95 \simeq 5$ —— (02)

g) $W_3 = 272.2\,g$ —— (02)

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

i) $\frac{\rho_{liquid}}{\rho_{water}} = \frac{321.2 - 272.2}{321.2 - 256.4} = \frac{49.0}{64.8} = 0.756 \simeq 0.76$ —— (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 —— ①
Temperature of air —— ① (02)

b) Slowly —— ①
To maintain the temperature at constant value. —— ① (02)

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

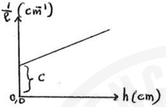
d) Slowly change the inclination of the tube, and measure the values of h and l. → 01

e) $(H + x\frac{h}{L})\rho g \cdot al = k$, where k is a constant. → 01

f) $\frac{1}{l} = \left(\frac{x\rho g a}{kL}\right) \cdot h + \left(\frac{H\rho g a}{k}\right)$ → 02

$y = m x + c$

g) i)



For straight line graph —— 1
Labelling of axes with units —— 1 → 02

ii) Atmospheric pressure can be obtained by dividing the intercept by the gradient and by substituting the values of x and L. → 02

iii) $H = \frac{c}{m} \cdot \frac{x}{L}$

$= \frac{0.05}{1.64 \times 10^{-4}} \times \frac{10}{40}$ → 01

$= 76.25$ cm Hg. → 01

iv) When the tube is horizontal, $h = 0$

$\therefore \frac{1}{l} = \text{Intercept}$ → 01

$\therefore l = \frac{1}{\text{Intercept}}$

$= \frac{1}{0.05 \text{ cm}^{-1}}$

$= 20$ cm → 01

v) Not possible —— 1

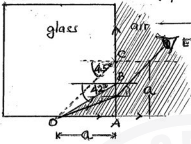
The pressure excerted by the mercury thread will be small. By changing the inclination of the tube, the readings obtained for the length of air coloumn will not have wider range of values. —— 1 → 02

TOTAL MARKS 20

Q3 a) • The ray of light must travel from optically denser medium to an optically less dense medium, and — (01)

• That the angle of incidence must be greater than the critical angle. — (01)

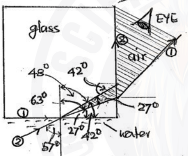
b) i) Yes the coin will appear to him. — ( )



(For a detail diagram) — (02)

This is possible, because any ray of light from the coin O, reaching the section AB of the vertical face, will have angle of incidence less than 42^0. Hence the ray will refract and emerge out into the air. — (01)

ii)



(For a detail diagram) — (02)

$\frac{4}{3}\sin 90^0 = \frac{3}{2}\sin c$

$\sin c = 0.8889$

$c \simeq 63^0$ — (01)

$\frac{4}{3}\sin i_w = \frac{3}{2}\sin 48^0$

$\sin i_w = \frac{9}{8} \times \sin 48^0$

$= 0.8360$

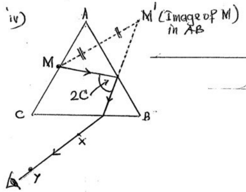
$i_w \simeq 57^0$ — (01)

Any ray from the coin within the film of water having an angle of incidence ranging from 57^0 to 90^0 will pass through the shaded area and finally into the air. Hence the boy will be able to see the image of the coin. — (01) ( )

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 extreemly 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 dissappearing as stated in c(ii) — (02)

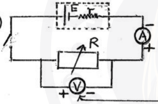
iv) 

(02)

v) Twice the critical angle for gas is obtained (= 2C) (01)

For marking the angle 2C in the above figure (01)

TOTAL MARKS (20)

04 a) i) 

For marking + and − (01)

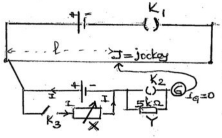
For marking + and − (01)

ii) Rheostat
(as its value is not needed) (01)

iii) $E = 1.5V$ (01)
$r = 0.5\Omega$ (01)

iv) Potentiometer dosen'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)

b) i) 

For marking X (01)
For marking Y (01)
For completing the circuit (02)

ii) X = resistance box, because it's values to be known. ——— (01)

iii) $\left.\begin{array}{l} E = k l_0 \\ IR = kl \\ I = \dfrac{E}{R+r} \end{array}\right\} \Rightarrow l_0 R = l(R+r)$ One mark for each equation ——— (04)

iv) $\dfrac{1}{l} = \dfrac{r}{l_0} \cdot \dfrac{1}{R} + \dfrac{1}{l_0}$ ——— (02)

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

$y = m \; x + c$

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

TOTAL MARKS (20)

PHYSICS IIB

05. a) i) Time taken $= \dfrac{4.8\times10^{3}\,m}{16\,ms^{-1}} = 3\times10^{3}\,s$ ——— ① + ① ——— (2)

ii) Work against gravity $= 1.2\times10^{4}\,N \times 0.3\times10^{3}\,m$ ——— (1)
$= 3.6\times10^{6}\,J$ ——— (1)

iii) Work against friction $= 5.0\times10^{2}\,N \times 4.8\times10^{3}\,m$ ——— (1)
$= 2.4\times10^{6}\,J$ ——— (1)

Minimum power $= \dfrac{\text{total work done}}{\text{time taken}}$ ——— (1)
$= \dfrac{3.6\times10^{6} + 2.4\times10^{6}}{3\times10^{3}}$ ——— (1)
$= 2.0\times10^{3}\,W.$ ——— (1)

b) i) Resultant force down the plane $= 1.2\times10^{4} \times \dfrac{0.3}{6.4} - 5.0\times10^{2}$ ——— (2)
$= 62.5\,N$ ——— (1)

Acceleration $= \dfrac{62.5}{1.2\times10^{3}}$ ——— (2)
$\simeq 5.2\times10^{-2}\,ms^{-2}$ ——— (1)

ii) $v^2 = u^2 + 2as$ ——— (1)
$= 0 + 2\times5.2\times10^{-2}\times6.4\times10^{3}$ ——— (1)
$= 665.6\,(ms^{-1})^2$

$v = \sqrt{665.6} \simeq 25.8\,ms^{-1}$ ——— (1)

iii) Frictional force = weight component down the plane ——— (1)
$= 1.2\times10^{4} \times \dfrac{0.3}{6.4}$
$= 562.5\,N$ ——— (1)

c) i) Acceleration of car B $= \frac{15\ ms^{-1}}{5s} = 3\ ms^{-2}$ .... (1)

ii) Distance between A & B $= 10 \times 5\ m - \frac{1}{2} \times 5 \times 15\ m$ .... (1)

$= 12.5\ m$ .... (1)

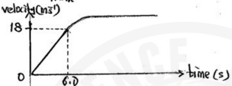
iii) 1) $9000 - F = 1500 \times 3$ .... (1)

$\therefore$ frictional force $F = 4500\ N$ .... (1)

2) As velocity increases, the drag due to air will increase. Therefore, to have constant acceleration pull of the engine must increase .... (1)

3) $\frac{V_{max}}{6} = 3$ (from graph of B)

$V_{max} = 18\ ms^{-1}$ .... (1)



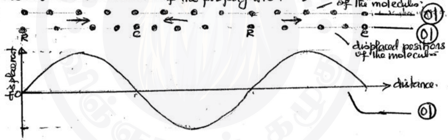
For labelling the axes and values (1)

Correct shape of the graph (2)

TOTAL MARKS 30

06. a) i) In sound waves, the molecules of the medium vibrate in the direction of the propagation .... (01)

ii)



b) $\lambda = \frac{c}{f} = \frac{340}{20 \times 10^3} = 17 \times 10^{-3}\ m$ .... (01)

$\lambda = \frac{c}{f} = \frac{340}{80 \times 10^3} = 4.25 \times 10^{-3}\ m$ .... (01)

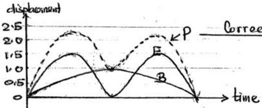
The range of the wavelength is 4.25 mm — 17 mm .... (01)

c) i) At L $= 0.7 + 1.5 = 2.2$ units of length .... (01)

At M $= 0.9 + 0.9 = 1.8$ " " " .... (01)

At N $= 1.0 + 0 = 1.0$ " " " .... (01)

ii)



Correct shape of the graph (02)

Labelling of axes. (01)

d i) $\Delta f = (51.25 - 50.80)\,kHz$

$= 0.45\,kHz = 450\,Hz$ ——— (01)

$V = \frac{c.\Delta f}{2f}$

$= \frac{340 \times 450}{2 \times 50.80}$

$= 1506\,ms^{-1}$ ——— (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)

$= \frac{1}{0.50}$

$= 2\,Hz$ ——— (01)

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

iii) Force on each wheel spring $= \frac{7500N}{4}$

$= 1875N$ ——— (01)

$k = \frac{F}{x}$ ——— (01)

$= \frac{1875\,N}{12 \times 10^{-2}\,m}$

$= 15625\,Nm^{-1}$ ——— (01)

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

v) $110\,kmh^{-1} = \frac{110 \times 10^3\,m}{60 \times 60\,s}$ ——— (01)

$= 30.56\,ms^{-1}$ ——— (01)

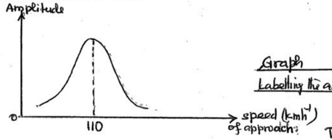
$v = f\lambda$ ——— (01)

$\lambda = \frac{v}{f}$

$= \frac{30.56\,ms^{-1}}{2\,s^{-1}}$

$= 15.28\,m$ ——— (01)

$\therefore$ Distance between crests $= 15.28\,m$ ——— (01)



Graph ——— (01)

Labelling the axes ——— (01)

TOTAL MARKS 30

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

Distinguishing A & B. — (02)

b) i) Young's modulus of steel, $Y_s = \frac{3\times10^{8}}{1.5\times10^{-3}}$ — (02)
$= 2\times10^{11}\ Nm^{-2}$

Young's modulus of copper $Y_c = \frac{2\times10^{8}}{2\times10^{-3}}$
$= 1\times10^{11}\ Nm^{-2}$ — (02)

ii) Max. load for steel wire (without exceeding proportional limit) = stress × area of cross-section
$= 3\times10^{8}\times0.8\times10^{-6}$
$= 240\ N$ — (02)

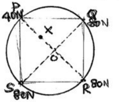
Max. load for copper wire $= 2\times10^{8}\times0.8\times10^{-6}$
$= 160\ N$ — (02)

iii) Max. load on composite wire = 160 N — (01)

c) Force on a wire $F = \frac{AYe}{l}$ — (01)
Each wire extends by 1mm – award marks for identifying this
$F = \frac{0.8\times10^{-6}\times2\times10^{11}\times1\times10^{-3}}{2}$ — (01)
$= 80N$ — (01)
Weight to be placed at the centre $= 80N\times4 = 320\ N$ — (02)
∴ The mass to be placed at the centre = 32 kg. — (01)

d) i) Force required to extend Cu wire 1mm be $= F_{cu}$.
$F_{cu} = \frac{0.8\times10^{-6}\times1\times10^{11}\times1\times10^{-3}}{2}$
$= 40\ N$ — (02)
Force on steel wire $F_s = 80N$ [from section (c)]
$\frac{F_{cu}}{F_s} = \frac{40N}{80N} = \frac{1}{2}$
$F_{cu} : F_s = 1 : 2$ — (01)

ii) Load required $= 3\times80N + 40N$
$= 280\ N$ 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.
$280\times PX = 80\times PR + 2\times80\times OP$
$280\times PX = 80\times15 + 2\times80\times\frac{15}{2}$
$PX = 8.57cm$ — (02)

8 i) Faradays law of electromagnetic induction. (statement) — (2)

ii) Lenz's law (statement) — (2)

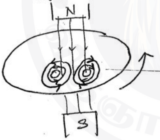
iii) Total number of magnetic flux lines passing through a given area at right angle to its surface. — (2)

iv) Normal magnetic flux per unit area. — (2)

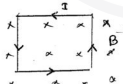
V. (a) Magnetic flux density
(b) The speed of the conductor
(c) the number of turns
} One mark each — (3)

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)

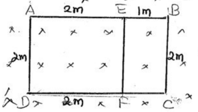
VI. — Vehicle's speedometer
— Magnetic levitation trains
— Brake system
— Electric saw/drill for emergency shutoff
— Cancer treatment.
— Induction welding
etc.
} For any two from this or any other two (one mark each) — (2)



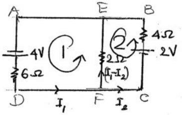
(2)



(2)



$\Rightarrow$



(2)

Induced e.m.f in closed circuit ① = 2x2x1 = 4V
" " " " ② = 2x1x1 = 2V
} One mark each — (2)

$\Sigma E = \Sigma IR$ for closed circuit 1

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

$2 = 4I_1 - I_2$ ——— (i) ——— 2

$\Sigma E = \Sigma IR$ for closed circuit 2

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

$1 = -I_1 + 3I_2$ ——— (ii) ——— 2

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

$\therefore I_2 = \frac{6}{11}$ A Current in BE ——— 1

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

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

$= \frac{7}{11}$ A — Current in AE ——— 1

$I_1 - I_2 = \frac{7}{11} - \frac{6}{11} = \frac{1}{11}$ A Current EF ——— 1

TOTAL MARKS 30

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

$= JC^{-1}$ ——— 2

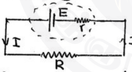
ii) $W = Eq$

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

$P = EI$

1 mark each ——— 3

b)



$I = \frac{E}{r+R}$ ——— 1

Total energy dissipated in the circuit in time t $= EIt$ ——— 1

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

$= \frac{E^2}{(R+r)} t$ ——— 1

c) i) 1) $P = VI$ ——— 1

$I = \frac{10}{20} = 0.5 A$ ——— 1

2) For the cell, $V = E - Ir$ ——— 1

$20 = 24 - 0.5 r$

$r = 8 \Omega$ ——— 1

3) $P = EI$ ——— 1

$= 24 \times 0.5$

$= 12 W$ ——— 1

ii) 1) $P = \frac{V^2}{R}$ —— (1)

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

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

$= \frac{24}{8+8+24}$ —— (1)

$= \frac{24}{40} = 0.6A$ —— (1)

3) The power supplied to the circuit = Power supplied by the cell − Power dissipated in the cell. —— (1)

$= EI - I^2r$

$= 24 \times 0.6 - 0.36 \times 8$ —— (1)

$= 14.4 - 2.88$

$= 11.52\,W$ —— (1)

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

$= \frac{6}{12}$

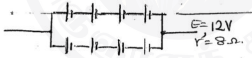
$= 0.5A$ —— (2)

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 = back e.m.f —— (1)

$0.5 = \frac{24-e}{40}$ —— (1)

$e = 4V$ —— (1)

d)  —— (1)

8 cells —— (1)

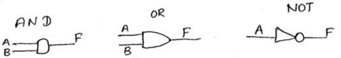
09 B

TOTAL MARKS (30)

(9) a) I. AND , OR, NOT —— [3]

B

II. AND, OR, NOT



—— [3]

III.

AND

A	B	F
0	0	0
1	0	0
0	1	0
1	1	1

OR

A	B	F
0	0	0
1	0	1
0	1	1
1	1	1

NOT

A	F
0	1
1	0

—— [3]

IV. i. இலகுவாக திட்டமிடப்படக் கூடியது.

ii. துல்லியம், தவறின்மை என்பன மிக உயர்வு

iii. இரைச்சல்களினால் பெரிதும் பாதிக்கப்படுவதில்லை. —— [2]

b)

P	Q	R	X
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

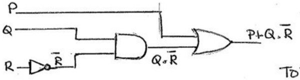
—— (1) (rows 3, 5, 6, 7, 8) —— [5]

$X = \bar{P}Q\bar{R} + P\bar{Q}\bar{R} + P\bar{Q}R + PQ\bar{R} + PQR$ —— [5]

$= \bar{P}Q\bar{R} + P\bar{Q}(R+\bar{R}) + PQ(R+\bar{R})$ $(R+\bar{R}) = 1$

$= \bar{P}Q\bar{R} + P(Q+\bar{Q})$ $(Q+\bar{Q}) = 1$

$= P + \bar{P}Q\bar{R} = P + Q\bar{R}$ —— [3]



6

TOTAL MARKS 30

10 a) i) By reducing the volume (increasing the pressure)
By reducing the temperature
By adding more liquid.
① mark each — 03

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) 1) i) Let the partial pressure of water vapour in the cylinder at 20°C be = p

$\frac{P}{1.75} \times 100 = 60$ — 1

$P = \frac{6 \times 17.5}{10}$ mm Hg

$= 10.5$ mm Hg — 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

$m = \frac{10.5 \times 136 \times 180 \times 10^{-3}}{293 \times 8.31}$

$= 10.557$

$\simeq 10.56\,g$

∴ Absolute Humidity = $10.56\,g\,m^{-3}$ — 1

2

2 For the unsaturated vapour: $P_1V_1 = P_2V_2$

$10.5 \times 1 = P_2 \times 0.6$ — 1

$P_2 = \frac{10.5}{0.6}$

$P_2 = 17.5$ mm Hg — 1

∴ 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 $= m_1$

$$17.5\times10^{-3}\times13600\times10\times0.25 = \frac{m_1}{18\times10^{-3}}\times8.31\times293 \quad —— (1)$$

$$m_1 = \frac{175\times18\times136\times0.25\times10^{-3}}{8.31\times293}$$

$$= 4.399\times10^{-3}\,kg \quad —— (1)$$

$$\approx 4.40\,g \quad —— (1)$$

∴ The mass of water vapour condensed $= 10.56 - 4.40$

$$= 6.16\,g \quad —— (1)$$

4

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

$$\therefore \frac{10.56}{M}\times100 = 60 \quad —— (1)$$

$$M = \frac{10.56}{6}\times10\,g \quad —— (1)$$

$$\therefore \text{Present R.H} = \frac{m_1}{M}\times100\%$$

$$= \frac{4.4\times6}{10.56\times10}\times100\% \quad —— (2)$$

$$= 25\% \quad —— (1)$$

5

OR.

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

$$P\times1 = \frac{4.4}{18}\times\frac{8.31\times293}{13600\times10\times10^{-3}} \quad —— 2$$

$$P = 4.376\,mmHg \quad —— (1)$$

$$\therefore \text{Present R.H} = \frac{4.376}{17.5}\times100\% \quad —— (1)$$

$$\approx 25\% \quad —— (1)$$

5

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

$\therefore \Delta U = 0$ —— (2)

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

When volume decreases $\Delta W < 0$ $\therefore \Delta U > 0$ —— (2)

Hence the temperature of the system will increase

4

TOTAL 30