G.C.E A/L Examination November - 2018

Fied Work Centre

FWC

Grade - 13 (2019) **PHYSICS** **Marking Scheme**

PART – I

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

TOTAL = 50 × 1 MARK
= 50 MARKS.

PART – II A (STRUCTURED ESSAY)

01) A. 0.01 mm ——— (01)

B. – 0.03 mm ——— (01)

C. 1) 1.81 mm ——— (01)

2) x = 1.84 mm ——— (01)

D. 1) Metre scale, Vernier Caliper. ——— (01)

2) By using the three legs, obtain the average distance between two legs by measuring the 3 distances between the tips of the legs.

OR

By using internal and external jaws of a Vernier caliper the distance between each pair of legs must be measured and mean distance between the legs must be obtained. ——— (01)

E. $R = \frac{x}{2} + \frac{y^2}{6x}$

$= \frac{0.184}{2} + \frac{3^2}{6 \times 0.184}$ ——— For substitution (01)

$= 8.244$ cm. ——— (01)

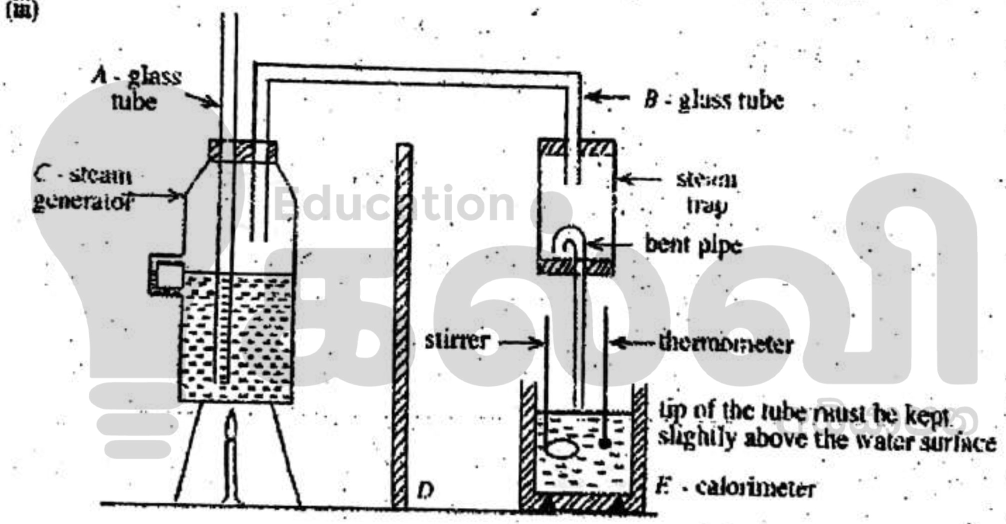
F. Length : Metre scale
Breadth : Vernier caliper
Mass : Triple beam balance ——— (01)
Thickness : Micrometer screw gauge. ——— (01)

TOTAL 10 MARKS

02) (a) (i) Heated water can splash out from the tube A. ——— (01)

(ii) To prevent buiding up of pressure inside the steam generator / To maintain the pressure inside the steam generator at atmospheric pressure ——— (01)

(iii)



(1 mark)

(b) Asbestos sheet / Insulation sheet
To minimise the flow of heat (by radiation) from Bunsen burner to the calorimeter. ——— (01)

(c) Begin the experiment by reducing the temperature of water 4 or 5°C below ambient temperature and continue to send steam until its temperature is 4 or 5°C above the ambient temperature. (01)

(d) (i)
1. Mass of empty calorimeter + stirrer . . . . = m_1
2. Mass of empty calorimeter + stirrer + water = m_2
3. Initial temperature of water . . . . = θ_1°C
4. Final highest temperature of the system . . . . = θ_2°C
5. Mass of empty calorimeter + stirrer + water + steam . . = m_3

(Award (2) marks if all five or the first four are correct (1) mark if first three are correct) (02)

(ii) $m_1 C(\theta_2-\theta_1) + (m_2-m_1) C_W(\theta_2-\theta_1) = (m_3-m_2)L + (m_3-m_2)C_W(100-\theta_2)$
[1 mark for each side of the equation) ——— (02)

(e) Since the Latent heat of vaporization of water is high, The mass of water collected will be small. Hence, the fractional error or percentage error will be Large. ——— (01)

TOTAL 10 MARKS

03 (a) (i) Press the stem of the tuning fork vertically on the sonometer box, in between the bridges.
The energy transfer is maximum when it is pressed against the box. ——— (01)

(ii) At the mid point between the bridges.
Because antinode is produced at the mid point between bridges.
The paper mount (rider) receives maximum Kinetic energy when the amplitude is maximum. ——— (01)

(iii) Having kept the vibrating tuning fork pressed on the sonometer box, obtain the resonating length which makes the paper mount (rider) to be thrown out, as the distance between the bridges is gently and gradually increased from a smaller value. ——— (01)

(b) (i) $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$

$= \frac{1}{2l}\sqrt{\frac{Vs\omega g - V\omega g}{As\omega}}$ ω = density of water

$= \frac{1}{2l}\sqrt{\frac{Vsg - Vg}{As}}$

$= \frac{1}{2l}\sqrt{\frac{Vg}{A}\left[1 - \frac{1}{s}\right]}$ ——— (01)

(ii) $l^2 = \frac{Vg}{4A}\left[1 - \frac{1}{s}\right] \cdot \frac{1}{f^2}$ ——— (01)

$y = m x$

(c) (i) Choosing two points on the graph which can be read easily in order to obtain the gradient. ——— (01)

Gradient $= 10^{7}\ cm^{2} s^{2}$ ———— (01)

(ii) $\frac{Vg}{4A}\left[1 - \frac{1}{s}\right] = \text{gradient} = 10^{7}\ cm^{2} s^{2}$ ———— (01)

$\frac{400 \times 10^{-6} \times 10}{4 \times 0.8 \times 10^{-6}}\left[1 - \frac{1}{s}\right] = 10^{7} \times 10^{-4}$

$s = 5$ ———— (01)

(d) $dB = 10 \log_{10}\left(\frac{I}{I_0}\right)$ (Here I_0 = threshold intensity of hearing)

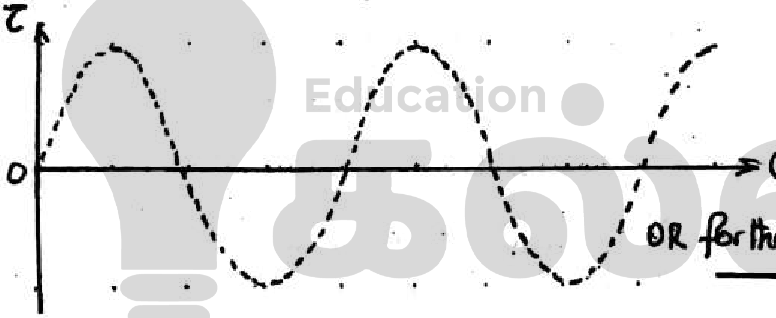
$40 = 10 \log_{10}\left(\frac{I}{10^{-12}}\right)$

$I = 10^{-8}\ Wm^{-2}$ ———— (01)

TOTAL 10 MARKS

04) (a) $\tau = NABI \cos\alpha$ ———— (01)

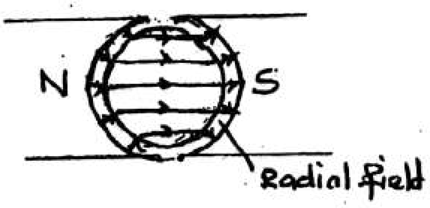
(b)



OR for the sinusoidal wave ———— (01)

(C)(i) Use semi cylindrical magnetic poles with soft iron cylinder/
semi cylindrical magnetic poles/
Use a radial magnetic field. For any one answer ———— (01)

(ii)



———— (01)

(iii) Magnitude — constant
Direction — changes
Field — not uniform. ———— (02)

(d) (i) $NABI = C\theta \Rightarrow I = \frac{C\theta}{NAB}$ ———— (01)

ii) First, the coil would perform rotational simple harmonic motion about that position and finaly comes to rest. ———— (01)

(iii)

Factor	Adjustment
N	Should be increased
A	Should be increased
C	should be decreased
B	should be increased

(02)

TOTAL 10 MARKS

PART II B
ESSAY

05) (a) (i) $P + \frac{1}{2}\rho V^2 + h\rho g = k$ (constant) ——— (01)

P = Pressure of fluid = pressure energy per unit volume

$\frac{1}{2}\rho V^2$ = Kinetic energy of unit volume of fluid.

$h\rho g$ = Potential energy of unit volume of fluid. ——— (01)

(ii) Streamline flow
Incompressible ——— (01)
Non viscous

(b) (i) $30\ ms^{-1}$ ——— (01)

(ii) $V = r\omega = 3.5\times10^{-2}\times 2\pi\times10 = 2.1\ ms^{-1}$ ——— (01)

(iii) 1. Velocity of air at point A = $30 - 2.1 = 27.9\ ms^{-1}$ — (01)

2. Velocity of air at point B = $30 + 2.1 = 32.1\ ms^{-1}$ — (01)

(iv) 1. $P_A + \frac{1}{2}\rho V_A^2 = P_0$

$P_B + \frac{1}{2}\rho V_B^2 = P_0$

$P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2$

$P_A - P_B = \frac{1}{2}\rho (V_B^2 - V_A^2)$

$= \frac{1}{2}\times1.3[(32.1)^2 - (27.9)^2] = 163.8\ Pa.$ (01)

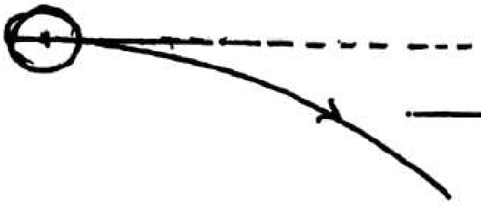
2. $F = \Delta P . A$

$= 163.8 \times \pi r^2$

$= 163.8 \times 3 \times (3.5 \times 10^{-2})^2$

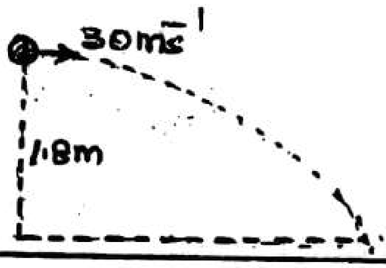
$= 0.6\,N$ ———— (01)

3.



———— (01)

(v) $\downarrow \quad s = ut + \frac{1}{2}at^2$



$1.8 = \frac{1}{2} \times 10 \times t^2$

$t = \sqrt{0.36} = 0.6\,s$ ———— (01)

$\rightarrow \quad s = ut$

$= 30 \times 0.6$

$= 18\,m$ ———— (01)

(vi) Horizontal acceleration;

$a = \frac{F}{m} = \frac{0.6}{150 \times 10^{-3}}\ ms^{-2}$ ———— (01)

$s = ut + \frac{1}{2}at^2$ (For the lateral motion)

$d = 0 + \frac{1}{2}\left(\frac{0.6}{150 \times 10^{-3}}\right)(0.6)^2$ ———— (01)

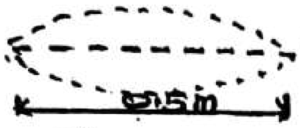
$= \frac{4}{2} \times 0.36$

$= 0.72\,m$ ———— (01)

TOTAL 15 MARKS

06)(a) $V = \sqrt{\frac{T}{m}}$ T = Tension in the string
m = mass per unit length or linear density of the string } ———— (01)

(b)(i)



Fundamental vibration

$V = f\lambda$

$350 = f_0 (2 \times 0.5) \Rightarrow f_0 = 350\,Hz$ ———— (01)

First over tone

$350 = f_1 \cdot (2 \times \frac{0.5}{2}) \Rightarrow f_1 = 700\,Hz$ ———— (01)

(2^{nd} overtone , $f_2 = 1050\,Hz$ not possible)

(ii) The maximum possible frequency for the 2^{nd} overtone must be 1000 Hz ———— (01)

$\sqrt{\frac{T}{m}} = 1000 \times (\frac{0.5}{3} \times 2)$ Equation — (1) ———— (01)

For initial situation:-

$\sqrt{\frac{0.15}{m}} = 350$ ——— Equation —— (2) ———— (01)

$\frac{\text{Equation }(1)^2}{\text{Equation }(2)^2} \Rightarrow T = \frac{1000^2 \times 0.15}{350^2 \times 3^2}$ ———— (01)

$= \frac{100}{735} = 0.136\,N$ ———— (01)

(c) (i) Density $= \frac{mass}{volume}$

$8000 = \frac{m}{A \times 1}$, A = area of cross section of the wire — (01)

$m = 8000A$

$\sqrt{\frac{0.15}{m}} = 350$

$\sqrt{\frac{0.15}{8000A}} = 350$

$\therefore A = \frac{0.15}{8000 \times 350^2} = 1.53 \times 10^{-10}\,m^2$ ———— (01)

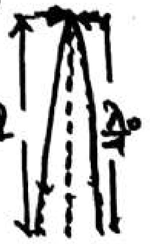
(ii) $m = 8000A = 8000 \times 1.53 \times 10^{-10} = 1.224 \times 10^{-6}\,kgm^{-1}$ — (01)

(iii) For longitudinal waves, $V = \sqrt{\frac{E}{\rho}}$ ———— (01)

$= \sqrt{\frac{2 \times 10^{11}}{8000}}$

$= 5000\,ms^{-1}$ ———— (01)

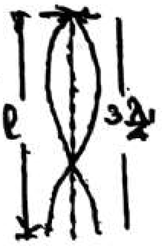
(iv)



$f_0 = \frac{v}{4L}$

$= \frac{5000}{4 \times 0.5}$

$= 2500\ Hz$ ——— (01)



$f_1 = \frac{3v}{4L}$

$= 7500\ Hz$ ——— (01)

(TOTAL 15 MARKS)

07. (a) LT^{-2} ——— (01)

(i) $\frac{GM}{R^2}$ ——— (01)

(ii) $\frac{GM}{r^2}$ ——— (01)

(b)(i) $J\,kg^{-1}$ ——— (01)

(ii) Maximum value of gravitational potential energy = 0 ——— (01)

(iii) 1. $V = -\frac{GM}{R}$ ——— (01)

2. $V = -\frac{GM}{r}$ ——— (01)

(c) (i) At point Q. ——— (01)

$-1\ MJ\,kg^{-1}$ ——— (01)

(ii) At point Q ——— (01)

(iii) $10\ N\,kg^{-1}$ ——— (01)

(iv) Energy supplied to throw it from P to Q

$W = m(V_Q - V_P)$

$= 10\left[-1 \times 10^6 - (-4 \times 10^6)\right] J$ ——— (01)

$= 30 \times 10^6\ J$ ——— (01)

(v) If v is the velocity when reaching earth,

$\frac{1}{2}mv^2 = m(60\times10^6 - 1\times10^6)$ — (01)

$v^2 = 2\times59\times10^6$

$v = \sqrt{118}\times10^3$

$= 10.8\ kms^{-1}$ — (01)

TOTAL 15 MARKS

08) (a) 1. $V = \frac{2.4\times10^2}{8000} = 0.03\ m^3$ — (01)

2. The mass of air in the balloon $= 1.3\times0.5 = 0.65\ kg$ — (01)

3. If the volume of the balloon being equal to V_B,

Weight = Upthrust

$2.4\times10^2\times g = (V_B + 0.03)\rho_w g$

$V_B = 0.24 - 0.03$

$= 0.21\ m^3$ — (01)

4. For the air inside the balloon;-

$P_i V_i = P_f V_f$

$0.5\times1\times10^5 = P_f\times0.21$ — (01)

$P_f = 2.38\times10^5\ Pa.$ — (01)

5. $P_f = P_i + h\rho_w g$

$h = \frac{P_f - P_i}{\rho_w g} = \frac{2.38\times10^5 - 1\times10^5}{10^4}$ — (01)

$= 13.8\ m$ — (01)

(b) 1. Volume of balloon $= 0.21\ m^3$ — (02)

2. For the air in the balloon:-

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$\frac{1\times10^5\times0.5}{300} = \frac{P_2\times0.21}{290}$ — (01)

$P_2 = \frac{0.5\times10^5\times290}{0.21\times300}$

$= \frac{145\times10^5}{63} = 2.3\times10^5\ Pa.$ — (01)

3. $\frac{145\times10^5}{63} = 1\times10^5 + h\rho_w g$ ——— (01)

$h = \frac{1450}{63} - 10$

$h = \frac{820}{63} = 13.01\ m$ ——— (01)

(c) 1. Adding additional load and explanation ——— (01)

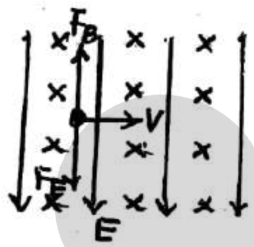
2. The body of bacteria will be destroyed due to vast expansion of air within it. ——— (01)

TOTAL 15 MARKS

09) (a) (i) $F_E = Eq$ ——— (01)

(ii) $F_B = BqV$ ——— (01)

(iii)



——— (01)

(iv) $F_E > F_B$ $F_E < F_B$ $F_E = F_B$

One mark for each ——— (03)

b) To escape :

$F_E = F_B$

$Eq = BqV$

$E = BV$ or $V = \frac{E}{B}$ ——— (01)

Not to escape.

$F_E \gtrless F_B$

$E \gtrless BV$ or $V \lessgtr \frac{E}{B}$

For any one or for both relationships. ——— (01)

(c) (i) Circular motion (∵ path) ——— (01)

(ii) Since the magnetic force is always perpendicular to the direction of motion/velocity. ——— (01)

(iii) $B_0 q v = m \frac{v^2}{(d/2)}$ For using this equation ——— (01)

$B_0 q = \frac{m}{d/2} \cdot \frac{E}{B}$ – For the substitution of $\frac{E}{B}$ for V ——— (01)

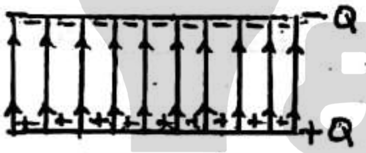
$\frac{m}{q} = \frac{B_0 B d}{2E}$ ——— (01)

(d) Based on the result obtained in (c)(iii) $m \propto d$, hence the distance d increases as the mass m increases. ——— (01)

(e) Isotopes of same element has same charge but different mass. Hence this device can separate them. ——— (01)

TOTAL 15 MARKS

10).(a)(i)



——— (01)

(ii) $E = \frac{V}{d}$ ——— (01)

$V = Ed = 2 \times 10^{3} \times 2 \times 10^{-2} = 40V$

$V_{lower\ plate} - V_{upper\ plate} = 40V$

$0 - V_{upper\ plate} = 40V$

$V_{upper\ plate} = -40\ V$ (Negative sign is essential) ——— (01)

(iii) $E = \frac{\sigma}{\varepsilon}$, $E = \frac{Q/A}{\varepsilon_0}$ ——— (01)

$2 \times 10^{3} = \frac{Q}{10 \times 10^{-2} \times 10 \times 10^{-2} \times 9 \times 10^{-12}}$ For substitution ——— (01)

$Q = 2 \times 9 \times 10^{-11}$

$= 1.8 \times 10^{-10}\ C$ ——— (01)

(b) (i) $Eq = ma$

$\therefore \quad a = \frac{Eq}{m}$ —— (01)

$\uparrow \quad v^2 = u^2 + 2as$

$0 = (V\sin 60^\circ)^2 - 2\frac{Eq}{m}.d_2$ —— (01)

$d_2 = \frac{\left(6\times10^6 \times \frac{\sqrt{3}}{2}\right)^2 \cdot 9\times10^{-31}}{2\times2\times10^3\times1.6\times10^{-19}}$ —— (01)

$= 3.79\times10^{-2}\,m$

$= 3.79\,cm$ —— (01)

(ii) $C = \frac{\varepsilon_0 A}{d}$

$\therefore \Delta C = \varepsilon_0 A\left[\frac{1}{d_1} - \frac{1}{d_2}\right]$ —— (01)

$= 9\times10^{-12}\times100\times10^{-4}\left[\frac{1}{2} - \frac{1}{3.79}\right]\times\frac{1}{10^{-2}}$

$= 2.125\times10^{-12}\,F$ (decrease) —— (01)

(iii) Work done $= \frac{1}{2}\frac{Q^2}{\varepsilon_0 A}(d_2 - d_1)$ —— (01)

$= \frac{1}{2}\times\frac{(1.8\times10^{-2})^2(3.79-2)\times10^{-2}}{9\times10^{-12}\times10^{-2}}$

$= 3.22\times10^{-9}\,J = 3.22\,nJ$ —— (01)

(iv) Yes, $\Delta V = E\Delta d$

$= 2\times10^3.(3.79-2) = 35.8\,V$ —— (01)

TOTAL 15 MARKS