G.C.E A/L Examination March - 2019

Fied Work Centre

FWC

Grade - 13 (2019) Physics Marking Scheme

Part I

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

(50×1 = 50)

Part II

1) a) i) Stable and vertical, Tested with the help of plumb line —— (1)

ii) Effective weight may not become different due to reaction of board —— (1)

b) i) 1. with the help of ruler draw lines through P_1 and P_2, through Q_1 and Q_2 through S_1 and S_2

2) Taking a scale 3) Complete parallelogram OABC and join OC

4) measure OC —— (2)

ii) weights are at rest —— (1) . iii) parallax error —— (1)

iv) 1) pulleys may have friction

2) Thread may have weight —— (1) v) 210 g —— (1)

vi) position O - move upward, $A\hat{O}B$ - increases, length OC - decreases —— (2)

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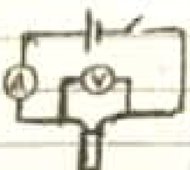
2) a)



—— (2)

b) 1) Balance or measuring cylinder

2) Stop watch —— (1)

c) To allow heater to reach temperature of the ice —— (1)

d) i) 0°C —— (1) ii) $mL = IVt$

$$L = \frac{IVt}{m} = \frac{1.6 \times 12.5 \times 2 \times 60}{(247.9 - 216.1) \times 10^{-3}} = 3.75 \times 10^{5}\ \mathrm{J\,kg^{-1}}$$

—— (1)

iii) All melted ice by heat from heater is collected in beaker —— (1)

e) Mass of ice melted by room temperature is avoided in calculation —— (1)

f) Thermometer —— (1)

g) decrease, part of the heat will use raising of temperature of ice —— (1)

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3) a)

—— (1)

b) A, High frequency tuning fork have minimum fundamental resonance length.

and also when piston pull to continue, may get fundamental resonance length for other turning fork ——(1)

c) To detect the fundamental note without missing. ——(1)

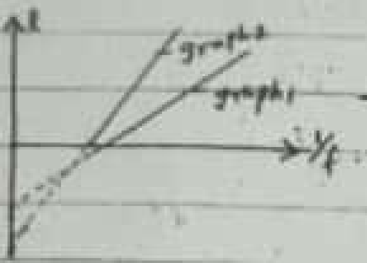
d) 1) Tube do not move, 2) measuring scale is fixed. ——(1)

e) $l = (V/4)\, 1/f - e$ ——(1)

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

$y = m\ x + c$

f)



——(2)

g) $\frac{V}{4} = \frac{(31.5 - 22.75)\times10^{-2}}{(3.5 - 2.5)\times10^{-3}} = 350\,ms^{-1}$ ——(1)

h) In graph ——(1)

i) $350 \propto \sqrt{300}$

$V \propto \sqrt{309}$

$V = 355.2\,ms^{-1}$ ——(1)

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4) a) $R = \rho l/A$ ——(1)

b)

——(2)

c) 1.68V ——(1)

d) brightness decreases as length increases ——(1)

e) No, V/l not constant ——(1)

f) heating changes resistance of wire. ——(1)

g) do not touch wire. ——(1)

h) Increase, when a increases R decreases so voltmeter reading increases ——(1)

i) Low resistivity ——(1)

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5) a) i) $v^2 = u^2 + 2as$

$12^2 = 30^2 - 2\times9\times s$

$s = 42\,m$ ——(1)

ii) Crash then, If mass increases, deceleration decrease so velocity increase ——(1)

b) i) $P = mg\sin30 + F$

$F = 900 - 1500\times\frac{1}{2} = 150\,N$ ——(1)

——(1)

ii) I) Car decelerate upward along the slope until it reach zero velocity ——(1)

II) $F = ma$

$-900 = 150\times a$

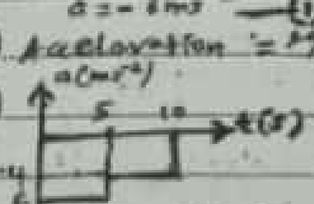
$a = -6\,ms^{-2}$ ——(1)

$a = 30/t$

$t = 30/6 = 5\,s$ ——(1)

III) Acceleration $= 20/(10-t) = 20/5 = 4\,ms^{-2}$ ——(1)

IV)



——(1)

V) changes the direction of friction force ——(1)

6) i) $\omega = \omega_0 + \alpha t$

$= 0 + 7\times4 = 28\,rads^{-1}$ ——(1)

ii) $E = \frac{1}{2} I\omega^2$

$588 = \frac{1}{2}\times I\times28^2$

$I = 1.5\,kgm^2$ ——(1)

iii) $\omega^2 = \omega_0^2 + 2\alpha\theta$

$0^2 = 28^2 + 2\times\alpha\times 14\pi\times 2\pi/1$

$\alpha = -4.45\,rads^{-2}$ ——(1)

$\tau = I\alpha$ ——(1)

$= 1.5\times(-4.45)$

$= -6.675\,Nm$ ——(1)

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6. a) Spontaneous Emission ——— (1)

b) Give long life time to atoms ——— (1)

c) Population inversion more efficient ——— (1)

d) Laser medium, pumping device, population inversion ——— (2)

e) Travelling straight line.

Same phase.

Monochromatic ——— (2)

f) Resonator ——— (1)

g) $E = hc/\lambda$ ——— (1)

$\lambda = hc/E = \frac{6.6\times10^{-34}\times3\times10^{8}}{2\times1.6\times10^{-19}} = 618.75\,nm$ ——— (1)

h) Intensity $= \frac{4\times10^{-3}}{1\times10^{-9}\times22/7\times(1.5\times10^{-5})^2}$ ——— (1)

$= 5.66\times10^{15}\,Wm^{-2}$ ——— (1)

i) $n_1\lambda_1 = n_2\lambda_2$ —(1) $m = \frac{30\times10^{-2}}{100/3\times10^{-9}\times2} = 4.5\times10^{5}$ ——— (1)

Index $= 1.7\times\lambda_2$

$\lambda_2 = 100/3\,nm$ ——— (1)

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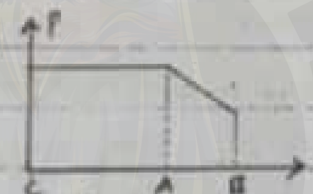
7. a) i) $\Delta p = \frac{8\eta l}{\pi r^4}Q$ ——— (1)

ii) 

——— (1)

iii) using above equation

$P_A - P_B = \frac{8\times2\times10^{-3}\times2\times10^{-2}\times10^{-6}}{3\times(0.02\times10^{-3})^4\times10} = 6.36\times10^{3}\,Nm^{-2}$ ——— (1)

iv) Rate of flow no change, therefore pressure difference across AB is same in the two situation. (π - Atmosphere pressure)

$\therefore P_A - P_B = P_A^1 -$ blood pressure. (P_A^1 - new pressure at A)

$P_A^1 - P_A =$ blood pressure $- \pi$ ($\because P_B = \pi$) ——— (1)

$= 100\,mmHg = 100\times10^{-3}\times13.6\times10^{3}\times10 = 1.36\times10^{4}\,Nm^{-2}$

Apply Additional force $= (P_A^1 - P_A)\times0.75\times10^{-4} = 1.36\times10^{4}\times0.75\times10^{-4} = 1.02\,N$ ——— (1)

v) $Q = Av = \pi r^2 v$ ——— (1)

$\frac{7\times10^{-5}}{70} = 3(0.02\times10^{-2})^2 v$ $\quad P = Fv$

$v = 0.83\,ms^{-1}$ ——— (1) $\quad = 1.02\times0.83 = 0.85\,W$ ——— (1)

b) i) $\Delta p = \frac{8\times2\times10^{-3}\times2\times10^{-2}}{3\times(2\times10^{-4})^4}\times1.5\times10^{-7} = 1\times10^{4}\,Nm^{-2}$ ——— (1)

$h\rho g = \Delta P$

$h = \frac{\Delta P}{\rho g} = \frac{1\times10^{4}}{1.25\times10^{3}\times10} = 0.8\,m$ ——— (1)

ii) Increasing height $= h^1$

$h^1\rho g = 3\times10^{3}$

$h^1 = 3\times10^{3}/1.25\times10^{3}\times10 = 0.24\,m$ ——— (1)

iii) If change of rate of flow is ΔQ, similar change of height Δh

$$\Delta h \rho g = \frac{8 \times 1 \times 10^{-3} \times 1 \times 10^{-1}}{3 \times (2 \times 10^{-3})^4} \times \Delta Q \text{ ——— (1)}$$

$$\Delta Q = \frac{3}{2} \times 10^{-11} \times 0.2 \times 1.25 \times 10^{3} \times 10 = 3.75 \times 10^{-8}\, m^3 s^{-1} \text{ ——— (1)}$$

iv) Maximum rate of flow $= 1.5 \times 10^{-7}\, m^3 s^{-1}$

Minimum rate of flow $= (1.5 - 0.375) \times 10^{-7}\, m^3 s^{-1} = 1.125 \times 10^{-7}\, m^3 s^{-1}$

Average rate of flow $= \left(\frac{1.5 + 1.125}{2}\right) \times 10^{-7} = 1.3125 \times 10^{-7}\, m^3 s^{-1}$ ——— (1)

v) $t = \frac{5.25 \times 10^{-3}}{1.3125 \times 10^{-7}} = 40000\, s$ ——— (1)

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8) a) i) $C = \frac{\varepsilon_0 A}{d}$ ——— (1)

$$= \frac{9 \times 10^{-12} \times 1.5 \times 10^{-2}}{2 \times 10^{-3}} = 67.5\, pF \text{ ——— (1)}$$

ii) $Q = CV$ ——— (1)

$$= 67.5 \times 10^{-12} \times 2.5 \times 10^{3} = 168.75\, nC \text{ ——— (1)}$$

iii) $E = \frac{1}{2} QV$ ——— (1)

$$= \frac{1}{2} \times 168.75 \times 10^{-9} \times 2.5 \times 10^{3} = 210.94 \times 10^{-6}\, J \text{ ——— (1)}$$

iv) $E = QV = 2 \times 210.94 \times 10^{-6} = 421.88 \times 10^{-6}\, J$ ——— (1)

v) Half of the energy delivered by source dissipate as heat energy in the circuit ——— (1)

vi) Increase, If plates are closely capacitance increases so charge increases ——— (1)

vii) $E = V/d$ ——— (1)

$$d = V/E = \frac{2.5 \times 10^{3}}{3 \times 10^{6}} = 0.833\, mm \text{ ——— (1)}$$

b) i) $I = E/R = \frac{12}{1.4 \times 10^{3}} = 8.6\, mA$ ——— (1)

ii) $\Delta E = \frac{1}{2} C V_1^2 - \frac{1}{2} C V_2^2 = \frac{1}{2} C (V_1^2 - V_2^2)$ ——— (1)

$$= \frac{1}{2} \times 67.5 \times 10^{-12} (12^2 - 4^2) = 4.32 \times 10^{-9}\, J \text{ ——— (1)}$$

iii) $\Delta E' = 6 \Delta E = 6 \times 4.32 \times 10^{-9} = 2.592 \times 10^{-8}\, J$ ——— (1)

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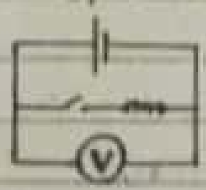
9 A) a) i) The E.m.f of a source of electrical energy converted in to electrical energy per unit charge supplied. potential difference is the energy changed from electrical energy to other forms of energy per unit charge ——— (1)

ii)  ——— (2)

iii) Emf - Switch should be opened; PD - Switch should be closed ——— (1)

(iv) $V = E - Ir$ ——— (1)

b) i) If $R = 0$; $P = 0$

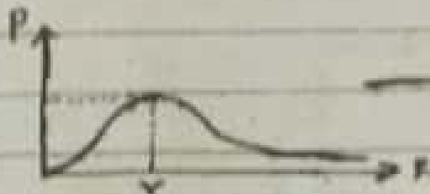
$R = r/2$; $P = \frac{2E^2}{9r}$

$R = r$; $P = \frac{E^2}{4r}$

$R = 3r/2$; $P = \frac{6E^2}{25}$

$R = \infty$; $P = 0$

——— (2)

ii) 

——— (1)

c) i) At fig(a), Resultant Emf 12V therefore it may use
At fig(b), Resultant Emf 6V therefore it may use
At fig(c), Resultant Emf 3V therefore It can not use } —— (1)

ii) At fig(a), Resultant Emf 12V, resultant internal resistance 3Ω
needed potential difference across bulb = 3V.

$V = E - Ir$
$3 = 12 - I \times 3$
$I = 3A$ —— (1)

Current passing through one bulb $= \frac{0.5}{3} = \frac{1}{6}A$
Number of bulb connect parallel $= \frac{3}{1/6} = 18$ —— (1)

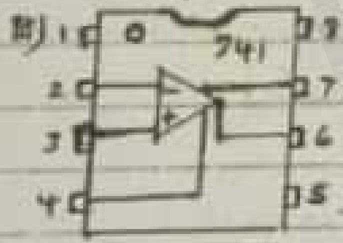
At fig(b), Resultant Emf 6V, resultant internal resistance $\frac{3}{4}\Omega$
needed potential difference across bulb = 3V

$V = E - Ir$
$3 = 6 - I \times \frac{3}{4}$
$I = 4A$ —— (1)

Current passing through one bulb $= \frac{0.5}{4} = \frac{1}{8}A$
number of bulb connect parallel $= \frac{4}{1/8} = 32$ —— (1)

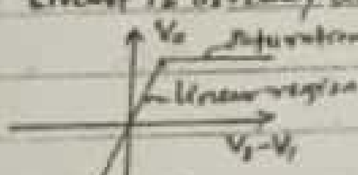
iii) fig(a), long life use or fig(b), more bulb lit at the recommended rating —— (1)
iv) At long time period, cell is discharge therefore current decrease —— (1) /15

9) a) i) Input Impedance high, output Impedance low, Voltage gain high —— (1)
ii) Voltage difference between the inputs zero
The inputs draw no current —— (1)

iii) 

2 - V_2
3 - V_1
6 - V_0
7 - $+V_s$
4 - $-V_s$ —— (1)

iv) circuit is already assembled. circuit is much smaller, circuit is well protected —— (1)

v) 

—— (1)

$A = \frac{V_0}{V_2 - V_1}$ —— (1)

b) i) 5kΩ, If choose 50Ω, Bulb will lit day and night —— (1)
ii) If Resistance of LDR is 5kΩ at night. Non-Inverting Input voltage is +6V, so V_0 is +6V current is passing through bulb. If Resistance of LDR is 50Ω at day Non-Inverting Input voltage is 0V so V_0 is 0V current does not passing through bulb. —— (1)

c) i) $10 = 0.7 + 100 \times 10^{-6} \times R_B + 0.7$
$R_B = 86k\Omega$ —— (1)
ii) $I_C = 100 \times 100 \times 10^{-6} = 10mA$ —— (1)
iii) $V_C = 10 - 1 \times 10^3 \times 10 \times 10^{-3} = 0$ —— (1)
(iv) 1) Potential difference across the diode = 0V. —— (1) 2) $V_C = 10V$ —— (1)

d) i) Input logic levels when day : S = 0 ; R = 0, Input logic levels when night S = 1 ; R = 0 —— (1)
ii) Alarm sounds continuously since it does not receive a reset signal to reset the alarm —— (1) /15

10- a) i) A → B - Adiabatic process ; B → C - Constant Volume process
C → D - Adiabatic process , D → A - Constant Volume process. } —— (1)

ii) $\Delta Q = \Delta U + \Delta W$, ΔQ - Absorbed/Supplied heat Energy, ΔU - Change of internal energy, ΔW - work done —— (1)

iii) At process A → B , $\Delta U = 12000J$, $\Delta Q = 0J$

$\Delta Q = \Delta U + \Delta W$
$0 = 12000 + \Delta W$
$\Delta W = -12000J$
cell (5) = -12000J —— (1)

At process B → C $\Delta V = 0$; so $\Delta W = 0$
$\Delta Q = \Delta U + \Delta W$
$\Delta Q = -12600 + 0$ cell (6) = 0J
$\Delta Q = -12600J$ cell (3) = -12600J } —— (1)

At process B → C $\Delta Q = nC_v \Delta T$
$-12600 = 5C_v (360 - 720)$ —— ①
At process D → A $\Delta Q = 5C_v (400 - 100)$ —— ②
$\frac{①}{②} \Rightarrow \frac{12600}{\Delta Q} = \frac{360}{300}$
$\Delta Q = 10500J$ —— (1)

$\because \frac{P_B}{T_B} = \frac{P_C}{T_C}$
$\frac{24\times10^5}{720} = \frac{12\times10^5}{T_C} \Rightarrow T_C = 360K$
$\frac{1\times10^5}{T_D} = \frac{4\times10^5}{400} \Rightarrow T_D = 100K$

$\therefore$ D → A, $\Delta V = 0$ so $\Delta W = 0$
$\Delta Q = \Delta U + \Delta W$ cell (4) = 10500J
$10500 = \Delta U + 0$ cell (2) = 10500J
$\Delta U = 10500J$ cell (8) = 0J } —— (1)

$\Delta U)_{ABCDA} = 12000 - 12600 +$ cell (1) $+ 10500 = 0 \Rightarrow$ cell (1) = -9900J —— (1)
At process C → D $\Delta Q = \Delta U + \Delta W \Rightarrow 0 = -9900 + \Delta W \Rightarrow \Delta W = 9900J$, cell (7) = 9900J —— (1)

iv) ① $\Rightarrow -12600 = 5C_v(-360) \Rightarrow C_v = 7\ J mol^{-1} K^{-1}$ —— (1)

v) $H = m s_w (30 - 0) + mL + m s_i (0 - (-20))$
$= 30 \times 4200 \times 30 + 30 \times 3\times10^5 + 30 \times 2100 \times 20 = 1.404\times10^7 J$
Number of cycle $= \frac{1.404\times10^7}{10500} = 1337$ —— (1)

vi) $H/t = \frac{1.404\times10^7}{60\times60} = 3.9\times10^3 W$
Heat sent through wall } —— (1)

b) i) choose high thickness wall
choose low thermal conductivity for wall } —— (1)

ii) $\frac{dQ}{dt} = ms\frac{d\theta}{dt}$
$= 30 \times 2100 \times 2.3\times10^{-4} = 14.49\ Js^{-1}$ —— (1)

iii) $\frac{dQ}{dt} = \frac{mL}{t}$; $\frac{30\times3\times10^5}{t} = 14.49$
$t = 6.21\times10^5 s$ —— (1)

iv) $\frac{dQ}{dt} = \frac{KA(\theta_1 - \theta_2)}{x}$
$14.49 = 0.05 \times 2.3 \times \frac{(\theta_1 - 0)}{10\times10^{-2}}$
$\theta_1 = 12.6°C$ —— (1)

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Part I = 50
Part II = 100
Total = Part I + $\frac{\text{Part II}}{2}$
$= 50 + \frac{100}{2}$
$= 100$