# G.C.E. A/L Examination November - 2016

## Conducted by Field Work Centre, Thondaimanaru
## In Collaboration with
## Zonal Department of Education Jaffna.

FWC

| Grade :- 13 (2017) | Marking Scheme | Physics |
|---|---|---|

### Part - I

| | | | |
|---|---|---|---|
| 01) | 3 | 26) | 2 |
| 02) | 5 | 27) | 5 |
| 03) | 4 | 28) | 4 |
| 04) | 4 | 29) | 2 |
| 05) | 5 | 30) | 5 |
| 06) | 2 | 31) | 5 |
| 07) | 2 | 32) | 3 |
| 08) | 3/5 | 33) | 1 |
| 09) | 5 | 34) | 4 |
| 10) | 3 | 35) | 4 |
| 11) | 2 | 36) | 3 |
| 12) | 5 | 37) | 4 |
| 13) | 2 | 38) | 5 |
| 14) | 3 | 39) | 2 |
| 15) | 1 | 40) | 5 |
| 16) | 3 | 41) | 1 |
| 17) | 2 | 42) | 1 |
| 18) | 1 | 43) | 4 |
| 19) | 2 | 44) | 1 |
| 20) | 3 | 45) | 2 |
| 21) | 4 | 46) | 3 |
| 22) | 3 | 47) | 3 |
| 23) | 2 | 48) | 2 |
| 24) | 1 | 49) | 2 |
| 25) | 4 | 50) | 4 |

| | | | |
|---|---|---|---|
| Part | I | $50 \times 2$ | = 100 Marks |
| | IIA | | = 40 |
| | IIB | | = 60 |
| | Total | | = 200 |
| | Final | | = $\frac{200}{2}$ = 100 Marks |

Scheme of marking

Physics 2017 Batch    Grade 13

(November 2016)

## Part II A - Structured Essay

① (a) (i) $d = \frac{L}{N}$ .................... 01

(ii) $\Delta d = 0.01$ mm , $\Delta L = 1$ mm .............. 01 01

$N = 100$ .................... 01

(b) (i) 0.01 mm

(ii) $\frac{2.06}{5} = 0.412$ .................... 01

$d_{ave} = 0.41$ mm .................... 01

(iii) zero error = −0.03 mm .................... 01

corrected value for $d = 0.41 + 0.03 = 0.44$ mm .................... 01

(iv) ① diameter of loop (X) .................... 01

② Vernier caliper .................... 01

(v) $V = (\pi \times N)\frac{\pi d^2}{4}$ ....................

10

② (a) P – metal bar / good conductor
Q – Thermal insulator
R – constant pressure head apparatus
S – metal tube
} All four Correct 01

(b) showing proper connections .................... 01

(c) Vernier caliper, triple / four beam / electronic balance
metre ruler, steam generator, stop watch } Any 3 - 01 02

(d) (i) To ensure steam chest filled with steam at 100 °C
(ii) To avoid the steam path blocked by condensed water (Accept any other correct reasons) } 02

(e) by ensuring that the thermometer readings becomes steady (constant) 01

(f) $KA\frac{(\theta_1 - \theta_2)}{d} = \frac{M}{t} s_w (\theta_3 - \theta_4)$ 02

$K \times 1.2\times10^{-3} \times \frac{(79-65)}{8\times10^{-2}} = \frac{0.4}{3\times60} \times 4200 \times (40-31)$

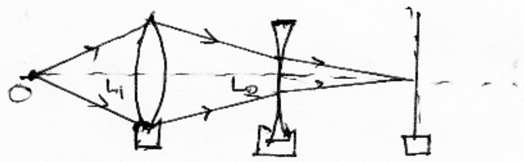
$K = 400\ W\,m^{-1}\,K^{-1}$

(g) Yes. will be difficult to maintain a measurable temperature difference $(\theta_3 - \theta_4)$ / Percentage error in the measurement of temp. difference will be significant. 01

10

③ (a) illuminated (point) object | illuminated light box having a hole. (No mark for pin) 01

(b) (i)




02

(ii) By adjusting the positions of $L_2$ (and S) until a clear (sharp) image of O is formed on S.

01

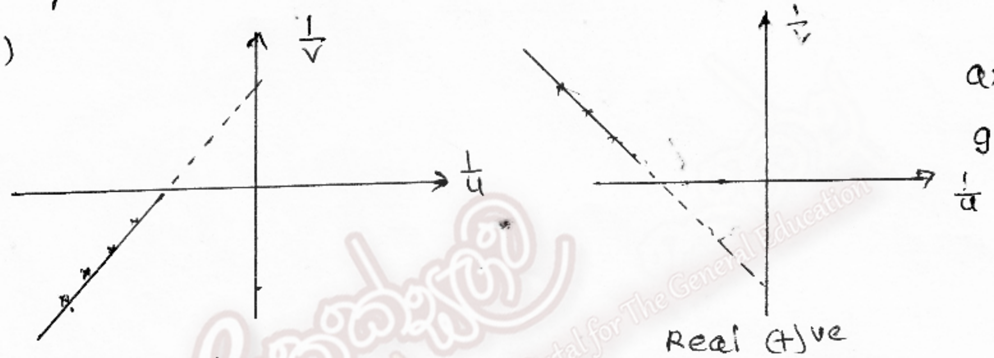
(c) (iii) distance between $L_1$ and $L_2$ - - - - - - - - - 01

(d) (i) $u = (x - z)$ , $v = y$ - - - - - - - - - 01

(ii) $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ if cartesian sign convention is adopted. 02

/ $\frac{1}{v} = -\frac{1}{u} + \frac{1}{f}$ Real - positive sign convention

(iii)




axes 01

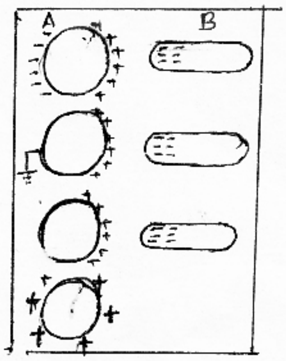
graph 01

(iv) Reciprocal of intercept | $\frac{1}{\text{intercept}}$ - - - - 01

10

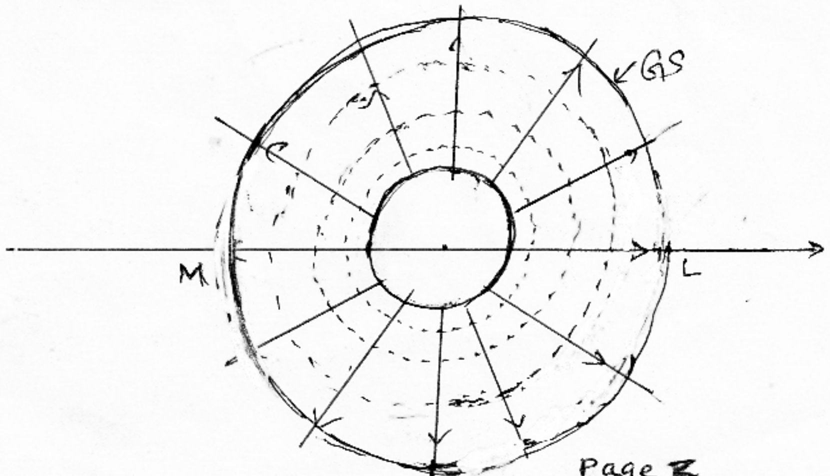
④ (a) Friction, contact (conduction), induction 01

(b)




01

(c)



(i) Lines of forces ( arrow on line - important) 01

(ii) three concentric spherical surfaces .......... 01

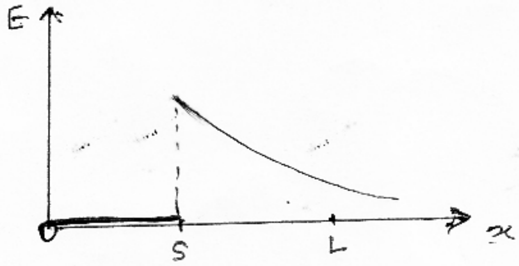
(d)(i) Gaussian surface (spherical) drawn through L & M 01

(ii) $\phi = E \times 4\pi r^2$

$\phi = \frac{Q_1}{\epsilon_0}$ ---------- 01

$E = \frac{Q_1}{4\pi\epsilon_0 r^2}$ ---------- 01

(iii)




01

(e) (i) $\frac{Q_1}{4\pi\epsilon_0 r}$ ---------- 01

(ii) 0 ---------- 01

10



## Essay Part II B

① (a) (i) deceleleration $= \frac{30-22}{1.3} = 6.15\ ms^{-2}$ ...... 01

(ii) $d_{min} = (30-22) \times 0.9 = 7.2\ m$ ........ 01

(iii) If continued with same deceleration (before comes to rest) car B would travel additional distance equals to $30 \times 0.9 = 27\ m$ (Area of v-t curve) 01

∵ 27 > 7.2 m, car B will collide with car A ...... 01

(iv) ① using $Ft = \Delta p$. (or any other correct form) 01

$F \times 0.07 = 50 \times 30$ ...... 01

$F = 21.43\ kN$

② No other forces such as friction, force exerted by seat, force due to steering wheel will also influence. ------ 01

(b) (i) Centripetal force that is necessary to maintain circular motion is provided by the radial frictional force which has a limiting value of 3 N. 01

(ii) If the maximum tangential speed of the car is $v$, $max^{m}$ centripetal acceleration $= \frac{v^2}{R}$

Applying $F = ma$ in the radial $dir^{n}$,

$3 = \frac{mv^2}{R}$ 01

$= 4 \times 10^{-3} \times \frac{v^2}{3} \Rightarrow v = 1.5\ ms^{-1}$ 01

(c)(i) Limiting value ($max^{m}$) of frictional force acting on the tyre $= \mu_s R = \mu_s mg$ ..... 01

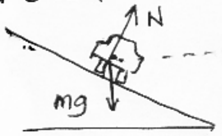
Applying $F = ma$ (towards centre)

$\mu_s mg = m\frac{v_m^2}{R} \Rightarrow v_m = \sqrt{Rg\mu_s}$ ..... 01

(ii) $v_m = \sqrt{70 \times 10 \times 0.7} = 22.13\ ms^{-1}$ .....

$30 > 22.13$ It is not safe for the car to turn around the bend. 01

(iii) banking the car so that outer edge of the road is elevated than the inner edge 01



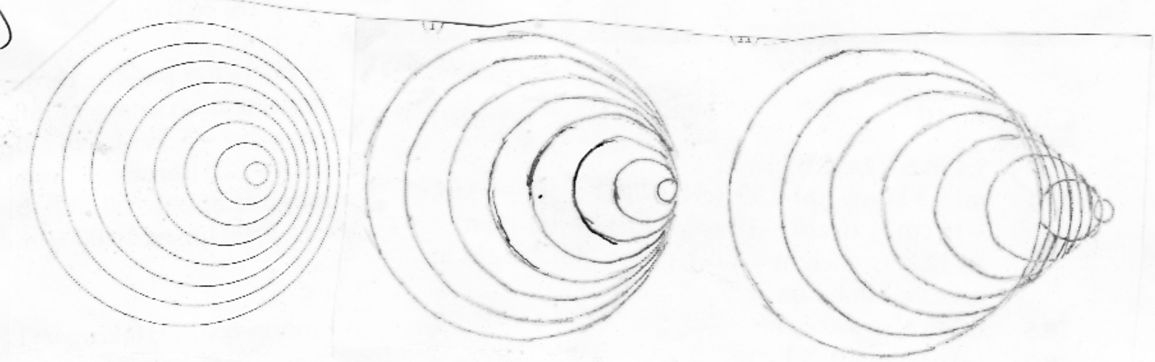

Horizontal component of the normal reaction will provide centripetal force. 01

---

② (a)(i) Doppler effect – Explanation ..... 01

(ii) Any two applications ..... 02

(b)



03

(c) (i) Apparent speed $v' = c + v_0$.
Apparent wavelength $\lambda' = \left(\frac{c - v_s}{f}\right)$ } 01.

(ii) App. speed $v' = c - v_0$, App. wavelength $\lambda' = \frac{c - v_s}{f}$ } 01

(d) (i) frequency of waves reaching submarine $f_1 = \left(\frac{c+V}{c}\right) f$ 01

frequency of waves reflected back to sonar device $f' = \left(\frac{c}{c-V}\right) f_1$ 01

$= \left(\frac{c+V}{c-V}\right) f$ ---- 01

(ii) beat frequency $\Delta f = f' - f$ ---- 01

$= \left(\frac{c+V}{c-V}\right) f - f = \frac{2Vf}{c-V}$ ---- 01

$c - V \approx c \quad \because V << c$

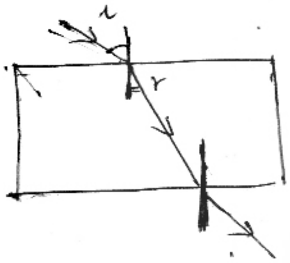
$\Delta f = \frac{2Vf}{c}$

(iii) $V = \frac{c\,\Delta f}{2f} = \frac{1500 \times 30}{2 \times 4500} = 50\ m\,s^{-1}$ ---- 01

(iv) $(\Delta f)_{min} = 6\ Hz \qquad V_{min} = \frac{1500 \times 6}{2 \times 4500} = 1\ m\,s^{-1}$ ---- 01

---

③ (a)

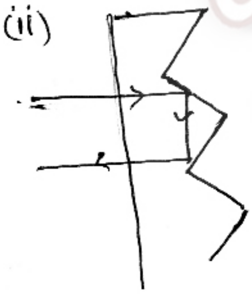



ray diagram with i and r denoted (arrow important) 01

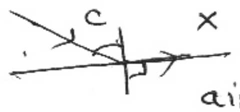
(b) (i) $n = \frac{\sin i}{\sin r}$ ; (ii) $n = \frac{c_a}{c_g}$ ---- { 01 + 01 } 02

(c) stating the two conditions for TIR ---- 01

(d) (ii)



(i)

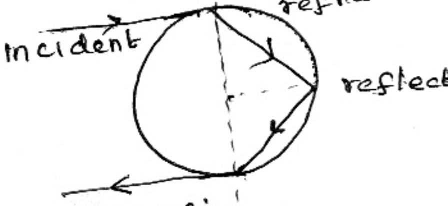



Using Snell's law, $1.41 \sin c = 1 \times \sin 90$ 01

$\sin c = \frac{1}{1.41} = \sin 45°$

$c = 45°$ ---- 01

(e) (i)



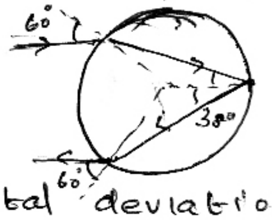

02

(ii) Pearl reverses the path of the incident ray 01

(f) (i) For the refraction at D, $1 \times \sin 60 = 1.41 \times \sin r$ ---- 01

$\sin r = \frac{0.8660}{1.41} = 0.6142$

$r = 38°$ ---- 01




01

(ii) total deviation $= 22°) + 104°) + 22°) = 148°$ 01

(4)(a) (i) $F = \frac{G m_1 m_2}{r^2}$

$m_1, m_2$ - (Point) masses
$r$ - separation bet$^n$ the masses
$G$ - universal gravitational const
$F$ - gravitational attractive force between $m_1$ and $m_2$. 02

(ii)


Gravitational force acting on the test mass, m = $m'g' = \frac{GMm'}{r^2}$ 01

$g' = \frac{GM}{r^2}$ ............ 01

(iii) $g = \frac{GM}{R^2}$, $g_s = \frac{GM}{r_s^2}$ } ............ 01

$g_s = \frac{gR^2}{r_s^2}$ ............ 01

(iv) To move in a circular orbit, $mg_s = m\omega^2 r_s$

$g_s = \omega^2 r_s$ ............ 01

$\frac{gR^2}{r_s^2} = \omega^2 r_s$, $r_s^3 = \frac{gR^2}{\omega^2}$ ............ 01

$\omega = \frac{2\pi}{T}$ ............ 01

$r_s = \left(\frac{gR^2}{2\pi^2} T^2\right)^{1/3}$

$= \left\{\frac{10 \times (6400 \times 10^3)^2 \times (24 \times 3600)^2}{(2\pi)^2}\right\}^{1/3} = 6^2 \times 4^2 \times 10^5 \times 0.4^{1/3}$

$= 4.24 \times 10^7$ m ............ 01

(b)(i) Geo-stationary satellite ............ 01

(ii) $V_s = r\omega = 4.24 \times 10^4 \text{ km} \times \frac{2\pi}{24} (h)^{-1}$ 01

$= 11105 \text{ km h}^{-1}$ (11095 – 11110)

(iii) Minimum energy required = Difference in potential energy

$= \left(-\frac{GMm}{r_s}\right) - \left(-\frac{GMm}{R}\right) = GMm\left(\frac{1}{R} - \frac{1}{r_s}\right)$ .... 01

$= mgR^2\left(\frac{1}{R} - \frac{1}{r_s}\right)$ [$\because GM = gR^2$]

$= 20 \times 10 \times (6.4 \times 10^6)^2 \times \frac{1}{10^6}\left[\frac{1}{6.4} - \frac{1}{42.4}\right]$

$= 1.086 \times 10^9$ J $= 1086$ MJ ............ 01

(iv) Additional energy required $= \frac{1}{2}mv^2$

$= \frac{1}{2} \times 20 \times \left(\frac{11.1 \times 10^3}{60 \times 60}\right)^2 = 95.1$ MJ 01

---

(5)(a)(i) $R_m = \frac{V_m}{I_m}$ ............ 02

(ii) $I_m = \frac{V_m}{R} + \frac{V_m}{R_V}$ ............ 01

$\frac{1}{R} = \frac{I_m}{V_m} - \frac{1}{R_V} = \frac{I_m R_V - V_m}{R_V V_m}$ ; $R = \frac{R_V V_m}{I_m R_V - V_m}$ 02

(b) (i) Voltage across Ammeter $= 5.5 - 5.0 = 0.5\,V$ | 01

Equivalent resistance of R and $R_V = 300\,\Omega$ --- 01

$\frac{1}{1200} + \frac{1}{R_V} = \frac{1}{300}$ $R = 400\,\Omega$ ----- 01

(ii) ① $R = \frac{\rho l}{A}$ ----- 02

② $l = \frac{RA}{\rho} = \frac{400 \times 0.04 \times 10^{-6}}{8 \times 10^{-6}} = 2\,m$ ----- 01

(c) (i) both $S_1$ and $S_2$ closed, Equivalent resistance $= R/2$

Power $P = \frac{V^2}{R}$ ----- 01

$= \frac{240^2}{200} = 288\,W$ ----- 01

(ii) $S_1$ closed while $S_2$ open, equivalent resistance $= R$

$P = \frac{240^2}{400} = 144\,W$ ----- 01

(iii) $S_2$ closed while $S_1$ open, equivalent resistance $= \frac{2R}{3}$

$P = \frac{240^2}{2 \times \frac{400}{3}} = 216\,W$ ----- 01

---

⑥ (a) (i) $\Delta Q = \Delta U + \Delta W$, identification of symbols 01

(ii) $A \to B$ is adiabatic compression.

$\Delta Q = 0$, $\Delta W < 0$ $\therefore \Delta U > 0$ } ---- 01

$\therefore$ temperature rises.

(b) $n = \frac{PV}{RT} = \frac{10^5 \times 2.25 \times 10^{-3}}{8.3 \times 300}$ OR any other appropriate values substituted 01

$= 0.09$ mol.

(c) (i) For constant volume process, $\Delta W = P\Delta V = 0$ 01

$\Delta Q = \Delta U$. $\Delta Q = n C_V \Delta T$ ----- 01

$\Delta W = n C_V \Delta T$

(ii) For process $A \to B$ $\Delta U = 0.09 \times 20.8 \times (1090 - 300) = +1479\,J$ . 01

$B \to C$ $\Delta U = 0.09 \times 20.8 \times (750 - 300) = +1872\,J$ 01

$C \to D$ $\Delta U = 0.09 \times 20.8 \times (750 - 2090) = -2508\,J$ 01

$D \to A$ $\Delta U = 0.09 \times 20.8 \times (300 - 750) = -842\,J$ 01

(iii) $\Delta W_{B \to C} = P\Delta V = 9060 \times 10^3 (173 - 90) \times 10^{-6} = +752\,J$ 01

$\Delta W_{D \to A} = 0$