



இலங்கையின் உயர்தர கணித விஞ்ஞான
பிரிவின்கான இணையதளம்

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FWC

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

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Zonal Department of Education Jaffna.

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 × 2 = 100 Marks
	IIA	= 40
	IIB	= 60
	Total	= 200
	Final	= $\frac{200}{2}$ = 100 Marks

Scheme of marking

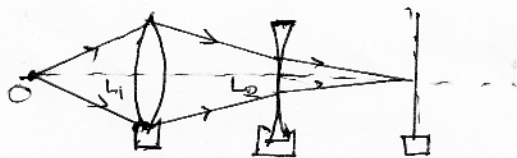
Physics 2017 Batch Grade 13
(November 2016)

Part II A - Structured Essay

- ① (a) (i) $d = \frac{L}{N}$ 01
 (ii) $\Delta d = 0.01 \text{ mm}$, $\Delta L = 1 \text{ mm}$ 01
 $N = 100$ 01
 (b) (i) 0.01 mm 01
 (ii) $\frac{2.06}{5} = 0.412$ 01
 $d_{\text{ave}} = 0.41 \text{ mm}$ 01
 (iii) zero error = -0.03 mm 01
 corrected value for $d = 0.41 + 0.03 = 0.44 \text{ mm}$ 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) $KA \left(\frac{\theta_1 - \theta_2}{d} \right) = \frac{M}{t} S_w (\theta_3 - \theta_4)$ 02
 $K \frac{1.2 \times 10^{-3} \times (79 - 65)}{8 \times 10^{-2}} = \frac{0.4 \times 4200 \times (40 - 31)}{3 \times 60}$
 $K = 400 \text{ W m}^{-1} \text{ K}^{-1}$
- (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

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

(b) (i)



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

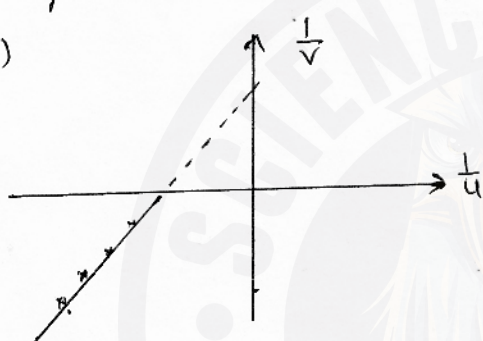
(c) (ii) distance between L_1 and L_2

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

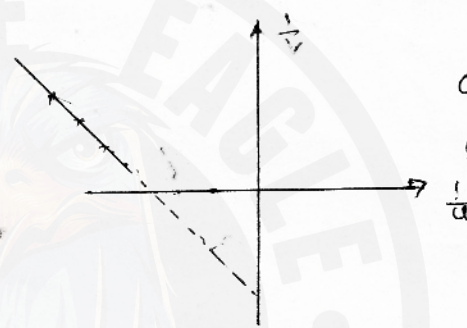
(ii) $\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$ if cartesian sign convention is adopted.

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

(iii)



cartesian



Real (+ve)

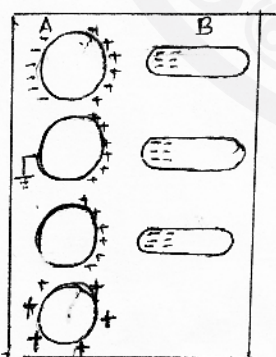
axes

graph

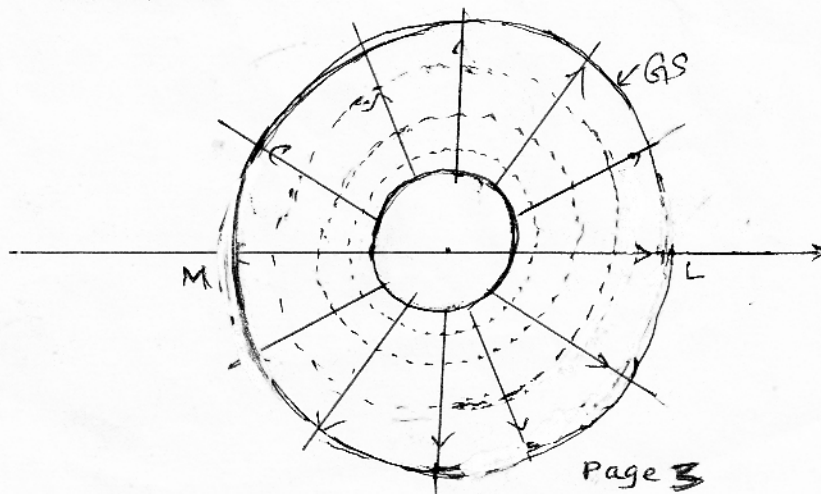
(iv) Reciprocal of intercept | $\frac{1}{\text{intercept}}$

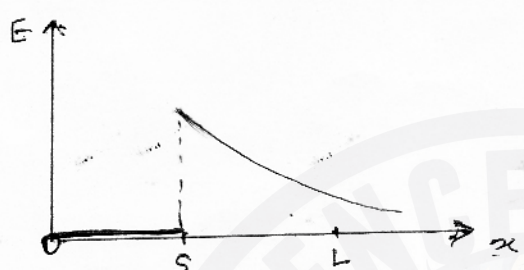
④ (a) Friction, contact (conduction), induction

(b)



(c)



- (i) Lines of forces (arrow on line - important) 01
- (ii) Three concentric spherical surfaces 01
- (iii) (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

Essay Part II B

- ① (a) (i) deceleration = $\frac{30-22}{1.3} = 6.15 \text{ m s}^{-2}$ 01
- (ii) $d_{\min} = (30-22) \times 0.9 = 7.2 \text{ m}$ 01
- (iii) If continued with same deceleration (before comes to rest) car B would travel additional distance equals to $30 \times 0.9 = 27 \text{ m}$ (Area of v-t curve) 01
- $\therefore 27 > 7.2 \text{ m}$, 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
- $F = 21.43 \text{ kN}$
- 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

- (i) If the maximum tangential speed of the car is v , max^m centripetal acceleration = $\frac{v^2}{R}$
Applying $F=ma$ in the radial dirⁿ,

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

$$= 4 \times 10^{-3} \times \frac{v^2}{3} \Rightarrow v = 1.5 \text{ m s}^{-1}$$

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

Applying $F=ma$ (towards centre)

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

$$(ii) v_m = \sqrt{70 \times 10 \times 0.7} = 22.13 \text{ m s}^{-1}$$

$$30 > 22.13$$

It is not safe for the car to turn around the bend.

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

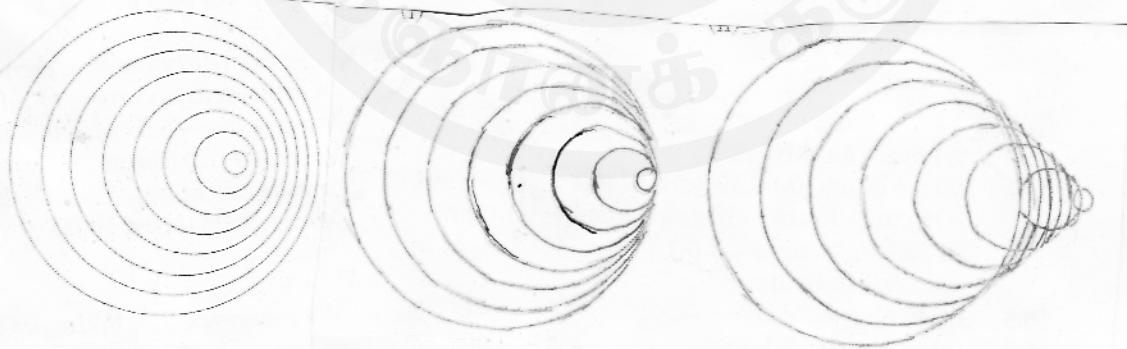


Horizontal component of the normal reaction will provide centripetal force.

- ② (a)(i) Doppler effect - Explanation

- (ii) Any two applications

(b)

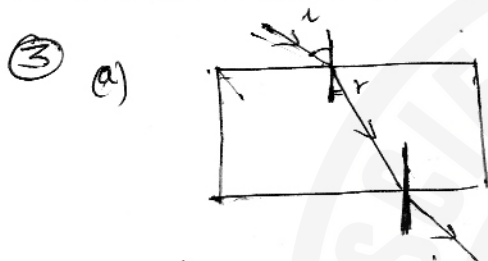


- (c) (i) Apparent speed $v' = c + v_o$

$$\text{Apparent wavelength } \lambda' = \frac{c + v_o}{f}$$

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

- (d) (i) frequency of waves reaching submarine $f_r = \left(\frac{c+v}{c}\right)f$ 01
 frequency of waves reflected back to sonar device $f' = \left(\frac{c}{c-v}\right)f$ 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
 $c-v \approx c \quad \because v \ll c$
 $\Delta f = \frac{2vf}{c}$
- (iii) $v = \frac{c \Delta f}{2f} = \frac{1500 \times 30}{2 \times 4500} = 50 \text{ m s}^{-1}$ 01
- (iv) $(\Delta f)_{\min} = 6 \text{ Hz} \quad v_{\min} = \frac{1500 \times 6}{2 \times 4500} = 1 \text{ m s}^{-1}$ 01

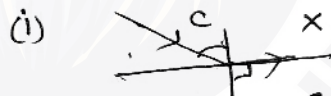
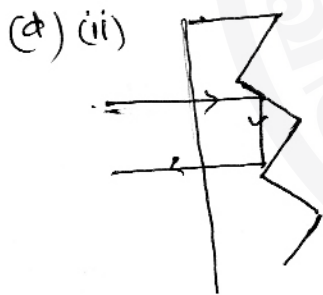


ray diagram with i and r denoted (arrow important)

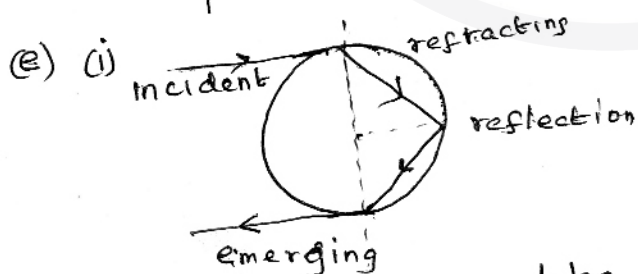
b) (i) $n = \frac{\sin i}{\sin r}$

(ii) $n = \frac{c_a}{c_g}$

c) stating the two conditions for TIR 01

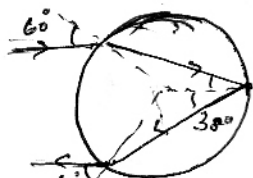


air
 using Snell's law, $1.41 \sin c = 1 \times \sin 90^\circ$ 01
 $\sin c = \frac{1}{1.41} = \sin 45^\circ$
 $c = 45^\circ$ 01



(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
 $\sin r = \frac{0.8660}{1.41} = 0.6142$ 01
 $r = 38^\circ$ 01



(ii) Total deviation = $22^\circ + 104^\circ + 22^\circ = 148^\circ$ 01

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

m_1, m_2 - (Point) masses
 r - separation betⁿ the masses
 G - universal gravitational const
 F - gravitational attractive force between m_1 and m_2 .



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

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

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

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

$$g_s = \omega^2 r_s$$

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

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

$$r_s = \left(\frac{gR^2 T^2}{4\pi^2} \right)^{1/3}$$

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

$$= 4.24 \times 10^7 \text{ m}$$

(b)(i) Geo-stationary satellite

(ii) $v_s = r\omega = 4.24 \times 10^4 \text{ km} \times \frac{2\pi}{24} (\text{h}^{-1})$
 $= 11105 \text{ km h}^{-1} \quad (11095 - 11110)$

(iii) Minimum energy required = Difference in potential energy

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

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

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

$$= 1.096 \times 10^9 \text{ J} = 1096 \text{ MJ}$$

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

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

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

(ii) $I_m = \frac{V_m}{R} + \frac{V_m}{R_v}$

$$\frac{1}{R} = \frac{I_m}{V_m} - \frac{1}{R_v} = \frac{I_m R_v - V_m}{R_v V_m}$$

$$; R = \frac{R_v V_m}{I_m R_v - V_m}$$

(b) (i) Voltage across Ammeter = $5.5 - 5.0 = 0.5 \text{ V}$ 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) (i) $R = \frac{\rho l}{A}$ 02

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

(c) (i) both S_1 and S_2 closed, Equivalent resistance = $\frac{R}{2}$

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

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

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

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

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

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

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

(ii) $A \rightarrow B$ is adiabatic compression. } 01

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

$\therefore$ 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

$= 0.09 \text{ mol}$

(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 $A \rightarrow B$ $\Delta U = 0.09 \times 20.8 \times (1090 - 300) = +1479 \text{ J}$ 01

$B \rightarrow C$ $\Delta U = 0.09 \times 20.8 \times (750 - 300) = +1872 \text{ J}$ 01

$C \rightarrow D$ $\Delta U = 0.09 \times 20.8 \times (750 - 2090) = -2508 \text{ J}$ 01

$D \rightarrow A$ $\Delta U = 0.09 \times 20.8 \times (300 - 750) = -842 \text{ J}$ 01

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

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



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