GCE(A/L) Examination, November - 2017

Conducted by Field Work Centre, Thondaimanaru

In Collaboration with

Provincial Department of Education Northern Province

Grade :- 13 (2018)	Physics	Marking Scheme

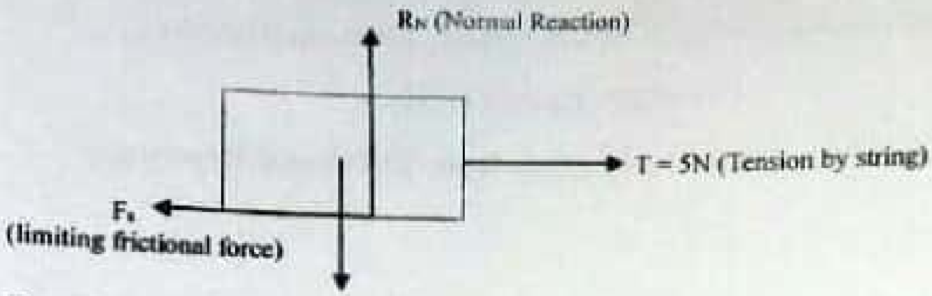
PART I (MCQ)

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

PART II A (STRUCTRED ESSAY)

1.

(a)



01

(b) $\mu_s = \frac{F_s}{R_N} = \frac{5}{20} = 0.25$ 01

(c) 5N 01

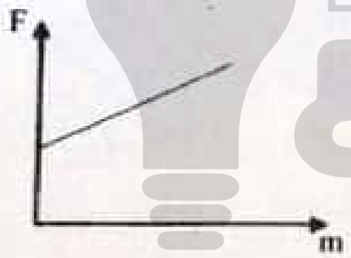
(d) (i) Without additional mass take the reading of spring balance when the block is in verge of moving. Next add 100g mass on the block, pull the spring balance and take the reading when the block is in verge of moving. Take at least six set of readings. 01

(ii) $\mu = \frac{F}{W + mg}$ 01

(iii) $\mu W + \mu mg = F$

$F = (\mu g)m + \mu W$ 01

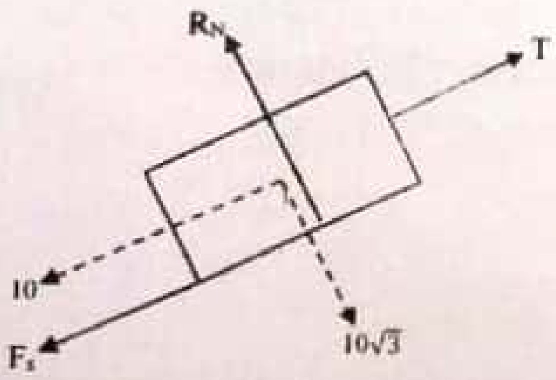
(iv)

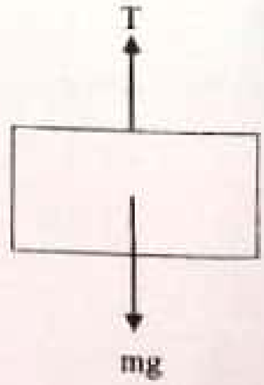


gradient $G = \mu g$ 01

$\mu = \frac{G}{g}$ 01

(e)





$F_s = 0.25 \times 10\sqrt{3} = 4.3N$

$T = 10 + 4.3 = 14.3N$ 01

$14.3 = m \times 10$

$m = 1.43$ kg 01

2.

(a) Thermometer (0-100°C), Thermometer (0-50°C), Beaker with water, wire gauze,

Triple beam balance, Tripod and stirrer 01

(b) Place the calorimeter on an insulating support

Close the calorimeter with lid

Polish the outer surface

Start the experiment 5°C below from room temperature and at 5°C above it. 01

(c) All lead shots attain same temperature

It's a fixed temperature and high temperature 01

(d) Small - Water may not cover the metal balls completely 01

Large - water may spill and increase in temperature may be too small 01

(e) Mass of empty calorimeter with stirrer $= X_0$

Mass of calorimeter + stirrer + water $= X_1$

Initial temperature of water $= Y_1$

Maximum temperature of water $= Y_2$

Mass of calorimeter + stirrer + water + lead shots $= X_2$ 02

(f) $[X_0 C_0 + (X_1 - X_0)C_w](Y_2 - Y_1) = (X_2 - X_1)C(100 - Y_2)$ 01

(g) Water should not splash

Reduce the heat loss to the surrounding } 01

(h) $S = \frac{1200}{0.15 \times 60} = 133.3\ \text{Jkg}^{-1}\text{K}^{-1}$ 01

3.

(a) (i) longitudinal mechanical wave 01

(ii) only transverse waves can be polarized but sound waves are longitudinal 01

(b) Due to interference standing wave is formed 01

Maxima - Constructive interference (antinode)

Minima - destructive interference (node) } 01

At constructive interference waves are in phase

At minima waves are in antiphase } 01

(c) (i) $\frac{\lambda}{2} = 0.05$, $\lambda = 0.1$ m 01

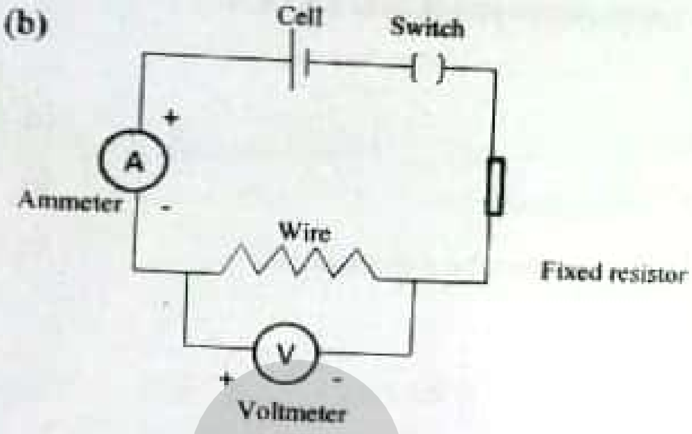
(ii) $v = 3300 \times 0.1 = 330\ m\ s^{-1}$ 02 (01 for unit)

(d) (i) There is no complete cancellation/ no total destructive interference 01

(ii) waves have different amplitudes. Amplitudes decrease with distance. Energy loss due to reflection.
01

4. (a) micrometer screw gauge 01

(b)



01

01

(c) (i) Fraction error = $\frac{1}{100} \times 100 = 1\%$

Fractional error $\leq 1\%$. It is better measurement. 01

(ii) α : voltmeter reading

β : Ammeter reading 01

(iii) $R = \alpha/\beta$ 01

(d) (i) $R = \frac{\rho}{lA}$

$$R = \left(\frac{\rho}{A}\right) l$$
$$y = m\ x$$
01

It is in the form of y=mx

At constant temperature $\left(\frac{\rho}{A}\right)$ constant

(ii) $41.9 = \frac{\rho}{3 \times (0.06 \times 10^{-3})^2}$ 01

$\rho = 41.9 \times 3 \times 10^{-10} \times 36 = 4.5 \times 10^{-7}\ \Omega m$

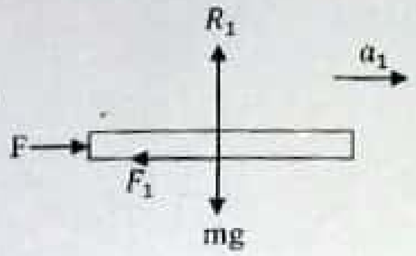
(e) Diameter is measured only once 01

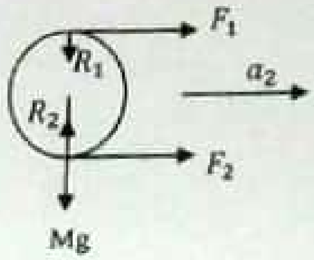
Voltmeter takes current to show reading 01

PART II B (ESSAY)

5.

(i)





01

(ii) $a_1 = 2a_2$ 01

(iii) plank F - F_1 = ma_1 => $a_1 = \frac{F-F_1}{m}$

Cylinder $F_1 + F_2 = Ma_2 => a_2 = \frac{F_1+F_2}{M}$ } 01

F_1 - friction between plane and cylinder

F_2 - friction between cylinder and floor

(iv) $\tau = I\alpha$

$(F_1 - F_2)R = \left(\frac{1}{2}MR^2\right)\alpha$

$\alpha = \frac{2(F_1-F_2)}{MR}$ 01

(v) no slipping $a_2 = R\alpha = \frac{2(F_1-F_2)}{M}$ 01

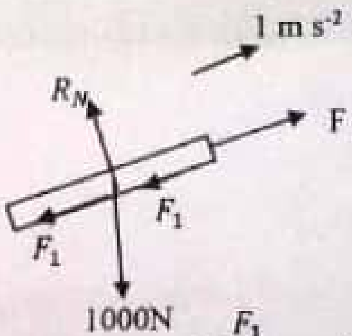
Solving the above equations

$a_1 = \frac{8F}{3M+8m}$ 01

$a_2 = \frac{4F}{3M+8m}$ 01

(vi) $f_1 = F - ma_1 = \frac{3MF}{3M+8m}$

$f_2 = \frac{MF}{3M+8m}$ } 01

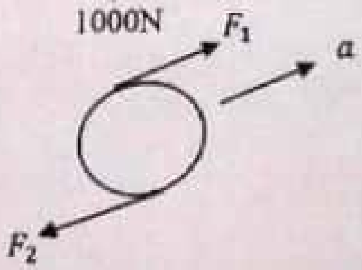


(b) $F - 2F_1 - 500 = 100 \times 1$

$F - 2F_1 = 600$ 01

$F_1 - F_2 - 100 = 20a$

$F_1 - F_2 = 100 + 20a$ 01



$(F_1 + F_2)0.1 = \left(\frac{1}{2} \times 20 \times 0.1^2\right)\alpha$ 01

$\alpha = F_1 + F_2$

$a = 0.1\alpha$

$F_1 - F_2 = 100 + 20 \times 0.1$

$3F_2 + F_1 = -100$ 01

$a + R\alpha = 1$

$a + 0.1 \times \frac{a}{0.1} = 1 \Rightarrow \; a = 0.5\, ms^{-2}$

$\alpha = \frac{0.5}{0.1} = 5\, rads^{-2}$ 01

$F_1 + F_2 = 5$

$F_1 - F_2 = 110$ 01

$F_1 = 57.5$ N $\qquad F_2 = -52.5$ N 01

F = 2 x 57.5 + 600 = 715 N

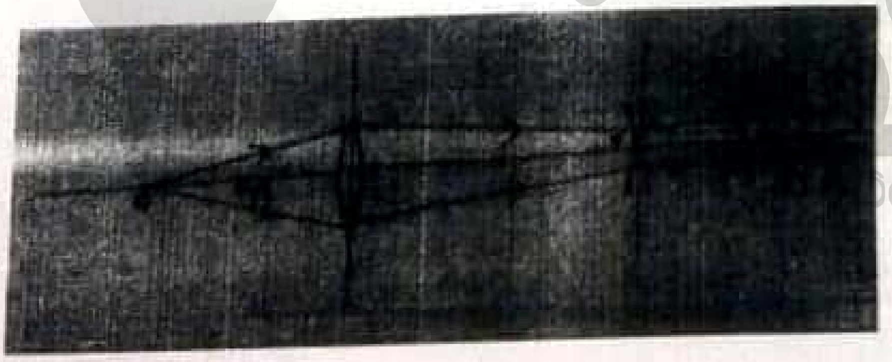
6.

(a) (i) $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\frac{1}{-(d+40)} - \frac{1}{20} = \frac{1}{-16}$ 01

d = 40 cm 01

(ii)



01

(iii) $\frac{50}{r} = \frac{80}{40}$

r = 25 cm 01

(iv) $\Pi x\, 0.5^2\, x\, I_1\, x\, \frac{95}{100} = \Pi x\, 0.25^2 x\, I_2$ 01

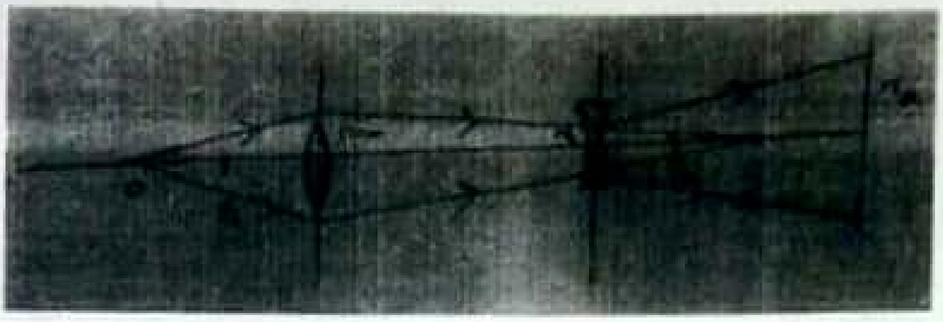
$\frac{I_2}{I_1} = \frac{19}{5} = 3.8$ 01

(b) (i) $\frac{1}{v} - \frac{1}{-50} = \frac{1}{+40}$ 01

v = 200 cm 01

from L_2 2m

(ii)



01

(iii) $\frac{50}{r_1} = \frac{80}{50}$

$r_1 = 31.25\ cm$ 01

(iv) $\frac{r_2}{r_1} = \frac{570}{200}$ 01

$r_2 = 89.1\ cm$

(c) (i) reflection, refraction, interference and diffraction 01

(ii) Coherent, monochromatic, highly directional, high intensity 01

(iii) Population inversion 01

(iv) $2^n - 1$ 01

7.

(a) (i) When one end of a solid is heated, the molecules vibrate more strongly. Whenever these molecules collide with the neighbouring molecules, the vibrational kinetic energy is transferred to the neighbouring molecules. This process is continued and heat is conducted through the solid. 02

(ii) Both involve a transfer of vibrational energy of the molecules in a medium 01

(b) (i) K - Thermal Conductivity

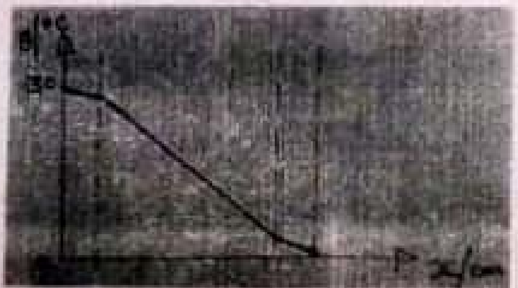
A - Cross sectional area perpendicular to the flow of heat.

$\frac{d\theta}{dx}$ - temperature gradient 01

(ii) The rod must be well lagged

Steady state must be attained 01

(c) (i)



01

No heat loss from the sides 01

(ii) $\frac{Q}{t} = KA\frac{(\theta_1-\theta_2)}{l}$ => $\frac{1}{A}\frac{Q}{t} = K\frac{(\theta_1-\theta_2)}{l}$ => $\theta_1 - \theta_2 = \frac{l}{KA}\frac{Q}{t}$

$30 - \theta_1 = \frac{1}{A}\frac{Q}{t}\left(\frac{2.00\times10^{-3}}{210}\right)$

$\theta_1 - \theta_2 = \frac{1}{A}\frac{Q}{t}\left(\frac{1.60\times10^{-2}}{0.024}\right)$ } 03

$\theta_2 - 0 = \frac{1}{A}\frac{Q}{t}\left(\frac{2.00\times10^{-3}}{210}\right)$

$30 = \frac{1}{A}\frac{Q}{t}\left(\frac{4.00\times10^{-3}}{210} + \frac{1.60\times10^{-2}}{0.024}\right)$

$\frac{Q}{At} = 45.0\ Wm^{-2}$ 01

(iii) Thickness of air layer is reduced, temperature gradient increases. Hence the rate of heat flow increases. 01

(iv) 'K' of metals are of the same order and are very high compared to air. Rate of heat flow almost same. 01

(v) Trapped air cannot move. Hence loss of heat by convection cannot take place. 01

(vi) heat is lost by convection 01

8.

(a) $\omega = 2\Pi f = 2 \times \Pi \times \frac{5000}{60}$ 01

$= 524$ rad s^{-1} 01

(b) (i) $\omega = \frac{2\Pi}{24\times60\times60} = 7.3 \times 10^{-5}$ rad s^{-1} 01

(ii) $a = r\omega^2$

$= 6.4 \times 10^6 \times (7.3 \times 10^{-5})^2$ 01

$= 3.4 \times 10^{-2}$ m s^{-2} 01

(c) (i)

at equator

$mg - F = mr\omega^2$

$F = m(g - r\omega^2) = mg'$

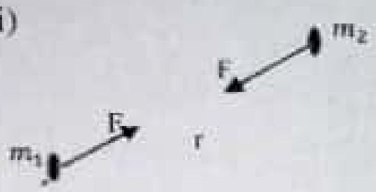
$g' = g - r\omega^2$ 01

at equator part of this 'g' has to provide the centripetal acceleration, the acceleration of free fall lower. But poles are not in circular motion 01

(ii) Earth's angular velocity is low. 01

At equator $g - g' = R\omega^2 = 0.03$

(d) (i)



Gravitational force of attraction F between two point. Masses m_1, m_2 is directly proportional to the product of masses. And inversely proportional to the square of their separation r 01

$$F \propto \frac{m_1 m_2}{r^2}$$

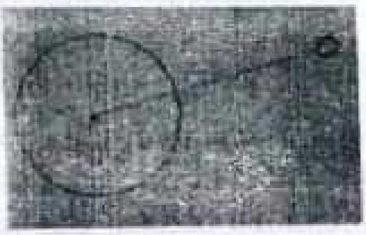
(ii)

$$F = \frac{GMm}{r^2}$$

$$g = \frac{F}{m}$$

$$g = \frac{GM}{R^2}$$ 01

(e) (i)



$$\frac{GMm}{r^2} = mr\omega^2$$ 01

$$r^3 = \frac{GM}{\omega^2} = \frac{gR^2}{\omega^2}$$

$$r^3 = \frac{10x(6.4\,x10^6)^2}{(7.3x10^{-5})^2}$$

$r = 4.2 \times 10^7$ m 01

(ii) 1.Satellite lies on a plane containing the earth's equator and is always directly above a point on the equator

2. The satellite rotates from west to east, the earth's direction of rotation. 01

(f) Polar - satellites in low orbits are closer to earth, signals are received more strongly. 01

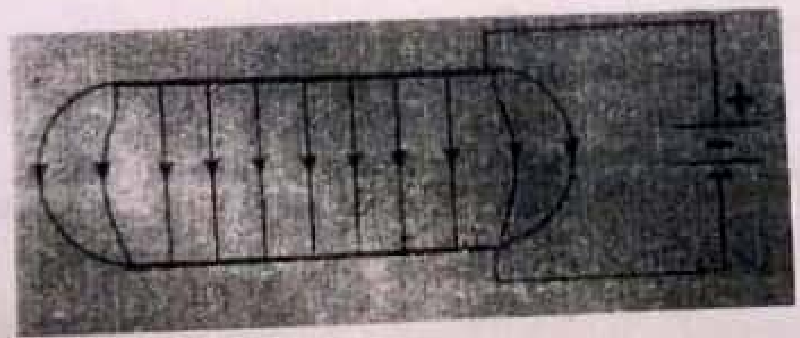
Geostationary - Continuous transmission between the ground station and the satellite, since they are always at the same spot above the equator 01

9.

(a) (i) Electrostatic force per unit positive charge placed at that point in the field. 01

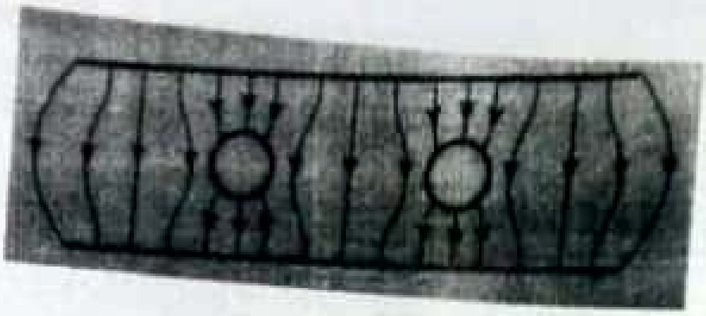
(ii) Magnitude of 'E' is equal at all points and direction at every point is same. 01

(iii) Connect a battery across a pair of parallel conducting plates.



01

(b) (i)



01

(ii)

01

(iii) The conductor must either be charged or close to another charged object so that a large electric field would exist near the conductor. This would occur near the pointed end where a high potential difference would exist between the pointed end and some nearby object. 01

(c) (i) F = qE

W = qE x d 01

= +qEd

(ii) $V = \frac{W}{q} = \frac{qEd}{q} = Ed$ 01

(d) (i) $n = \frac{8.6 \times 10^{-3} Cs^{-1}}{1.6 \times 10^{-19} C}$ 01

$n = 5.4 \times 10^{16}\ s^{-1}$ 01

(ii) Gain in Kinetic energy = loss in electrical potential energy

$\frac{1}{2}mv^2 = eV$ 01

$v = \sqrt{\frac{2eV}{m}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 60 \times 10^3}{9.11 \times 10^{-31}}}$

$v = 1.45 \times 10^8\ m\ s^{-1}$ 01

(iii) energy = 60 keV

Power = $5.4 \times 10^{16} \times 60$ keV $s^{-1} = 5.4 \times 10^{16} \times 60 \times 10^3 \times 1.6 \times 10^{-19} = 517$ W 01

(e) (i) $E = 9 \times 10^9 \times \frac{0.060 \times 10^{-6}}{(0.10)^2} = 5.4 \times 10^4\ NC^{-1}$ 01

(ii) $V_B - V_C = V_A - V_B$

$$\frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_B}-\frac{1}{r_C}\right]=\frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_A}-\frac{1}{r_B}\right]$$

$$\frac{1}{0.50}-\frac{1}{r_C}=\frac{1}{0.40}-\frac{1}{0.50}$$

$$r_C = 0.67m$$ 01

10.

(a) (i) One volt is the potential difference between two points in a circuit if one joule of energy is converted from electrical to non-electrical form per Coulomb of positive charge flowing between two points. 01

(ii) Work done to take one Coulomb positive charge from negative terminal to positive terminal through the cell is e.m.f.

Work done to take unit positive charge from positive terminal to negative terminal through external circuit is potential difference 01

(b) (i) Q = 0.24 x 5 x 60 = 72 C 01

(ii) EQ = 1.5 x 72 = 108 J 01

(iii) Energy loss in 'r' = I^2rt = 0.2rt = 0.24^2 x 0.25 x 5 x 60 = 4.32 J 01

Energy transferred in 'R' = 108 - 4.3 = 103.7 J 01

(iv) R = $\frac{103.7}{4.32}$ x 0.25 = 6.0 Ω 01

(c) (i) $R = \frac{1.5+1.5}{0.41} = 7.32\Omega$ 01

New R = 7.32 - (0.25+0.25) = 6.82 Ω 01

(ii) Current causes more heating an increase in amplitude of vibrations. More collisions. This increases resistivity. 01

(d) (i) The external loads will have a minimum total resistance of 3800 Ω (20°C)

Internal resistance 0.5 Ω ≪ 3800 Ω 01

(ii) 0°C, $V_1 = \frac{4000}{6000} x\ 3 = 2.0V$ 01

0°C, $V_2 = \frac{1800}{3800} x\ 3 = 1.4V$ 01

(iii) $\frac{R}{4000+R} x\ 3 = 1.2$

R = 2670Ω

$\frac{R}{1800+R} x\ 3 = 2.4$ } 01

R = 7200 Ω

There is no single value for R that satisfies both conditions. 01