

අවසාන වාර පරීක්ෂණය ජූනි - 2018
Term End Test June - 2018

භෞතික විද්‍යාව I **Physics I**	**01 E I**	පැය දෙකයි ***Two hours***

13- ශ්‍රේණිය Grade -13

3 – වන වාරය, 3rd Term Test

Instructions :-

*Answer all 50 questions .

* Mark the correct or most suitable answer with (×) out of the five choices given for each question from 1 to 50.

g= 10 Nkg $^{-1}$

(1) Gravitational field intensity on Earth's surface g = Krd where r - radius of Earth d- density of Earth, [assuming that Earth is a perfect sphere]. Units of the constant K is;

(1) $kgms^{-2}$ (2) $kgm^{-1}s^{-1}$ (3) $kgm^{-3}s^{-2}$ (4) $kg^{-1}m^{3}s^{-2}$ (5) $kg^{-1}m^{2}s^{-2}$

(2) Which of the following statement/s is/are true?

A - Due to a moving charge only a magnetic field is created.

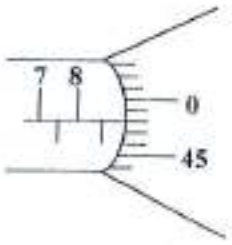
B - A current carrying conductor placed in a magnetic field, always experiences a magnetic force acting on it.

C - There is always only an attractive force occures between two parallel conductors carrying current towards the same direction.

(1) A only (2) B only (3) C only

(4) A and C only (5) B and C only

(3) Shown in the diagram is a micrometer screwguage which consists of 0.5mm pitch and 50 divisions in its' circular scale. When checked for zero error, 48th circular division coincided with the horizontal line of the sleeve. The actual value of the measurement corresponding to the reading shown here is;



(1) 9.02mm (2) 8.48mm (3) 8.98mm

(4) 8.96mm (5) 9.00mm

(4) A particle "A" is projected vertically upwards at 30ms^{-1} velocity from a point 80m above ground level. After 5s another particle B is released from rest from a point 35m right below the point of projection of A. The time taken for particle A to pass B;

(1) 6s (2) 3s (3) 4.5s (4) 10s (5) 8s

(5) The path of an electron entering a magnetic field at a certain inclination with a certain velocity is a;

(1) Circle (2) Straight line (3) Parabola

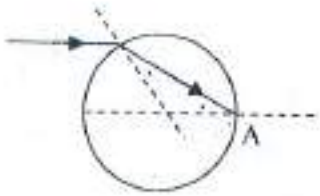
(4) Spiral [helical] (5)doesn't move at all

(6) A particle projected up at θ angle with the horizontal from the level ground hit a point which is at d horizontal distance and h vertical height from the point of projection. θ is equal to;

(1) $\frac{g}{\cos\theta}\sqrt{\frac{d}{2(d\tan\theta-h)}}$ (2) $\frac{d}{\cos\theta}\sqrt{\frac{g}{2(d\tan\theta-h)}}$ (3) $\sqrt{\frac{gd^2}{\cos^2\theta}}$

(4) $\sqrt{\frac{gd^2}{d-h}}$ (5) $\frac{d}{\cos\theta}\sqrt{\frac{g}{2(d\tan\theta+h)}}$

(7) Consider the following statements regarding a ray of light entering a spherical drop of water.



A - incident rays are partially reflected at point A.

B - incident rays are totally reflected at point A.

C - incident rays are totally transmitted through A.

of the statements, .

(1) Only A is true (2) Only B is true (3) Only A and B are true.

(4) Only A and C are true. (5) None of these is true.

(8) A bullet of mass 100g flying at $150ms^{-1}$ horizontal velocity gets embedded into a wooden cube of mass 2.9kg hanging from a string of length 50cm. The tension of the string (with the wooden block and the bullet init) when the system makes 60^0 angle with the vertical.

(1) 135N (2) 125N (3) 140N (4) 90N (5) 100N

(9) A plane with total extension of its' wings 50m flies $360kmh^{-1}$ horizontal constant speed Vertical component of Earth's magnetic field is 5×10^{-4}T . EMF induced across the ends of the wingspan;

(1) 0.25V (2) 2.5V (3) 25V (4) 40V (5) 50V

(10) Water flows steadily through a horizontal tube of flow at $1ms^{-1}$ speed through $10cm^2$ cross section at 2kPa pressure. The pressure at $5cm^2$ cross section of tube is;

(1) 200Pa (2) 400Pa (3) 500Pa (4) 800Pa (5) 1000Pa

(11) The equivalent resistance across A and B is;

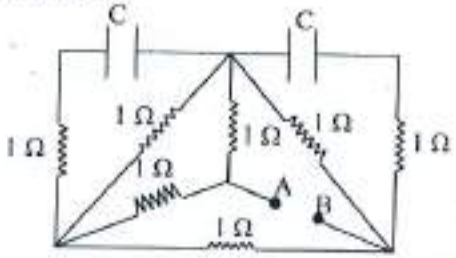
(1) 1 Ω

(2) 2 Ω

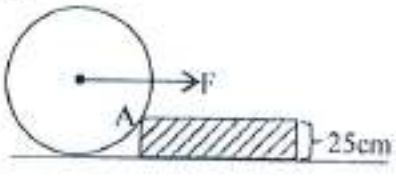
(3) 3 Ω

(4) 4 Ω

(5) 5 Ω



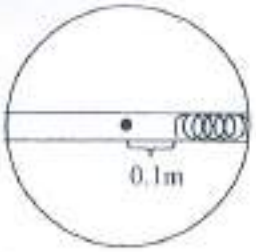
(12) A plate of radius 50cm and mass 5kg is held verically and is in contact with a step of height 25cm at A. What is the minimum value of the horizontal force F applied perpendicular to the axis of plate so that the plate could get into the step?



(1) 50N (2) $50\sqrt{3}$ N (3) 25N

(4) 100N (5) Non of the above

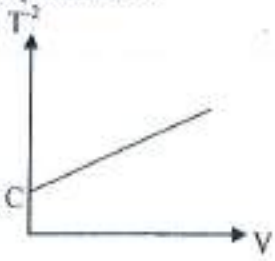
(13) A smooth cavity is located along a diameter of a circular horizontal table of radius 0.5m. A ball of mass 90g connected to one end of a spring of spring constant 19Ncm^{-1} is at rest at 0.1m distance from the centre of the table. The other end of the spring is fixed to the edge of the table. Now the table starts to rotate at 100 rads^{-1}

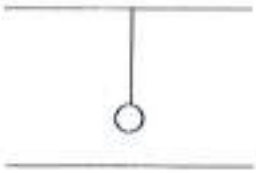


Constant angular velocity. The displacement of the ball from its' equilibrium position is;

(1) 9×15^{-1} m (2) 9×10^{-2} m (3) 1×15^{-1} m
(4) 9×10^{-3} m
(5) 1×10^{-2} m

(14) Shown here is a string of length L attached to a positively charged particle oscillating inbetween two parallel horizontal plates under a potential difference. V. The variation of the reciprocal of the square of time period ($1/T^2$) of the simple pendulum with the potential difference (V) applied at the two parallel sheets is depicted here.





Which of the following statement/s is/are true?

(a) Bottom plate is negatively charged while the upper plate is positively charged.
(b) Gradient of the graph increases if the separation between plates increases.
(c) Gravitational acceleration $g = 4\pi^2 LC$

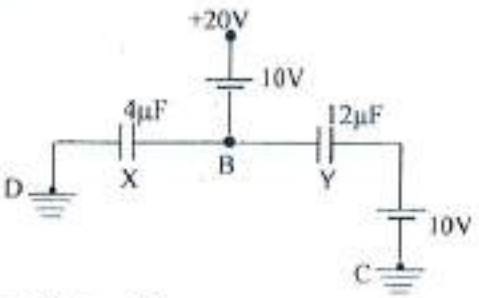
(1) a only (2) a and b only (3) a and c only
(4) b and c only (5) All a, b and c

(15) Two cubes A and B made of the same material are of similar surface nature, with different sizes, of sidelength "2a and a" respectively.
They are heated to the same temperature and allowed to cool under identical enviranmental conditions. The ratio between the initial rates of temperature loss of A and B is;

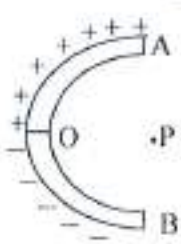
(1) 1 : 2 (2) 2 : 1 (3) 4 : 1 (4) 8 : 1 (5) 1 : 6

(16) Which of the following is true about the setup shown here?

(1) Charge on capacitor Y is zero.
(2) Charge on capacitor Y is 30μC
(3) Charge on capacitor X is 30μC
(4) Charge on capacitor X is 20μC
(5) None of the above.



(17) A thin glass rod is bent into a hemispherical shape of radius r. +Q charge is uniformly distributed on its' upper half and -Q on bottom half. The electric field intensity at P which is the centre of the hemispherical structure;



(1) $\frac{Q}{\pi^2\varepsilon_0 r^2}$ (2) $\frac{2Q}{\pi^2\varepsilon_0 r^2}$ (3) $\frac{4Q}{\pi^2\varepsilon_0 r^2}$ (4) $\frac{Q}{4\pi^2\varepsilon_0 r^2}$ (5) 0

(18) Two identical spherical drops of Mercury each charged to a potential V, combines to form a single drop of potential;

(1) V (2) $2^{1/3}$ V (3) $2^{1/2}$ V (4) $2^{2/3}$V (5) 2V

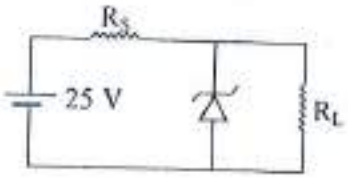
(19) A uniform metal rod of length L and mass M is rotated at a constant angular velocity ω about an axis through one of its' ends. Now the temperature of the system is raised by an amount of t°C. The corresponding change in angular velocity is directly proportional to;

(1) $\sqrt{\omega}$ (2) ω (3) ω^2 (4) $\frac{1}{\omega}$ (5) $\frac{t}{\omega^2}$

(20) A40cm long capillary tube with 20cm length of a Mercyry column rapped is sealed in an environment with 99Hgcm pressure, at the horizontal position shown here. When the capillary tube is held vertical, the length of space above Mercury is;

(1) 12 (2) 11 (3) 15 (4) 9 (5) 16

(21) Zener Voltage of the Zener Diode shown here is 10V and the maximum current passed through it is 100mA.The minimum current at steady operational state is 20mA for R_L = 250Ω The ratio between minimum and maximum values of Rs is;

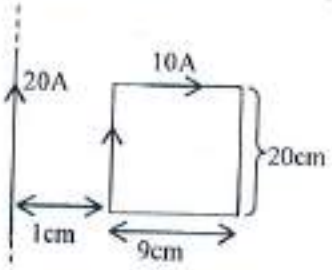


(1) $\frac{1}{5}$ (2) $\frac{2}{5}$ (3) $\frac{3}{5}$ (4) $\frac{4}{5}$ (5) 1

(22) An AC voltage source V = 240 sin (100πt) drives a current through 50 Ω resistor. The time taken by the current through the resistor to reach its' root mean square value from the peak value is; ($I_{peak} \rightarrow I_{rms}$)

(1) 25s (2) 2.5s (3) 0.25s (4) 2.5ms (5) 25ms

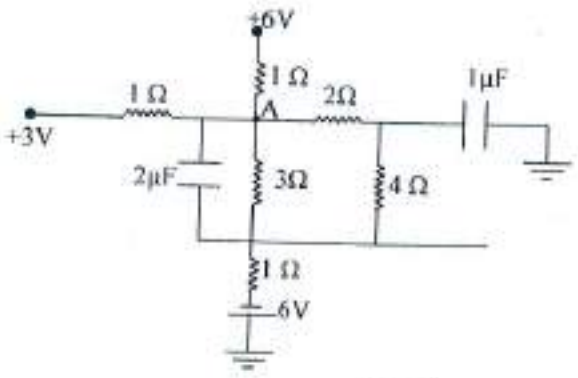
(23) A rectangular loop of Area (20cm x 9cm) is placed at 1cm distance from an infinitely long conductor carrying 20A current; both on the same plane. The resultant force on the loop when 10 A current circulates through it is;



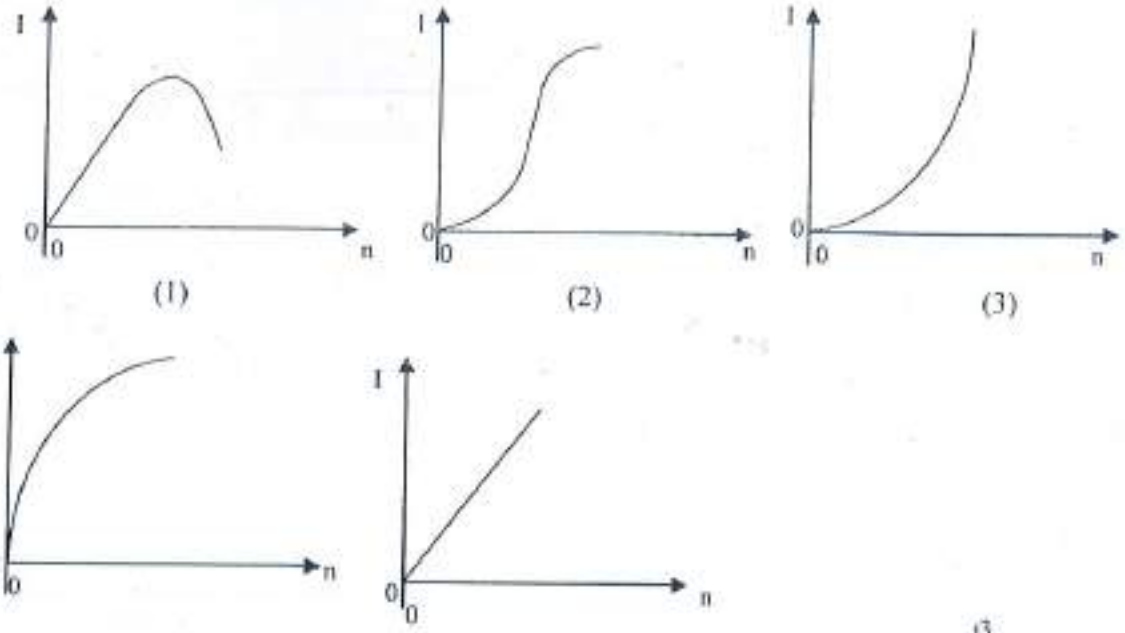
(1) 0N (2) 3.6×10^{-4}N towards left (3) 3.6×10^{-4}N towards right
(4) 7.2×10^{-4}N towards left (5) 7.2×10^{-4}N towards right

(24) The potential at point A of the circuit shown here is;

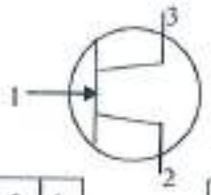
(1) 1V
(2) 2V
(3) 3V
(4) 3.6V
(5) 4V



(25) Which of the following correctly depict the variation of I with n where n is the no. of identical cells connected in parallel (cells having an internal resistance) and I is the current flowing through the circuit?



(26) Which of the following shows the correct biasing polarities of JFFT given here?



1	2	3
+	−	+

(1)

1	2	3
+	+	−

(2)

1	2	3
−	+	−

(3)

1	2	3
−	−	+

(4)

1	2	3
−	+	+

(5)

(27) Current flows through a metal wire of temperature coefficeint of resistance $0.004K^{-1}$. When the temperature of the wire is increased from 20^0C to 80^0C, for the current to remain the same as before, what should be the percentatge increment of the potential difference across the wire?

(1) 46.6% (2) 40% (3) 22.2% (4) 20% (5) 19%

(28) A moving coil galvanometer shows 50 units deflection when a constant electric current flows through it. When a shunt of 12Ω is connected across the galvanometr, its' deflection reduced to 10 units. The internal resistance of the galvanometer is;

(1) $36\ \Omega$ (2) $48\ \Omega$ (3) $50\ \Omega$ (4) $54\ \Omega$ (5) $72\ \Omega$

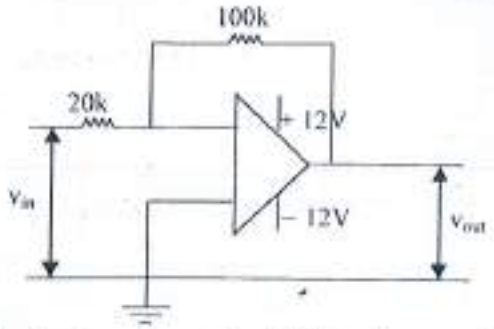
(29) Two cylindrical containers A and B each contains V volume of an ideal gas at room temperature, covered with two smooth pistons. m_A mass of the gas in A, m_B mass of the gas in B. Now the two systems are allowed to expand isothermally up to 2V volume each. Final pressure of gas samples in A and B are P and 1.5 P respectively. Which of the following is the correct relationship between m_A and m_B ?

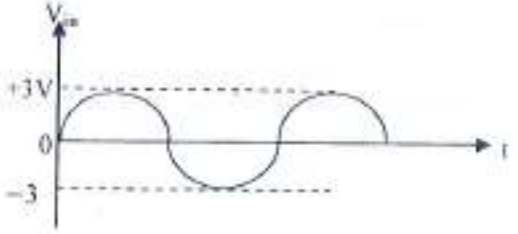
(1) $4m_A = 9\ m_B$ (2) $2m_A = 3m_B$ (3) $3m_A = 2m_B$ (4) $9m_A = 4\ m_B$ (5) $2m_A = 9m_B$

(30) The speed of sound in Oxygen (O_2) at a certain temperature is ~~460~~ 355 ms^{-1}. The speed of sound in Helium (He) at the same temperature will be,

(1) $330\ ms^{-1}$ (2) $1420\ ms^{-1}$ (3) $500\ ms^{-1}$ (4) $650\ ms^{-1}$ (5) $400\ ms^{-1}$

(31)

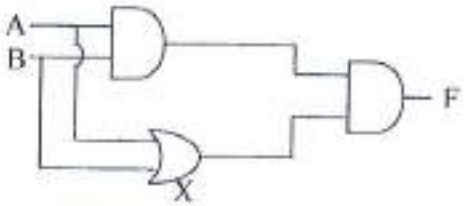




The input voltage signal fed to the operational Amplifier circuit is as shown here. What are the possible maximum and minimum values for the output voltage?

(1) 15V , - 15V (2) 16V , - 16V (3) +12V, - 12V (4) 13V, -13V (5) 3V , -3V

(32) The Boolean expression for the output F of the Logic circuit shown here is $F = (A.B)(A + B)$ for output to be $F = (A.B).\overline{(A + B)}$ the logic gate X is replaced with;

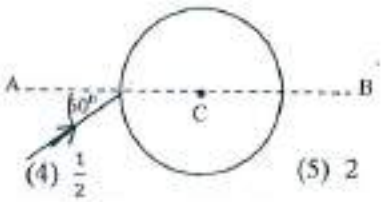


(1) AND (2) OR (3) NOR (4) NAND (5) NOT

(33) A cube of iron floats on Mercury (Hg) with K_1 faction of its' volume submerged at 0^0C temperature and K_2 fraction submerged at 60^0C. Volume expansivity of Hg = γ_{Hg}. Volume expansivity of iron= γ_{Fe}. The ratio $\frac{K_1}{K_2}$ is equal to;

(1) $\frac{1+60\,\gamma_{Fe}}{1+60\,\gamma_{Hg}}$ (2) $\frac{1-60\,\gamma_{Fe}}{1+60\,\gamma_{Hg}}$ (3) $\frac{1+60\,\gamma_{Fe}}{1-60\,\gamma_{Hg}}$ (4) $\frac{1+60\,\gamma_{Hg}}{1+60\,\gamma_{Fe}}$ (5) $\frac{1-60\,\gamma_{Fe}}{1-60\,\gamma_{Hg}}$

(34) Figure shows a ray of light falls on a transparent sphere with center at C. The ray emerges from the sphere parallel to line AB. The refractive index of the sphere material is,



(1) $\sqrt{2}$ (2) $\sqrt{3}$ (3) $\frac{3}{2}$ (4) $\frac{1}{2}$ (5) 2

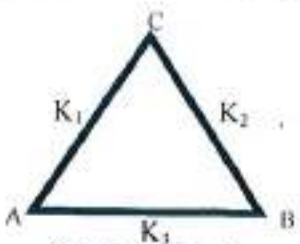
(35) A uniform metal rod of length L and mass M is rotated at a constant angular velocity about an axis through one of its' ends. Now the temperature of the system is raised by an amount of t^0C. The corresponding change in angular velocity is directly proportional to;

(1) $\sqrt{\omega}$ (2) ω (3) ω^2 (4) $\frac{1}{\omega}$ (5) $\frac{1}{\omega^2}$

(36) Two identical containers with initial volume $8.2dm^3$ temperature 27^0C and at pressure "P" are connected using a thin tube. Now the temperature of one of the containers is made 177^0C while the other remaining at 27^0C . Now the pressure of the system would be;

(1) 1P (2) 1.2P (3) 1.4P (4) 1.6P (5) 1.8P

(37) Three rods having equal dimensions with thermal conductivities K_1, K_2 and K_3 are connected as shown here. The ends A and B are maintained at two different temperatures. Heat flows through the paths ACB and AB at the same rate. Which of the following relationships is true?



(1) $K_3 = 2(K_1 + K_2)$ (2) $K_3 = \frac{K_1 K_2}{K_1 + K_2}$ (3) $K_3 = K_1 + K_2$

(4) $K_3 = \frac{1}{2}(K_1 + K_2)$ (5) $K_3 = \frac{1}{(K_1 + K_2)}$

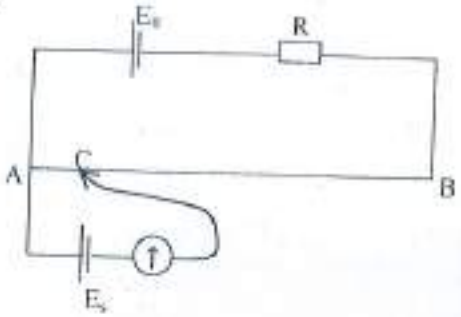
(6)

(38) Radius of moon interms of its' mass (M) universal Gravitational constant (G) and gravitational acceleration (g) at "h" height above moon's surface is;

(1) $\sqrt{\frac{GM+h^2}{g}}$ (2) $\sqrt{\frac{GM-h^2}{g}}$ (3) $\sqrt{\frac{GM}{g}}-h$ (4) $\sqrt{\frac{GM}{g}}+h$ (5) $\sqrt{\frac{GM}{g}-h^2}$

(39) The balance point C of the circuit shown here is obtained closer to A. Inorder to shift it closer to B;

(1) The value of R should be reuced
(2) A resistor is connected in series with the cell E_S and the galvanometer.
(3) Interchange E_0 and E_S
(4) Increase the value of R.
(5) None of he above.



(40) Which of the following expression/s is/ are true about the equation $E = \sigma T^4$ Corresponding to a perfect blackbody radiator?

a) T is measured either in ^0C or K.
b) The value of σ is independent of the surface nature of the blackbody.
c) The above equation is valid for object of any geometrical shape.

(1) a only (2) a and b only (3) a and c only
(4) b and c only (5) c only

(41) Which of the following relationships is correct about kinetic energy of a moving particle (E) and its' De Broglie wavelength (λ_D) ?

(1) $\lambda_D \propto \sqrt{E}$ (2) $\lambda_D \propto E$ (3) $\lambda_D \propto \frac{1}{\sqrt{E}}$ (4) $\lambda_D \propto \frac{1}{E}$ (5) $\lambda_D \propto E^2$

(42) A 16g sample of radioactive element having Half Life (T 1/2) two days, decays for 14 days. The mass of radioactive element left undecayed after 14 days is;

(1) 1g (2) 0.5g (3) 0.25g (4) 0. 125g (5) 1mg

(43) A simple pendulum oscillating at time period "T" consists of a string of length "l" cross section "A" and Young's modulus "Y". When an additional weight mg is attached at the pendulum's bottom end, its' new period of oscillation (T^1) is given by;

(1) T (2) mg T (3) $T\sqrt{mg/yA}$ (4) $T\sqrt{1+\frac{mg}{YA}}$ (5) $T\sqrt{YA/mg}$

(44) The work done in making a square shaped film of soap (10cm ×10cm) ; surface tension of soap = $3 \times 10^{-2} Nm^{-1}$

(1) $6 \times 10^{-4}J$ (2) $3 \times 10^{-4}J$ (3) $6 \times 10^{-3}J$ (4) $3 \times 10^{-3}J$ (5) $3 \times 10^{-2}J$

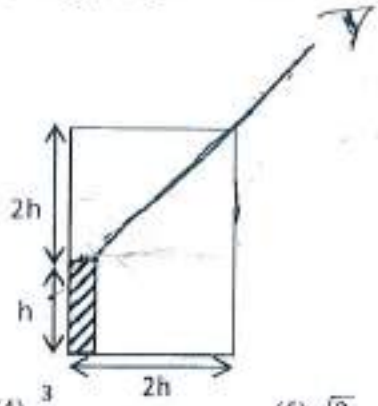
(45) A piston of radius "r" and length "l" is sent at speed "u" through a thin layer of oil of viscosity η and thickness "d" which covers the inner surface of a cylinder. The resistive force on the piston is;

(1) $\frac{2\pi r l \eta u}{d}$ (2) $2\pi r l \eta u d$ (3) $\frac{\pi r^2 l \eta u}{d}$ (4) $\pi r^2 l \eta u d$ (5) $2\pi r l \eta u$

(46) A ray of light incident normally on the horizontal face of the glass slab and just fails to emerge from the diagonal face of the prism. The refractive index of the prism could be,

(1) $\sqrt{2}$ (2) $\sqrt{3}$ (3) Slightly greater than 2
(4) Slightly less than 2 (5) 2

(47) An observer can see through a pin-hole the top end of a thin rod of height h, placed in a beaker as shown in the diagram. The height of the beaker is 3h and its' radius is h. When the beaker is filled with a liquid up to a height 2h, he can see the lower end of the rod. The refactive index of the liquid is,



(1) $\frac{5}{2}$ (2) $\sqrt{\frac{5}{2}}$ (3) $\sqrt{\frac{3}{2}}$ (4) $\frac{3}{2}$ (5) $\sqrt{3}$

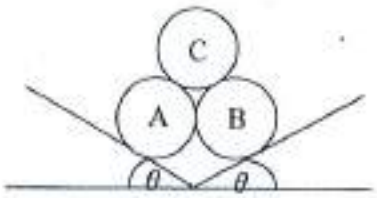
(48) A radar emits a signal 9×10^{9}Hz towards an approaching aeroplane and detects the change in frequency on receiving the reflected wave as 3×10^{3}Hz Speed of Radio Waves in air = $3\times10^{8}ms^{-1}$ Speed of the aeroplane is ms^{-1};

(1) 150 2] 100 3] 50 4] 25 5] 2

(49) A uniform rope of length 12m and mass 6kg hangs vertically from a rigid support, A block of mass 2kg is attached to the free end of the rope. A transverse pulse of wave length 0.06m is produced at the lower end of the rope. The wave length of the pulse when it reaches the top of the rope is,

(1) 0.03m (2) 0.06m (3) 0.12m (4) 0.18m (5) 2.2m

(50) A, B, C are three identical rigid cylinders in equilibrium in-between two smooth inclined planes at θ inclination to horizontal. The minimum possible value of θ would be;



(1) $\tan^{-1}\left(\frac{1}{2}\right)$ (2) $\tan^{-1}\left(\frac{1}{3}\right)$ (3) $\tan^{-1}\left(\frac{1}{2\sqrt{3}}\right)$ (4) $\tan^{-1}\left(\frac{1}{3\sqrt{3}}\right)$ (5) $\tan^{-1}\left(\frac{1}{4\sqrt{3}}\right)$

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General Certificate of Education (Adv. Level) Examination, June-2018

භෞතික විද්‍යාව II
Physics II

01 E II

13- ශ්‍රේණිය Grade -13

3 - වන වාරය, 3rd Term Test

පැය තුනයි
Three hours

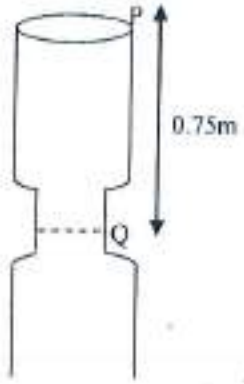
Part B - Essay

Answer 4 questions only.

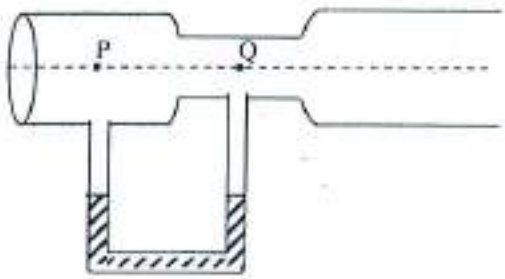
5. (a) State the conditions required for the validity of Bernoulli's principle.

(b) Show that the Bernoulli's equation is dimensionally correct.

(c) The tube shown in the figure can be used to measure speed of a fluid flow. It's diameters at P and Q are 0.8m and 0.4m respectively. Two pressure gauges are connected to the apparatus at P and Q to measure pressure inside it. A liquid of relative density 0.6 flows vertically downwards through the apparatus. P is at a vertical height 0.75m above Q. If both pressure gauges at P and Q read same value, calculate the volume of liquid flowing per second.

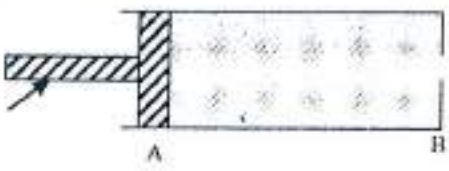


(d) A system of tubes with same cross-sections as the above tubes is place as shown below and made air to flow through.



The density of the liquid in the U tube is $1600kgm^{-3}$ and density of air is $1.2kgm^{-3}$. The velocity of air at P is $20ms^{-1}$ Find the height difference of the liquid columns in the U tube.

(e) A water sprayer used in a garden has a horizontal cylindrical tube as shown below.



It consists of a piston of cross-sectional area $4cm^2$ at the end A and small hole of cross sectional area $4mm^2$ at end B. Calculate speed of ejection of water through this small hole when a force of 50N applied on the piston.

The speed of the piston is negligible and no frictional forces act on the piston. Density of water is $1\times10^3 kgm^{-3}$.

6. (a) To find the velocity of sound in air, a student uses a tube vertically clamped by a stand and changes the water level inside it. Initially the tube is completely filled with water. Then the water level in the tube is gradually lowered. A small loud speaker connected to a variable signal generator is placed above the open end of the tube The air column inside the tube resonates for the first time for the length of air column 130mm when the frequency of the sound of the speaker is 600Hz. The second resonance is obtained at the length of air column 414mm for the same frequency.

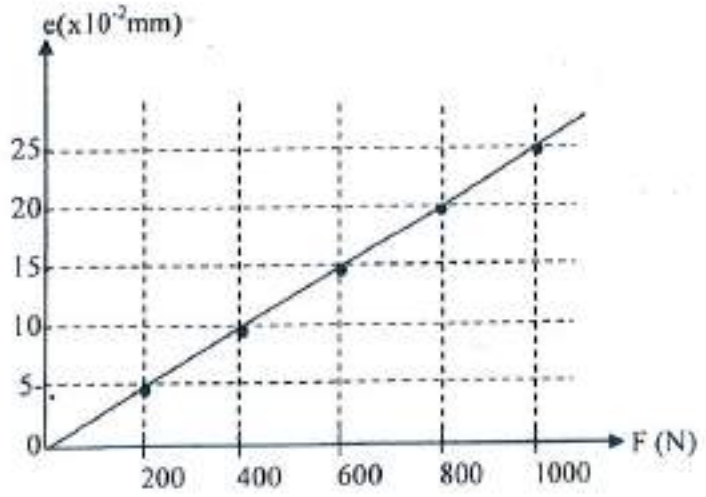
   1) Draw the patterns of the variations of **pressure** inside the tube for the above two situations.
   2) Calculate the end correction of the tube.
   3) Find the velocity of sound in air.
   4) Find the approximate diameter of the tube.

   (b) Next the frequency of the lauds speaker is adjusted to a certain value and the air inside the tube at temperature 39^0C is made to vibrate. Then the beats of frequency 4Hz is heard. When temperature of air inside the tube is decreased to 10^0C, heard beat frequency is 1Hz. Calculate the frequency of the speaker.

   (c) The student next fixes the tube horizontally and makes the air inside the tube to vibrate with a certain frequency of the speaker. Then one end of the tube is suddenly closed. As a result it is found that the fifth harmonic of the closed tube is 150Hz greater than the fundamental frequency of the open tube. Calculate the fundamental frequency of the open tube. (neglect the end corrections)

7. (a) Define Young's modulus (Y) for a thin metal wire. Name two other physical quantities having similar dimensions to that of Young's modulus.

   (b) Shown here is the variation of contraction (e) of a uniform hollow cylindrical plastic rod under a variable comperessional force (F)



(i) Write down the Law with which you can interpret this graph. What elastic potential energy (in mJ) is stored in the plastic rod under the external force of 500N?

(ii) Calculate Young's modulus for plastic ($\pi = 3$). External diameter of the plastic rod = 4cm, Diameter of the cavity = 2cm Length of the rod = 90cm

(iii) The maximum compressional force applied on the rod is 3600N. What is the corresponding maximum contraction? What is your assumption for this calculation?

(c) A sealed cubical container of external dimensions 2m ×2m ×2m is resting at the bottom of a deep reservoir with still water. Its' total mass with the content is 1×10^4 kg . Now it is being lifted gently under a constant force using 4 steel wires each of original length 10m and area of uniform cross section $1cm^2$ connected at the 4 corners of the container, such that the wire remain straight and vertical while the container is horizontally stable. Young's modulus of steel = $2\times10^{11}Nm^{-2}$. Density of water $1000kgm^{-3}$ Proportionality limit for each steel wire $4\times10^8Nm^{-2}$

(i) Up to what maximum mass the four wires together can support? What is the corresponding extension in each wire?

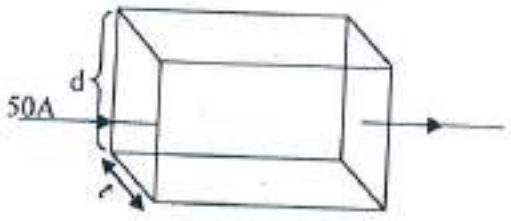
(ii) What is the extension of each wire in water, Once the container is just raised above the bottom of reservoir ?

(iii) Now the container is lifted with constant speed by uniformly decreasing the length of wires using a pulley mechanism. Once the box is completely raised out of water, extension of each string is 2.5mm. At this instance, what is the difference in height between the container and pulley?

(iv) If the container is completely raised above water surface, by directly pulling up the wires (without reducing their length using pulley mechanism) what would be the corresponding extension of each wire?

8. (a) Write down an expression for the force acting on moving charged particle entering to a magnetic field at an angle θ to the field. Introduce the symbols used.

As shown in the following figure current of 50A flows through a thick Cu plate.



t = 0.1cm d = 0.02m

(i) Find drift velocity of electrons.

Charge of an electron = $1.6\times10^{-19}C$

Number of electron per volume of Cu = $2\times10^{29}m^{-3}$

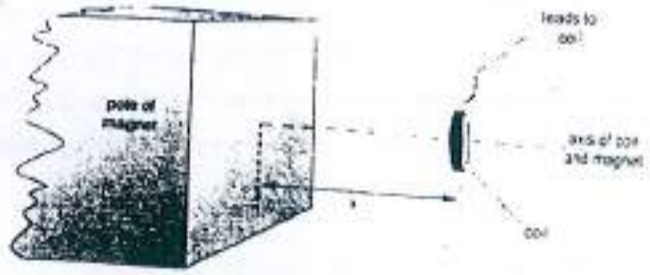
(ii) Now consider there is a uniform magnetic field of flux density 2T acting perpendicular to the direction of the current in the Cu plate and directed out of the paper. What is the magnitude of magnetic force acting on electrons.

(iii) What is the magnitude and direction of the electric field required to balance the above magnetic force.

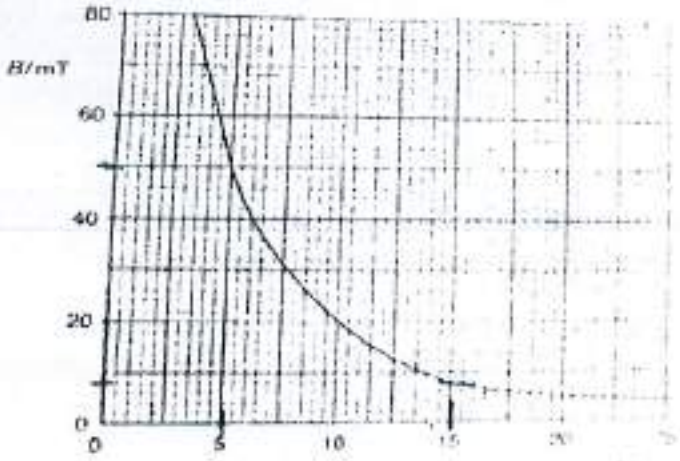
(iv) Find the required potential difference that should be on either side of conductor to obtain this electric field. State it's polarity.

(v) Without applying this potential difference externally, it can be obtained by the deviated of electrons. For this purpose what should be the magnitude and direction of electric field in the conductor.

(b) In the following figure, it is shown a small wire coil placed near a large bar magnet. The axis of the coil is parallel to the axis of the magnet.



The cross-sectional area of the coil is $0.4cm^2$ and has 150 turns. The variation of magnetic flux density (B) of the bar magnet with the distance x from it is shown below.



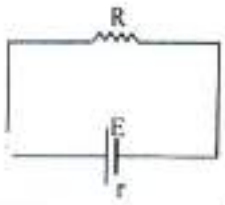
(i) What is magnetic flux density at a distance 5cm when the coil is at that position.

(ii) What is the total magnetic flux through the coil.

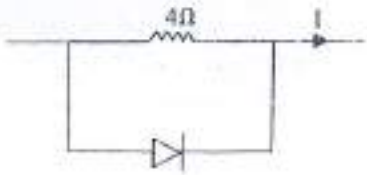
(iii) The coil is moved from the point at distance 5cm to the point at distance 15cm in time 0.2s, Calculate the induced electric motive force in it.

9. **Answer either part A or part B only**

(A) (i) A cell of emf E and internal resistance r is connected across a resistor R as shown in the diagram. The current in the circuit is I. Write the expression for the power of the resistor R interms of E, I and r.

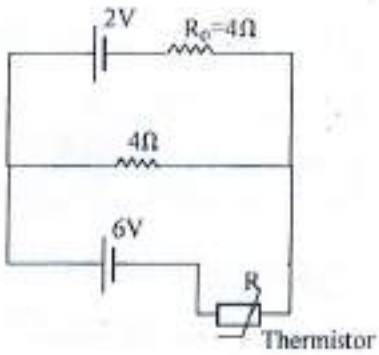


(ii) To send a constant current through the resistor 4Ω a diode of barrier potential 0.6V is connected across it a as shown in the diagram.



If the current through the forward biased diode is 0.05A, find the current through the 4Ω resistor and the total current I.

(iii) A circuit with a thermistor shown in the diagram is used to measure the temperature of a car engine. R is the resistance of the thermistor.



a) Obtain an expression for the current I through R_0 in terms of R.

b) When the engine temperature 30^0C, the current through R_0 is zero. Find the value of R at 30^0C.

c) The current through R_0 is 0.15A when the engine temperature is 100^0C. Find the value of R at 100^0C.

d) Sketch the variation of the resistance of the thermistor with the its temperature.

e) Find the temperature - resistance co-efficient of the thermistor.

(iv) To limit the current to 0.15A through R_0, the diode is used as in part (ii). Then find the value of R.

(B) a) (i) Name the three configurations of the transistor and draw the relevant circuit diagrams for npn transistor. Clearly show the input and output.

(ii) The configuration having a voltage and current gain is used as an amplifier.

a) Write three requirements in basing the transistor.

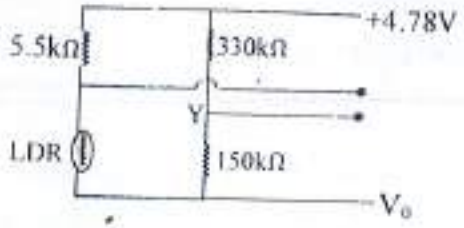
b) Draw the circuit diagram for the amplifier which is biased using a single 9V power supply and two resistors R_B and R_C .show clearly the input and output terminals.

c) Calculate the value of R_B to produce 40 mA base current. The transistor is a si-type and potential barrier is o.7 V.

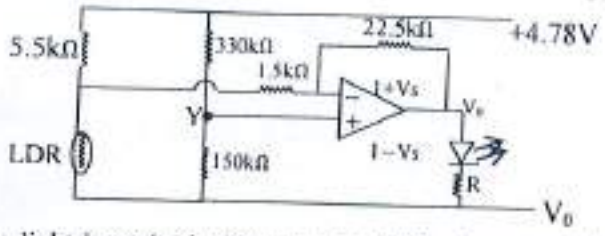
d) Taking the dc current gain a 100.Find R_C .

(iv) What are the two biasing regions of the transistor when it is used as a switch.

b) (i) Light dependent resistor (LDR) is used in a Wheatstone bridge as shown in the diagram. When light is incident with certain intensity on the LDR, the bridge is balanced. Find the resistance of the LDR under the light.



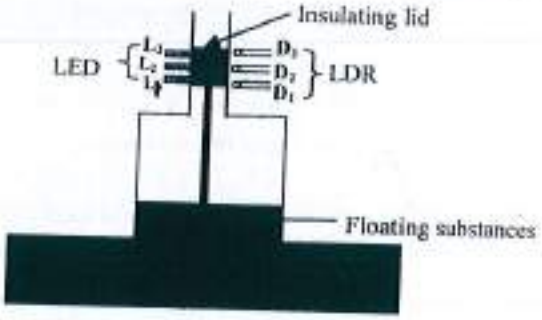
(ii) The X and Y terminals of the Wheatstone bridge is applied to the two inputs of the operational amplifiers as shown in the diagram.



For certain light intensity incident on the LDR, the potential at X is 1.38V .Then the LED connected to the output emits light. Find,

a) The resistance of the LDR under this light intensity.
b) The voltage gain of the amplifier.
c) Output voltage.

c) The diagram below shows a part of a device used to inform people about the flood in a region where there is a flood threat due to over flow of a river.



L_1 , L_2 and L_3 are laser beam directed to LDR's , D_1,D_2 and D_3 respectively. Initially laser beams are covered by an opaque moveable knob connected to the piston. When the water level is 5m the knob is little lifted and the light from L_1 falls on D_1.When the water level is 6m, the knob is further lifted and light from L_1 and L_2 fall on D_1 and D_2 respectively. When light falls on a LDR it produces a logic '1' and when no light is incident on a LDR it produces a logic '0'.
When D_1 receives light , a yellow colour LED is lighted to indicate the potential flood threat. When D_1 and D_2 both receive light orange colour LED is lighted to indicate minor flood thread. When D_1 , D_2 and D_3 all receive light from L_1 , L_2 and L_3 respectively , red LDD is lighted to indicate the major flood threat.

(i) Taking the input signals of D_1, D_2 and D_3 as A, B and C prepare the relevant truth table. F_1, F_2 and F_3 indicate the initial flood threat , minor flood and major flood respectively.

(ii) Write the corresponding Boolean expression for F_1, F_2 and F_3 respectively.

(iii) Draw the corresponding circuit diagram using basic logic gates.

10. **Answer either part A or part B only**

(A) (i) Write down an expression for the external work done by gas if it's volume is increased from V_1 to V_2 under a constant pressure P. State whether this work is done by gas or on the gas.

(ii) Mass of 1kg of water at temperature 100^0C is converted in to vapour under constant atmospheric pressure 1.01×10^5Pa . Therefore it's volume increases 1.00×10^{-3} m^3 to $1.671m^3$. The specific latent heat of vapourisation of water is 2260kJkg (Give all answers to its nearest integer value)

(1) What is the amount of external work to be done in the process?

(2) Calculate amount of heat to be supplied to the system externally.

(3) What is the change of internal energy of system? In what form does this energy exist in gas.

(4) What percentage of energy is used to do external work, during the process?

(5) Can you name the above process as an isothermal process? Explain.

(iii) (1) A certain mass of eather in a container at 13^0C is transferred to a large container. As a result it's pressure drops and eather starts boiling. In consequence to this the eather cools. What percentage of eather will evaporate when cooling to 0^0C.
The specific heat capacity of liquid eather = $2.4\times10^3Jkg^{-1}K^{-1}$ The specific latent heat of vapouration of eather = $3.9\times10^5Jkg^{-1}$. Assume there is no heat exchange between the system and the surroundings.

(2) 500g of water at initial temperature 20^0C is placed in the freezer of a refrigerator. In 2 hours the it's temperature falls to -10^0C. Calculate the rate at which the heat is released by water.
Specific heat capacity of water = $4200Jkg^{-1}k^{-1}$
Specific heat capacity ice = $2100Jkg^{-1}k^{-1}$
Specific talent heat of fusion of ice = $336000\ Jkg^{-1}k^{-1}$

(3) What happens to the heat release by water in the freezer.

(4) The door of a refrigerator is kept open inside a room. But the temperature of the room does not fall. Instead the temperature in the room rises. Explain this.

(B) The liberation of electrons from any surface of a substance is called **electron emission**. Any piece of metal block consists of plenty of free electrons. Although the free electrons move randomly inside, they can not leave the surface of the metal to initiate **electron emission**.

On reaching the extreme surface of the metallic block, the free electrons do not get any positive nucleus ahead of them, but they will have attractive force by the nuclei behind them inside the metallic block. So, to leave the metallic surface an electron must cross a potential barrier offers by the positive nuclei. This potential barrier which prevents a free electron to liberate from the metallic surface is called surface barrier. When a sufficient external energy is given to the free electrons, it can cross the surface barrier and liberate from the metallic surface.
A free electron possesses some kinetic energy. But this kinetic energy is not sufficient to overcome the surface barrier. The extra energy required to just overcome the surface barrier of any metal by an electron is called work function.

There are mainly four types of electron emission commonly used, thermionic, field, photo electric and secondary.

When a metal is heated sufficiently, the free electrons at the extreme surface of the metal get sufficient energy to overcome the surface barrier and emit from the metal. This is referred to as thermionic emission.

When high positive field is applied in front of the metal surface. The influence of this high electric field pulls the free electrons and help them to cross the surface barrier of the metal. This is referred as field emission

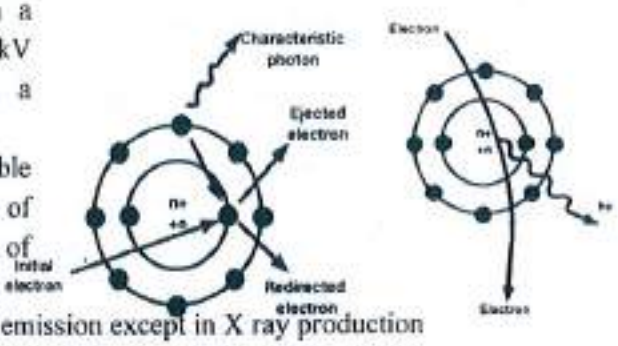
When a beam of high-velocity electrons strikes on the metal surface, the kinetic energy of the electrons is transferred to the free electrons on the metal surface. Thus the free electrons may get sufficient kinetic energy to overcome the surface barrier and start electron emission.

(a) What is meant by the surface barrier and the work function according to the passage?

(b) Surface barrier of a certain metal is 5eV. Kinetic energy of free electron is 1eV. Find the work function of the metal

(c) What are the four types of electron emission? Explain each method briefly

(d) Thermionic electron beam produced from a tungsten filament is accelerated by 200 kV potential difference and bombarded with a tungsten metal to produce X-rays



(i) Copper filament is not practically suitable to produce thermionic electron instead of tungsten filament. Explain this in terms of their melting points

(ii) Write one application of the thermionic emission except in X ray production

(iii) Find the kinetic energy gained by an electron in electron volts(eV)

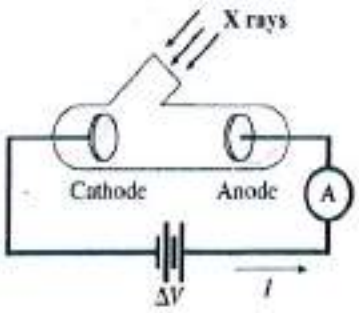
(iv) Some electrons collide with K- cell electrons of tungsten atoms and they are knocked out creating empty spaces .L-shell electrons move into these empty spaces. This movement from high energy to low energy shells releases x-ray photons of wave length $4x10^{-11}m$ which is characteristic of the tungsten and it is called K_α. Most elections are slowed down due to the repulsion from nucleus and their path is deflected. Due to this 8 keV is lost and it appears in emitted as x rays

(1) Find the binding energy difference between cells K and L

(2) Does the K_α depend on the accelerating potential? Explain

(3) Find the wave length of x rays emitted by deviated electrons

(e) X-rays of wave length $2x10^{-10}m$ hit with the cathode metal of photo shell. The work function of the cathode metal is 5 keV.



(i) Find the maximum kinetic energy of the photoelectrons

(ii) Find the stopping potential

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General Certificate of Education (Adv. Level) Examination, June 2018

භෞතික විද්‍යාව II
Physics II

01 E II

පැය තුනයි
Three hours

13– ශ්‍රේණිය Grade -13

අවසාන වාර පරීක්ෂණය, Final Term Test

නම
Name

$g = 10\ Nkg^{-1}$

PART A -Structured Essay)pages 2 -6 (

* *Answer all four questions on this paper itself*
* *Write your answer in the space provided for each question. Note that the space provided is sufficient for your answer and extensive answers are not expected.*

PART B– Essay (Page 07-11)

**Answer four questions only. Use paper supplied for this purpose .*
**At the end of the time allocated For this paper, tie the two together so that part A is on the top of part B before handing over the supervisor.*

For Examiner's Use Only

Part	Q.No	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
C	8	
	9A	
	9B	
	10A	
	10B	
Total		
Percentage		

Final Marks

In Number	
In words	

Part A - Structured Essay

Do not write anything

*Answer all four questions.

$g = 10 Nkg^{-1}$

1. You are required to find the density of coconut oil from a graphical method. You are given a 100 mL graduated cylinder of mass 50 g, coconut oil and a triple-beam balance only for this experiment

(a) What is the least count of the triple beam balance?

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(b) The cylinder is filled to the 100 mL level with oil and its mass is measured to be 132.6 g. Estimate the density of the oil

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(c) Write the experimental procedure to find the density from the graphical method

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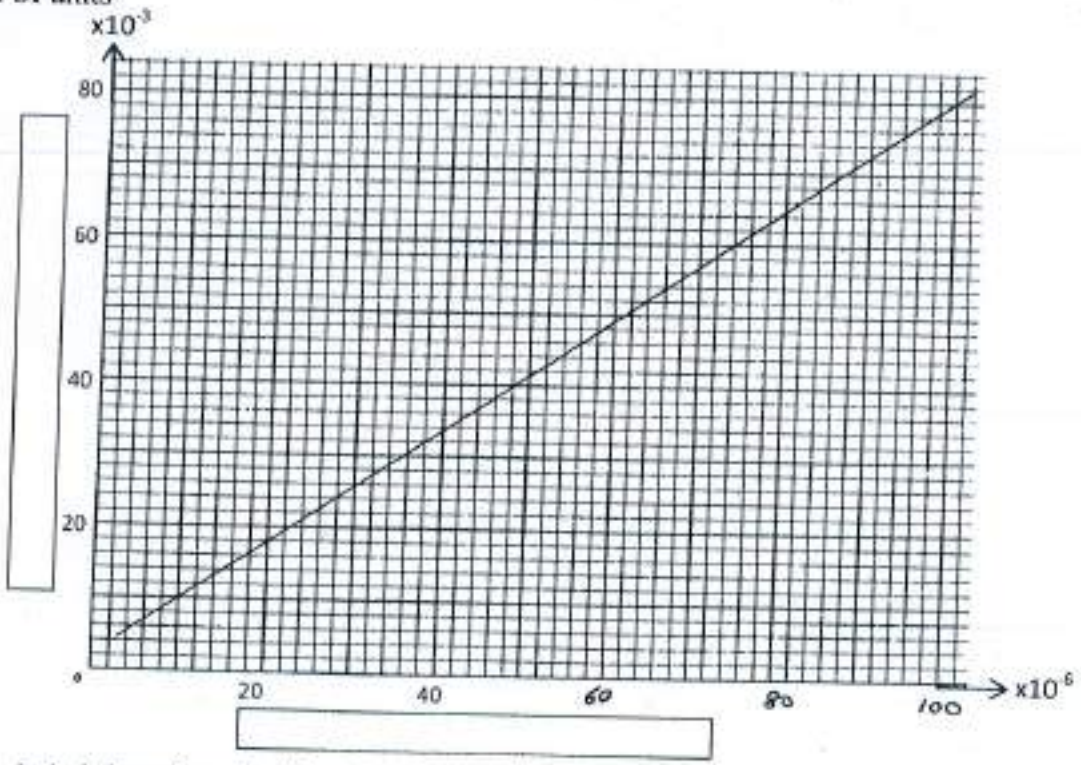
(d) The graph plotted base on experimental data is given below. All quantities are marked in SI units



(i) Label the axis with SI units

(ii) Calculate the gradient. Show the two points clearly, which is used to find the gradient

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.....

.....

(iii) What is the density of the oil?

.....

(iv) Which value of the oil density calculated in part (b) and part (d) (iii) is more accurate ? Explain

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.....

(e) As an indicator of the accuracy and precision of this method, the experiment is repeated for water having precisely known density.

(i) Sketch the shape of the relevant graph in previous two axis

(ii) How do you check the accuracy of the density of oil ?

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(f) How do you use this set up to find the density of an irregular shape metal piece?

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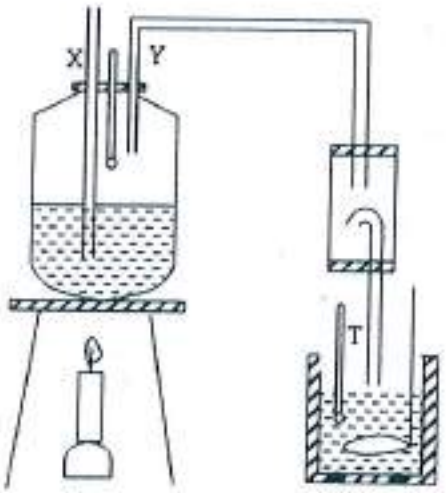
2. It is shown in the following figure, an experiential setup used to determine the specific latent heat of vaporization of water by the method of mixture.



(i) What is the use of the tube X ?

.....

(ii) What is the use of the steam trap ?

.....

(iii) Calorimeter is place right below the tube T after it starts producing steam at steady rate. Give the reason for not placing it below T from the beginning?

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Do not write anything

Do not write anything

(iv) Write down the measurements you take in the correct order (Introduce the symbols used)

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(v) Other than the above measurements, what are the other data required to calculate the latent specific heat of vapourisation of water.

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(vi) Write an expression for specific latent heat of vapourisation in terms of measurements in part (iv) and data in part (v). Assume the temperature of steam as 100^0C.

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(vii) Other than the measurements and the data in parts (iv) and (v), what is the other important factor that you should handle with care? State why you should care it that much ?

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.....

(viii) What procedure do you follow to correct the error due to heat exchange with the surrounding ?

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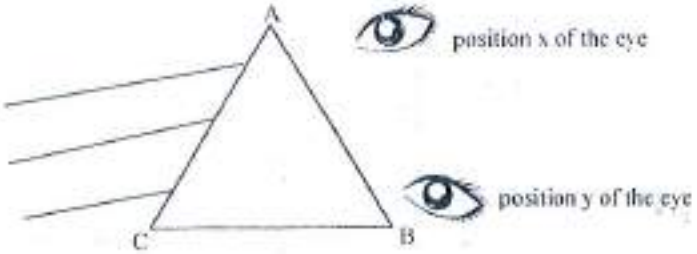
Do not write anything

3. In an experiment to find refractive index of glass , using a glass prism, you are provided with a drawing board with a white sheet of paper fixed , an equilateral glass prism, pins, a pencil and a ruler. It is required to find angles of deviation for different angles of incidence.



(i) Out of the three lines drawn , select the correct line as the incident ray and show the correct positions of placing pins P_1 and P_2 on it.

.....

.....

(ii) To see the images of pins P_1 and P_2 through side AB, out of eye positions x any y which position is more correct.

.....

(iii) State the experimental procedure do you follow to trace the ray of emergence.

.....

.....

.....

.....

(iv) What are the other apparatus you require to carry out this experiment?

.....

(v) Complete the path of the ray emerging from the prism on the above figure and mark the angle of incidence and angle of deviation.

(vi) Draw the rough sketch of the graph you expect and lable the axis.

(vii) To calculate the refractive index of the prism you obtain the most important quantity, the angle of minimum deviation of the prism from the graph. What experimental procedure can you take to increase the accuracy of the minimum deviation?

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Do not write anything

(viii) If the angle of minimum deviation you found from the graph is 37^0 , what is the refractive index of the prism?

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.....

(ix) What difficulty do you find if you try to find the angle of deviation for the incident angle 15^0.

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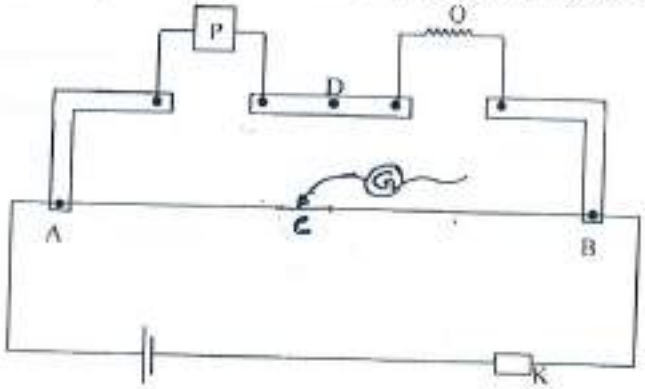
.....

4. Following figure shows a setup circuit to find the value of an unknown resistor (Q) by a metre bridge.



(i) You are provided with an extra key S, —( )— and a resistor of $1k\Omega$. Show how you connect them to the galvanometer for it's safety?

(ii) If the resistance of resistance box P is zero, will you be able to find a balance point? Explain this interms of potential.

.....

.....

.....

.....

(iii) If the resistance of the resistor box P is infinity, will you be able find a balance point? Explain this interms of potential.

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.....

(iv) While trying to find a balance point, no balance point is found. Write down two possible reasons for this .

1) .....

2) .....

(v) Derive the theoretical relation to plot a straight line graph to determine the value of Q.

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(vi) State how you calculate Q using the above graph.

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.....

(vii) Explain, how you check the uniformity of the meter bridge wire.

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.....

(viii) The wire may be heated up due to the a current flow in it. Explain the dependence of balance point on the heating effect.

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.....

(ix) How can you minimum the heating of the wire?

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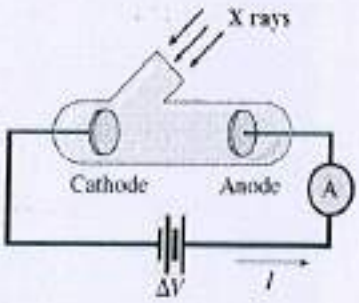
.....

Do not write anything

05B

G.C.E.(A/L)

PHYSICS



Marking Scheme

2018 – June – Grade – 13

Grade 13 – June – 2018 – M.C.Q.

Visakha Vidyalaya – Colombo - 05

Q.No.	Answer
1.	4
2.	3
3.	5
4.	5
5.	4
6.	2
7.	1
8.	1
9.	2
10.	3
11.	1
12.	2
13.	2
14.	3
15.	1
16.	1
17.	1
18.	4
19.	5 EM (2)
20.	2
21.	3
22.	4
23.	4
24.	3
25.	5

	Answer
26.	4
27.	3
28.	2
29.	3
30.	2
31.	3
32.	3
33.	1
34.	2
35.	2
36.	2
37.	2
38.	3
39.	4
40.	4
41.	3
42.	4
43.	4
44.	1
45.	1
46.	3
47.	2
48.	3
49.	3
50.	4

Gr. 13 June 2018. APB

1 - 4
2 - 3
3 - 5
4 - 5
5 - 4
6 - 2
7 - 1
8 - 1
9 - 2
10 - 3
11 - 1
12 - 2
13 - 2
14 - 3
15 - 1
16 - 1
17 - 1
18 - 4
19 - 5 EM 02
20 - 2
21 - 3
22 - 4
23 - 4
24 - 3
25 - 5
26 - 4
27 - 3
28 - 2
29 - 3
30 - 2
31 - 3
32 - 4 3
33 - 1
34 - 2
35 - 2
36 - 2
37 - 2
38 - 3
39 - 4
40 - 4
41 - 3
42 - 4
43 - 4
44 - 1
45 - 1
46 - 3
47 - 2
48 - 3
49 - 3
50 - 4

Final T. T.

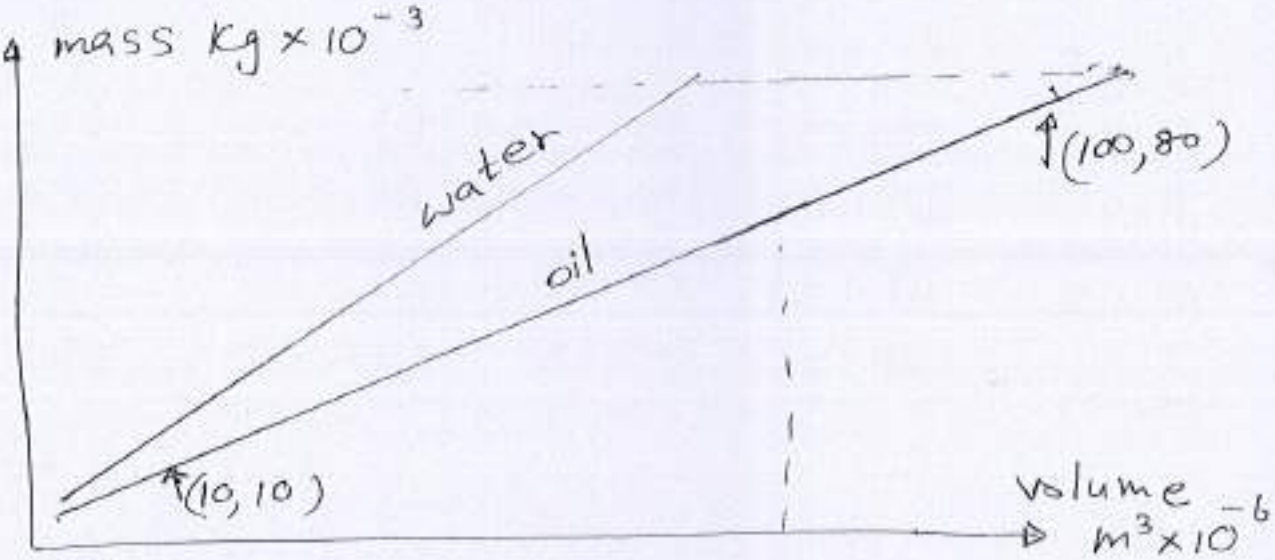
Structured — (1)

a) 0.1 g — (01)

b) $d = \frac{m}{V} = \left(\frac{132.6 - 50}{100}\right) = 0.826\ g\,cm^{-3}$ (01)

c) By adding oil to the cylinder by 15 ml, measure the total mass each time (01)

d)



i) — (01)

ii) (m) gradient $= \frac{(80 \times 10) \times 10^{-2}}{(100 - 10) \times 10^{-6}} = \frac{70}{90} \times 10^{3}$

$= 778\ Kg\,m^{-3}$ (01)

iii) $\rho = |m| = 778\ Kg\,m^{-3}$ — (01)

iv) Part (d) (01)
It is a graphical method. Therefore more readings are taken. But in (b) only one reading is used.

e) i) (01)
ii) Find the density of water from the graph. (01) Compare it with the standard value. If the experimental value is closer to the standard value, then method is accurate. And the density of oil found from the experiment is accurate.

f) Put the piece of metal into the measuring cylinder having water init. Measure the increase of volume. which is equal to the volume of the piece of metal. Then measure the mass of the piece of metal. (01) $d = m/v$.

(2) (i) පද්ධතියේ ස්කන්ධය ඇති කිරීමට / ජලය හෝ තාප හානිය ලැබෙන නිසා ... වැළැක්වීමට. — (01)

(ii) වියළි හුමාලය ලබා ගැනීමට / උෂ්ණ ජලයෙන් තොරව හුමාලය ලබා ගැනීමට — (01)

(iii) හුමාල ද්‍රාවකයෙන් විකිරණ තාපයෙන් කැලරිමීටරය හා ජලය රත් වීමට ඉඩ ඇති නිසා. — (01)

(iv) (1) හිස් කැලරිමීටරය + කලවනයේ ස්කන්ධය (m_1)
(2) ජලය + කැලරිමීටරය + කලවනයේ ස්කන්ධය (m_2)
(3) ජලයේ ආරම්භක උෂ්ණත්වය (θ_1)
(4) හුමාලය යැවූ පසු මිශ්‍රණයේ අවසාන උපරිම උෂ්ණත්වය (θ_2)
(5) පද්ධතියේ අවසාන ස්කන්ධය (m_3) සියල්ල ✓ නම් (02)

(v) ජලයේ විශිෂ්ට තාප ධාරිතාව (s_w)
කැලරිමීටරය සාදා ඇති ද්‍රව්‍යයේ වි. තා. ධාරිතාව (s_c) } (01)

(vi) හුමාලය පිට කළ තාපය + හුමාලයෙන් ලැබුණු ජලය පිට කළ තාපය } = කැලරිමීටරය හා ඊට අදාළ ජලය ලබාගත් තාපය.

$$(m_3-m_2)L + (m_3-m_2)s_w(100-\theta_2) = m_1 s_c(\theta_2-\theta_1) + (m_2-m_1)s_w(\theta_2-\theta_1)$$

— (01)

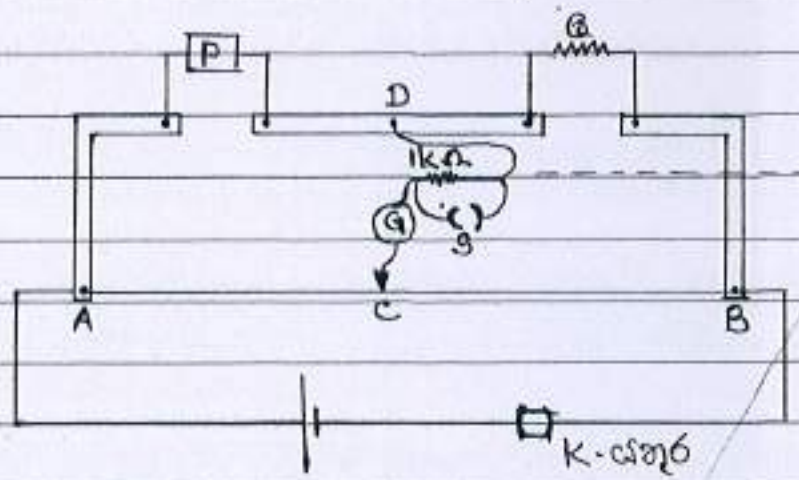
(vii) වායුගෝලීය පීඩනය — (01)
වායුගෝලීය පීඩනය සමග හුමාලයේ උෂ්ණත්වය (ජලයේ තාපාංකය) වෙනස් වන නිසා. — (01)

(viii) කැලරිමීටරයට දමන ජලයේ ආරම්භක උෂ්ණත්වය කාමර උෂ්ණත්වයට වඩා 5°C කින් පමණ පහළ කර කැලරිමීටරයට දමා පරීක්ෂණය ආරම්භ කර කැලරිමීටරයේ ඇති ජලයේ උෂ්ණත්වය කාමර උෂ්ණත්වයට වඩා 5°C කින් වැඩි වන තෙක් වියළි හුමාලය යැවීම. — (01)

[10]

(4)

a)



(01)

b) P හි අගය ශූන්‍ය වූ විට D හි විභවය C හි විභවයට වඩා වැඩිනිසා සෑම විටම ගැල්වනෝමීටරය හරහා විද්‍යුත් ධාරාවක් D සිට C ට ගමන් කරයි. (01)

c) P හි අගය අනන්තය වූ විට P හරහා ධාරාවක් ගමන් නොකරයි. එවිට C හි විභවය D හි විභවයට වඩා වැඩිවී ගැල්වනෝමීටරය හරහා C සිට D ට විද්‍යුත් ධාරාවක් ගමන් කරයි. (01)

d) (1) සමීකරණය ස්ථාපන කුරුල් වී නිගමනය. (01)
(2) සන්සන්දනය කරන ත්‍රිකෝණ දෙකෙන් එකක් හිතා කැඩා පීම. (01)

e) $\frac{P}{Q} = \frac{l}{100-l}$

$\frac{Q}{P} = \frac{100-l}{l}$

$\frac{1}{l} = \left(\frac{Q}{100}\right)\left(\frac{1}{P}\right) + \frac{1}{100}$ (01)

$y = m x + C$

f) අනුක්‍රමණය $m = \frac{Q}{100}$

$Q = 100m$ (01)

VIII

$$n = \frac{\sin\left[\frac{A+D_m}{2}\right]}{\sin\left(A/2\right)}$$

$$n = \frac{\sin\left(\frac{60+37}{2}\right)}{\sin\left(\frac{60}{2}\right)} \quad \text{--- (01)}$$

$$n \simeq 1.5 \quad \text{--- (01)}$$

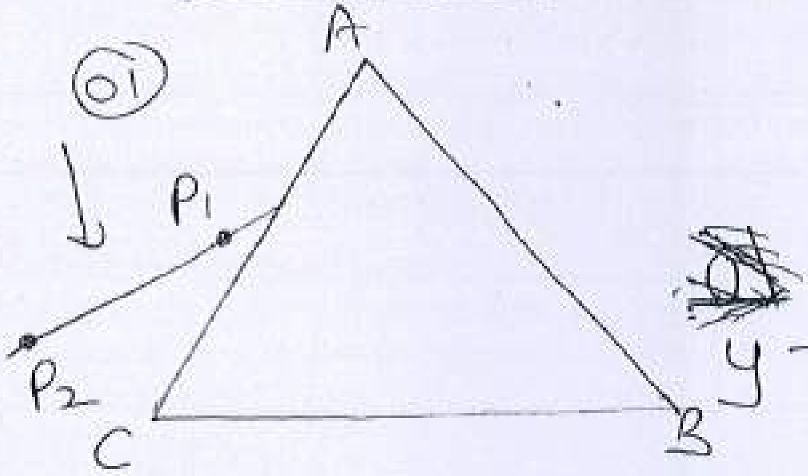
IX මෙවැනි ප්‍රිස්ම සඳහා AB
පෘෂ්ඨය [illegible] [illegible] [illegible] --- (01)
[illegible] [illegible]
[illegible] [illegible] [illegible]
[illegible].

10

(3)

ප්‍රකාශ විද්‍යාව

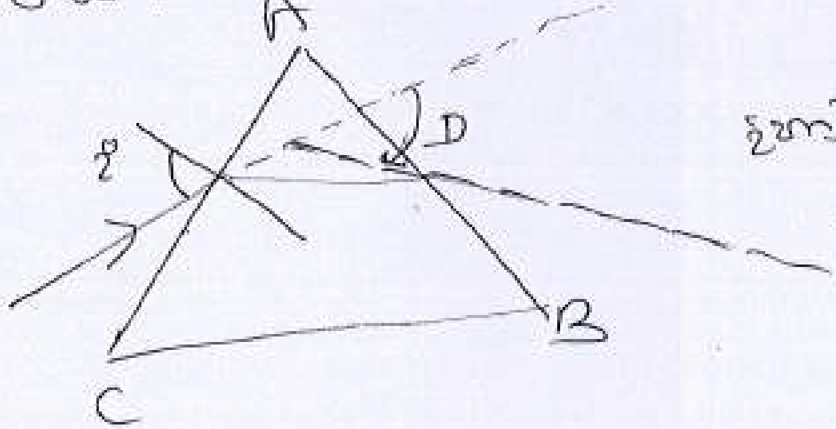
(01)



III y පිහිටුමේ ඇස තබා P_1 හා P_2 අල්පෙනෙත්ති වල ප්‍රතිබිම්බ සමඟ අල්පෙනෙත්ති 2ක් එක රේඛාවට පෙනෙන සේ — (01)

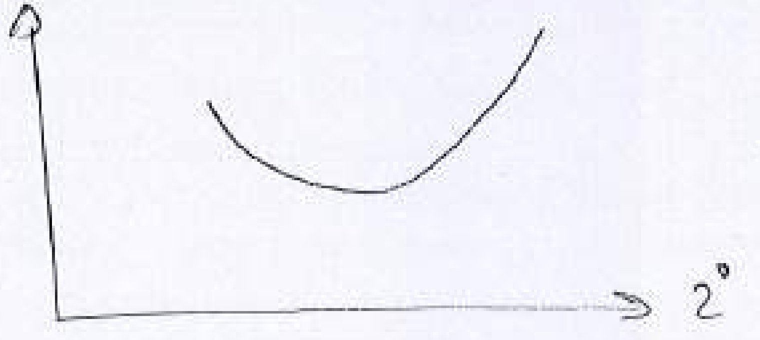
IV සමුච්චය
ශ්වේතාලෝකය, තාපය, ශක්තිය — (01)

V



i හා D ලකුණු කිරීම — (01)

VI

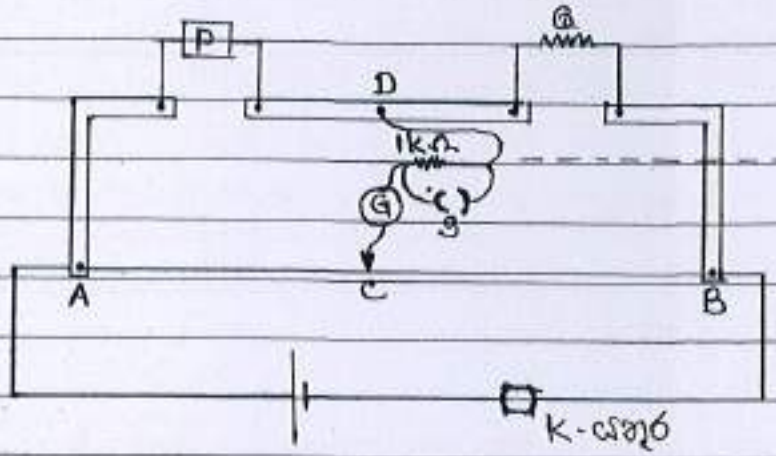


— (01)

VII දීප්ත තරංග කෝණය වෙනස් වන කෝණය ...
කෝණය ... හා ... කෝණය
...

4

(a)



(01)

(b) No P හි අග්‍රය ගැනය වූ විට D හි විභවය C හි විභවයට වඩා වැඩිනිසා සැම විටම ගැල්වනෝමීටරය හරහා විද්‍යුත් ධාරාවක් D සිට C ට ගලන් කරයි. (01)

(c) No P හි අග්‍රය අනන්නය වූ විට P හරහා ධාරාවක් ගලන් නොකරයි. එවිට C හි විභවය D හි විභවයට වඩා වැඩිවී ගැල්වනෝමීටරය හරහා C සිට D ට විද්‍යුත් ධාරාවක් ගලන් කරයි. (01)

(d) (1) සන්තුලන්ධක ස්ථාන සොයාගැනීම. (01)

(2) සන්සන්දනය කරන ප්‍රතිරෝධ දෙකෙන් එකක් නිසැක කළ හැකි වීම. (01)

(e) $\frac{P}{Q} = \frac{l}{100-l}$

$\frac{Q}{P} = \frac{100-l}{l}$

$\frac{1}{l} = \left(\frac{Q}{100}\right)\left(\frac{1}{P}\right) + \frac{1}{100}$ (01)

$y = m x + c$

$\frac{1}{l} = Q \cdot \frac{1}{P} + 1$

(f) අනුක්‍රමණය $m = \frac{Q}{100}$ Q = gradient.

$Q = 100m$ (01)

(g) P හා Q මාරු කල විට සංතුලන ලක්ෂ්‍යය Q සිට (100-l) දුරින් ඇතිවේ දැයි බැලීම. ______ (01)

(h) මෙවිට කම්බියේ ප්‍රතිරෝධය වෙනස් වී සංතුලන දිග වෙනස් වේ. එබැවින් සංතුලන දිග සඳහා ලැබෙන අගය වරින් වර වෙනස් වේ. ______ (01)

(i) ප්‍රධාන පරිපථයට යතුරක් සම්බන්ධ කර ධාරාව අවශ්‍ය විට පමණක් ස්විචය සංවෘත කිරීම. ______ (01)

Non viscous Incompressible steady streamlined flow.

(5)(1) දුස්ස්‍රාවී නොවන, අසම්පීඩ්‍ය, අනවරත ධාරා රේඛීය ප්‍රවාහයක් විය. —— (01)

(2) $P + \frac{1}{2}\rho v^2 + \rho g h = $ නි

$[P] = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

$[\frac{1}{2}]\,[\rho v^2] = ML^{-3}(LT^{-1})^2 = ML^{-1}T^{-2}$

$[\rho g h] = ML^{-3}LT^{-2}L = ML^{-1}T^{-2}$

∴ සමීකරණයේ මාන අනුව නිවැරදි වේ.

The equation is dimensionally correct.

—— (02)

1 කට × ගණ (01)

(3) P හා Q ට බර්නූලි යෙදීමෙන්

$P_p + \frac{1}{2}\rho v_p^2 + \rho g h_p = P_Q + \frac{1}{2}\rho v_Q^2 + \rho g h_Q$

$P_p = P_Q \qquad h_Q = 0 \qquad h_p = 0.75\,m$

$g(h_p - h_Q) = \frac{1}{2}(v_Q^2 - v_p^2)$ —— ① —— (01)

$A_p v_p = A_Q v_Q$

$\pi(0.4)^2 v_p = \pi(0.2)^2 v_Q$

$4v_p = v_Q$ —— (01)

① ⇒ $g(h_p - h_Q) = \frac{1}{2}((4v_p)^2 - v_p^2)$

$10 \times 0.75 \times 2 = 15 v_p^2 \Rightarrow v_p^2 = 1$

$v_p = 1\,ms^{-1}$ —— (01)

∴ 1s දී ගලන ජල පරිමාව $= A_p v_p$

$= \pi(0.4)^2 \times 1 = \frac{22}{7} \times 0.4 \times 0.4 \times 1$

$= \frac{3.52}{7}$

$= 5.03 \times 10^{-1}\,m^3s^{-1}$ —— (01)

$A_P V_P = A_Q V_Q$

$\pi(0.4)^2 20 = \pi(0.2)^2 V_Q$

$V_Q = 80 m s^{-1}$ — (01)

P සහ Q අතර ඇඳුම් සමීකරණය

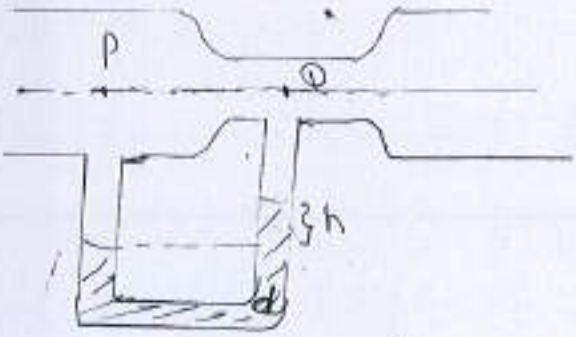
$P_P + \frac{1}{2}\rho V_P^2 = P_Q + \frac{1}{2}\rho V_Q^2$

$P_P - P_Q = \frac{1}{2}\rho(V_Q^2 - V_P^2)$ — (01)

$h\rho_3 g = \frac{1}{2}\rho(80^2 - 20^2)$ — (01)

$h = \frac{1.2 \times 60 \times 100}{2 \times 1600 \times 10} = \frac{9}{40}$

$h = 0.225 m$ — (01)



$A_P > A_Q$

$V_P < V_Q$

$P_P > P_Q$

$P_P - P_Q = h d g$

$P_0 + \frac{F}{A}$ atmospheric pressure + extra pressure due to push.

(5) A සහ B අතර ඇඳුම් සමීකරණය

$P_0 + \frac{F}{A} + \frac{1}{2}\rho V_A^2 = P_0 + \frac{1}{2}\rho V_B^2$

$\frac{50}{A \times 10^{-4}} = \frac{1}{2}\rho(V_B^2 - V_A^2)$ — (01)

$1.25 \times 10^5 = \frac{1}{2}\rho(V_B^2 - V_A^2)$ — (1)

$A_A V_A = A_B V_B$

$4 \times 10^{-4} V_A = 4 \times 10^{-6} V_B$

$V_A = 10^{-2} V_B$ — (01)

(1) ඇ; $1.25 \times 10^5 = \frac{1}{2} \times 10^3 (V_B^2 - (10^{-2} V_B)^2)$ — (01)

$1.25 \times 10^5 \times 2 = 10^3 \times 1.01 \times 0.99 V_B^2$

$V_B^2 = \frac{250 \times 10^4}{101 \times 99}$

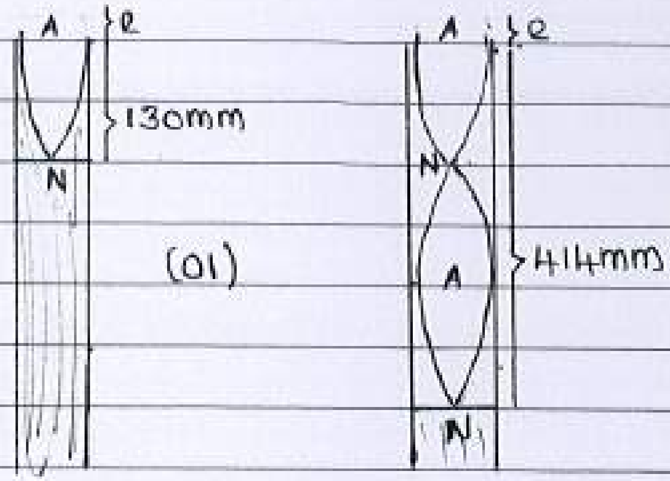
$V_B = \sqrt{250.03}$

$V_B = 15.81 m s^{-1}$ — (07)

15

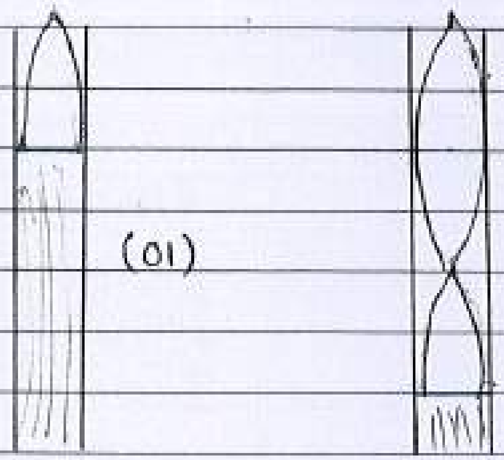
(06)

(i)



(01) (01)

(ii)



(01) (01)

(iii) $\frac{\lambda}{4} = 130 + e$ ——— ①

① ගෙන් ② ——————— (01)

$\frac{3\lambda}{4} = 414 + e$ ——— ②

$3(130 + e) = 414 + e$

$390 + 3e = 414 + e$

$2e = 24$

$e = 12\,mm$ ——————————————— (01)

(iv) $v = f\lambda$

$v = 600\,(130 + 12)\,10^{-3}$

$v = 600 \times 142 \times 10^{-3}$

$v = 340.8\,ms^{-1}$ ——————————————— (01)

(v) $\boxed{e = 0.3d}$ ——— (01)

$d = \frac{12}{0.3}$

$d = 40mm$ ——— (01)

(b) $v = \sqrt{\frac{\gamma RT}{M}}$ $\quad v \propto \sqrt{T}$

වායුවක් සඳහා γ, R හා M නියත වේ.

$\downarrow T \; v \downarrow \; f \downarrow$

$v \propto \sqrt{T}$

$f\lambda \propto \sqrt{T}$

අවස්ථා දෙකේදීම λ නියත වන නිසා

$f \propto \sqrt{T}$ වේ.

$f-4 \quad f \quad f+4$

$596 \leftarrow 600 \rightarrow 604$

$599 \leftarrow 600 \rightarrow 601$

$f-1 \quad f+1$

චිකා ගැනෙන් සංඛ්‍යාතය f යැයි සිතමු.

(01) $\frac{f+4}{f+1} = \sqrt{\frac{312}{283}}$ ——— (01)

$\frac{f+4}{f+1} = \sqrt{1.1025} = 1.05$

$f+4 = 1.05f + 1.05$

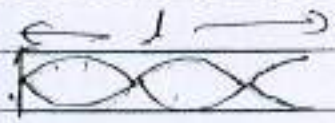
$f = 59Hz$ ——— (01)

(c)

$\frac{\lambda}{2} = l$

$\lambda = 2l$ //

$f = \frac{V}{2l}$ ——— ① (01)



$\frac{\lambda}{4}(5) = l$

$\lambda = \frac{4l}{5}$

$f + 150 = \frac{5V}{4l}$ ——— ② (01)

$\frac{f+150}{f} = \frac{5V}{4l} \cdot \frac{2l}{V}$

$2f + 300 = 5f$

$f = 100Hz$ ——— (01)

5th harmonic → 2nd overtone.

$F_0, 3F_0, 5F_0$

Grade 13 – June 2018 (Final)
Marking scheme – Essay.

(7) සමානුපාතික සීමාව තුළදී ප්‍රත්‍යාබලය $\left(\frac{F}{A}\right)$ විකුර්යාවර්ධ (e/l) දරණ අනුපාතය — (01)

නිර්වචනය, ප්‍රත්‍යාබලය — (01)

a) i) හුක්ගේ නියමය: සමානුපාතික සීමාව තුළදී කම්බියක සිදුවන චිත්තිය යොදනු ලබන බලයට අනුලෝමව සමානුපාතික වේ. — (01)

ii) 500N → 12.5×10^{-2} mm

$EPE = \frac{1}{2} Fe = \frac{1}{2} \times 500 \times 12.5 \times 10^{-5}$ m

$= 31.25$ mJ — (01)

iii) $A = \pi r_1^2 - \pi r_2^2 = 3\left(2 \times 10^{-2}\right)^2 - \left(1 \times 10^{-2}\right)^2$

$A = 3 \times 10^{-4}(4-1) = 9 \times 10^{-4} m^2$

$\frac{F}{A} = Y \frac{e}{l}$ හෝ $Y = \frac{F/A}{e/l} = \frac{Fl}{Ae}$ — (01)

$Y = \frac{1000\,N \times 0.9\,m}{9 \times 10^{-4} m^2 \times 25 \times 10^{-5} m} = 4 \times 10^9 Nm^{-2}$ (01)

iv) දුන්ඩ හේදක ලක්ෂ්‍යයේ දී සමානුපාතික සීමාව තුළ පවතින බව උපකල්පනයේ කෙරේ. (01)

$\frac{F}{A} = Y \frac{e}{l} \rightarrow e = Fl/AY$

$e = 3600\,N \times 0.9\,m / 9 \times 10^{-4} m^2 \times 4 \times 10^9 Nm^{-2}$

$= 0.9$ mm $= 9 \times 10^{-4}$ m → (01)

හෝ $\left(\frac{25 \times 10^{-2}\,mm}{1000\,N}\right) \times 3600\,N = 0.9$ mm

$= 9 \times 10^{-4}$ m

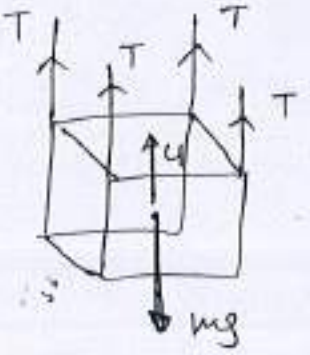
b) i) $4\times10^{8}\ Nm^{-2} \times 10^{-4}m^{2} \times 4 = 16\times10^{4}\ N$

$= \underline{16\times10^{3}\ kg}$ — (01)

එක් කම්බියක් සඳහා

$\frac{F}{A} = Y\frac{e}{l} \rightarrow e = \frac{Fl}{AY} = \frac{4\times10^{8}\times 10\ m}{2\times10^{11}} = \underline{2\ cm}$ (01)

ii)



$4T + 4 = mg$ → (01)

$T = \frac{mg-4}{4}$

$= \frac{10^{5}\ N - (2\times2\times2\times10^{3}\times10)}{4}$

$T = \frac{(10\times10^{4}) - (8\times10^{4})}{4} = 5\times10^{3}\ N$

$\therefore e = \frac{Fl}{AY} = \frac{5\times10^{3}}{10^{-4}} \times \frac{10}{2\times10^{11}}$

$e = \underline{2.5\ mm}$ → (01)

iii) $F = mg/4 = 10\times10^{4}/4 = 2.5\times10^{4}\ N$ — (01)

$l = AeY/F = \frac{10^{-4}\times 2.5\times10^{-3}\times 2\times10^{11}}{2.5\times10^{4}}$

$= \underline{2\ m}$ (01) → $l + e = 2\ m\ 2.5\ mm$ කම්බිය ඉහළින් වේ.

iv) $e = \frac{Fl}{AY} = \frac{2.5\times10^{4}\times 10\ m}{10^{-4}\ m^{2}\times 2\times10^{11}}$

$= \underline{12.5\ mm}$ → (01)

15

60m සිංහල KCS.

(8)

A $F = BQV\sin\theta$? (01)

F, B, Q, V නම් කළ යුතු (01)

I $I = N \cdot A \cdot V_d \cdot e$ (01)

$50 = 2\times10^{29} \times (0.1\times10^{-2} \times 0.02) \cdot V_d \times 1.6\times10^{-19}$

$V_d = 7.8\times10^{-5}\ ms^{-1}$ — (01)

II $F = BQV_d$ $\theta = 90^\circ$ $\sin\theta = 1$

$F = 2\times1.6\times10^{-19} \times 7.8\times10^{-5}$

$F = 24.96\times10^{-24}$ — (01)

$F = 25\times10^{-24}\ N$

III $F = EQ$

$25\times10^{-24} = E\times1.6\times10^{-19}$ — (01)

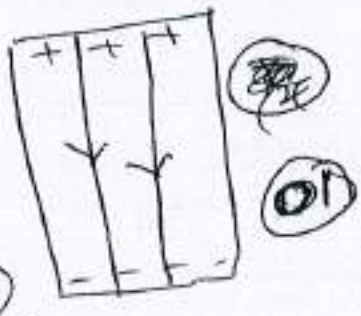
$E = 15.6\times10^{-5}\ NC^{-1}$

(01)

IV $E = \frac{V}{d}$

$15.6\times10^{-5} = \frac{V}{0.02}$ (01)

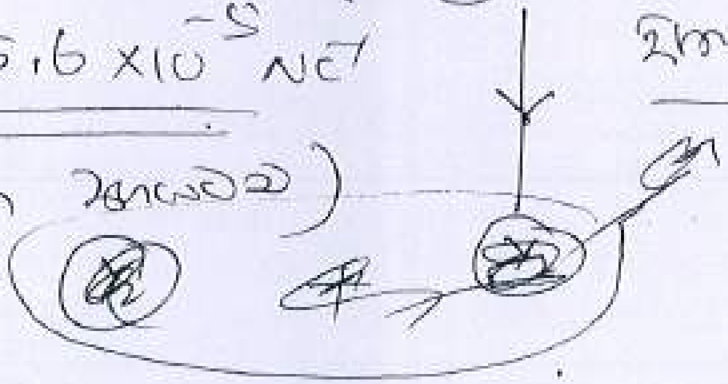
$V = 3.12\times10^{-6}\ V$



b

V $E = \underline{\underline{15.6 \times 10^{-5}\ NC^{-1}}}$ — (01)

([illegible])



— (01)

[10]

(B)

ii

I $50 \times 10^{-3}\ T$ — (01)

II $\phi = BAN$

$\phi = 50 \times 10^{-3} \times 0.4 \times 10^{-4} \times 150$ — (01)

$\phi = \underline{\underline{3 \times 10^{-4}\ wb}}$ — (01)

III $\phi = 8 \times 10^{-3} \times 0.4 \times 10^{-4} \times 150$

$= 4.8 \times 10^{-5}\ wb$

iii

$E = \left(\frac{\phi_1 - \phi_2}{t}\right)$

$E = \frac{[3 \times 10^{-4} - 4.8 \times 10^{-5}]}{0.3}$ — (01)

$E = \underline{\underline{8.4 \times 10^{-4}\ V}}$ — (01)

[15]

(9) A)

I කෝෂයේ ශක්තිය = {අභ්‍යන්තර ප්‍රතිරෝධය වැයවන ශක්තිය} + {බාහිර ප්‍රතිරෝධය වැයවන ශක්තිය}

$E = Ir + IR$

$EI = I^2r + I^2R$

$EI = I^2r + P$

$P = I^2R$

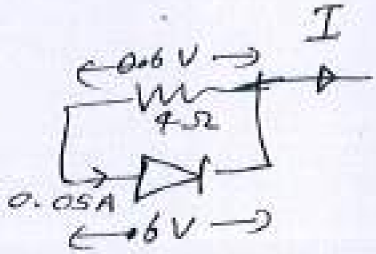
$P = EI - I^2r$

$P = EI - I^2r$ // — (01)

II $V = IR$ මගින්

$0.6 = I_1 \times 4$ — (01)

$I_1 = 0.15A$ // — (01)

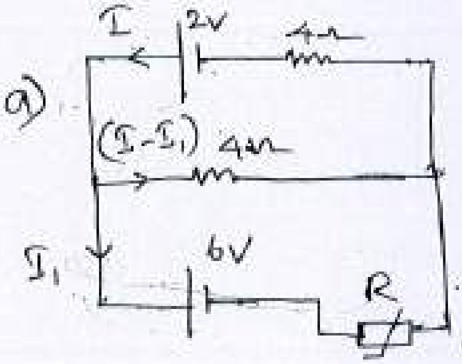


$\Sigma E = \Sigma IR$

$I = 0.15 + 0.05$

$I = 0.2A$ // — (01)

III a)



$2 = 4I + 4(I - I_1)$ — (01)

$1 = 4I - 2I_1$ — (1)

$-4 = 4I + I_1R$ — (2) — (01)

(1) × R + (2) × 2 න්:

$I = \frac{R-8}{(4R+8)}$ // — (01)

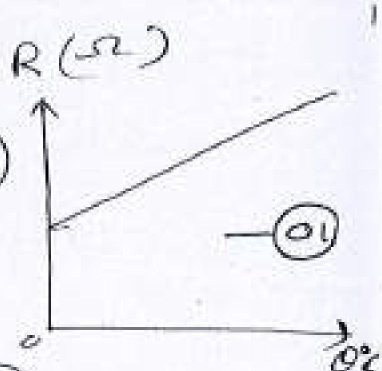
b) $\frac{R-8}{4R+8} = 0 = I$ (at 30°C)

$\therefore R = 8\Omega$ — (01)

c) $\frac{R-8}{4R+8} = \frac{15}{100} = I$ — (01)

$R = 23\Omega$ // — (01)

d)



— (01)

e) $R_{30} = 8 = R_0(1 + 30\alpha)$
$R_{100} = 23 = R_0(1 + 100\alpha)$ } — (01)

$R_\theta = R_0 + R_0\alpha\theta$

$R_\theta = R_0\alpha\theta + R_0$

$y = mx + c$

$\alpha = m/c = \frac{R_0\alpha}{R_0}$

$\alpha = 1.36 \times 10^{-1}\,°C^{-1}$ // — (01)

$R_\theta = R_0(1 + \alpha\Delta\theta)$

v

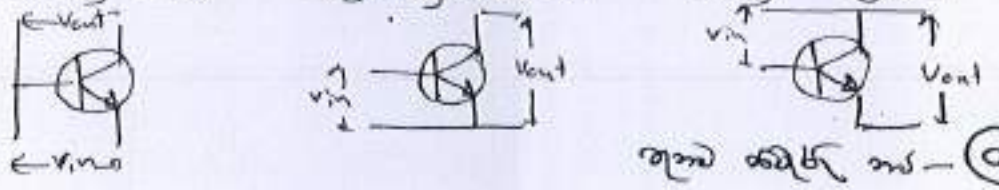
$$I = \frac{R - 8}{4R + 8} = \frac{2}{10} A \quad \text{—} (01)$$

$$R = 48 \Omega \quad \text{—} (01)$$

15

Q(B)

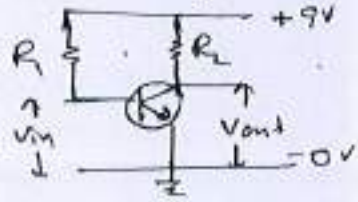
a) I පොදු විමෝචක | පොදු විමෝචක | පොදු එකතැන



නිවැරදි සටහන — (01)

II (අ) 1) BE හරහා වෝල්ටීයතාව ශූන්‍ය වේ
2) BC හරහා ද ශූන්‍ය වේ
3) $V_{CE} = \frac{1}{2} V_{cc}$ වේ
} නිවැරදි — (01)

(ආ)



— (01)

(ඇ) (අ) R_1 ට/ $V = IR$

$9 - 0.7 = \frac{40}{100} \times R_1$

$R_1 = 207.5\,\Omega$ // — (01)

(ආ) $I_C = \beta I_B$

$I_C = 100 \times \frac{40}{1000} = 4A$ — (01)

R_2 ට/ $V = IR$

$9 - 4.5 = 4 \times R_2$

$R_2 = 1.125\,\Omega$ // — (01)

II ON - සංතෘප්ත කලාපයේ
OFF - කපාගත් කලාපයේ
} — (01)

(b) I $\frac{R}{5.5} = \frac{150}{330}$

$R = 25\,k\Omega$ // — (01)

II (අ) $\frac{R}{5.5} = \frac{1.28}{(4.8 - 1.28)}$

$R = 2\,k\Omega$ // — (01)

(ආ) $\frac{V_o}{V_{in}} = \left(1 + \frac{R_f}{R_1}\right)$

$= 1 + \frac{22.5}{1.5}$

$= 16$ // — (01)

(ඇ) $V_o = 16\,V_{in} + 1.5$

$= 16(1.5 - 1.28) + 1.5$

$= 16 \times 0.22 + 1.5$

$= 4.72V$ // — (01)

c)

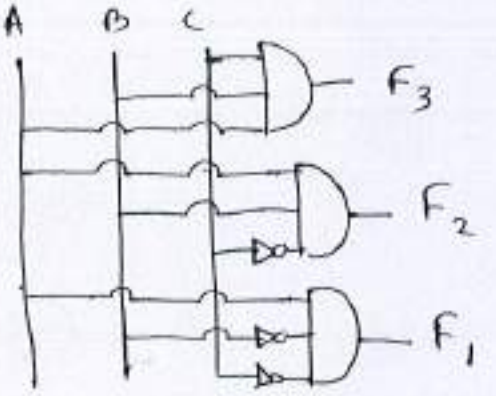
i)

A	B	C	F_1	F_2	F_3
1	1	1	0	0	1
1	1	0	0	0	0
1	0	1	1	0	0
1	0	0	0	0	0
0	1	1	0	0	0
0	1	0	0	0	0
0	0	1	0	0	0
0	0	0	0	0	0
			↓	↓	1
			$A.\bar{B}.\bar{C}$	$A.B.\bar{C}$	$A.B.C$

— (01)

(01)

ii)



— (02)

15

10 (A) (i) $W = P(V_2 - V_1)$ ——— (01)

පද්ධතිය මගින් → පරිසරය මත කෙරෙන කාර්යය. ——— (01)

(ii) 1) $W = 1.01 \times 10^5 (1.671 - 1 \times 10^{-3})$.

$= \underline{1.6867} \times 10^5\ J$. ——— (01)

2) $Q = mL +$ ——— (01)

$= 1 \times 2260 \times 10^3$

$2.26 \times 10^6\ J = \underline{2260\ kJ}$ ——— (01)

3) $\Delta U = mL = 2.260 \times 10^6\ J$. ——— (01)

අන්තර් අණුක ආකර්ෂණ බල බිඳීම. ——— (01)

4) $E\% = \dfrac{W}{Q} \times 100\ \%$

$= \dfrac{1.6867 \times 10^5}{2.26 \times 10^6} \times 100$ ——— (01)

$= \underline{\quad}\ 7.46\%$ ——— (01)

5) අභ්‍යන්තර ශක්තිය නියත නොවේ. උෂ්ණත්වය නියත වුවද
එය
සමෝෂ්ණ ක්‍රියාවලියක් නොවේ. ——— (01)

(iii) වාෂ්පවන ස්කන්ධය − m.

මුළු ස්කන්ධය − M.

Heat lost from eather at 13°C → 0°C = Latent heat of vapourisation.

$m \times 3.9 \times 10^5 = M \times 2.4 \times 10^3 \times 13$.

$mL = MS\Delta\theta$ ——— (01)

වාෂ්ප වන ප්‍රතිශතය $= \dfrac{m}{M} \times 100\ \%$

$= \dfrac{2.4 \times 10^3 \times 13}{3.9 \times 10^5} \times 100\% = 8\%$ ——— (01)

2) 20°C ජලය 500g $\xrightarrow{mc\theta}$ 0°C ජලය $\xrightarrow{mL}$ 0°C අයිස් $\xrightarrow{mc\theta}$ -10°C අයිස්

තාප ඉවත්වීමේ ශීඝ්‍රතාව $= \dfrac{0.5(4200 \times 20 + 336000 + 2100 \times 10)}{3600 \times 2}$ W

$= \underline{\underline{30.625}}$ W ——— (01)

3) ශීතකරණ දොර නිතර විවෘත කිරීම වැළකේ. ——— (01)

4) පිටුපස තිබෙන කළු ශීතකාරකය ගමන් කරන බට
තාප පරිවාරක ද්‍රව්‍යයකින් වේ.
නමුත් ශීතකාරකය ගමන් කරන බට
...වලට ... තාප ...
... ද්‍රව්‍ය ... ——— (01)

10-B

(a) The potential barrier which prevents the free electron leaving from the surface / free electrons on the surface have attractive force by the nuclei behind them this is called surface barrier potential. (01)

The extra energy required to just overcome the the surface barrier potential, is called the work function. (01)

(b) $\varphi = 5 - 1 = 4\,eV$. (01)

(c) Thermionic, Field, photoelectric and secondary. (01)

(d) (i) To produce thermionic electrons, the temp. of the filament should be very high. under this temp, Lopers can melt as its melting point is relatively low. But tungsten melting point is very high so it can produce thermionic electrons without melting. (01)

(ii) Electron microscope. (01)

(iii) K.E is equal to the W.done by the field to accelerate it. (01)

$W = Vq = 200\times10^{3} \times 1.6\times10^{-19} = 3.2\times10^{-14}\,J.$

$= \frac{3.2\times10^{-14}}{1.6\times10^{-19}} = 2\times10^{5}\,eV = 200\,keV.$ (01)

(iv) (1) $\Delta E = hf = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{4\times10^{-11}} = 5\times10^{-15}\,J$ (01)

(2) No. K_α is the energy difference of the K and L shells of the tungsten atom. (01)

(3) $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.63\times10^{-34}\times3\times10^{8}}{8000\times1.6\times10^{-19}}$

$= 1.5\times10^{-10}\,m$ (01)

3) (i) $hf = \phi + K_{max}$

Energy of the radiation

$$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^{8}}{2 \times 10^{-10} \times 1.6 \times 10^{-19}} \text{ eV}$$

$$= 6.2 \times 10^{3} \text{ eV}$$

$$= 6.2 \text{ keV}.$$

$hf = \phi + K_{max}$ ——— (01)

$6.2 = 5 + K_{max}$

$K_{max} = 1.2 \text{ keV}.$ ——— (01)

(ii) $K_{max} = qV_s$ ——— (01)

$V_s = 1.2 \text{ kV}.$ ——— (01)

15