 5 copies

3rd Term Test - 2014 June

G.C.E. Advanced Level Examination - 2014 August

Physics - I	Grade 13	Time : 02 hours

- Answer all the questions and mark the correct responses in the given answer sheet.
- Use of calculators are not allowed

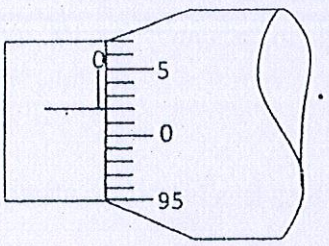
(g = 10 N kg^{-1})

01). The amplitude of a damped oscillator of mass m varies with time t as

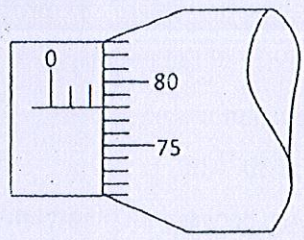
$A = A_0 e^{(-at/m)}$ The dimensions of 'a' are,

1). ML^0T^{-1} 2). M^0LT^{-1} 3). MLT^{-1} 4). $ML^{-1}T$ 5). $M^0L^0T^{-1}$

02). The given instrument has a least count of 0.01 mm. The fractional error of this measurement is,



Initial position



Final position

1). $\frac{1}{2.78}$ 2). $\frac{0.01}{2.78}$ 3). $\frac{0.01}{2.76}$ 4). $\frac{0.1}{2.76}$ 5). $\frac{0.1}{2.78}$

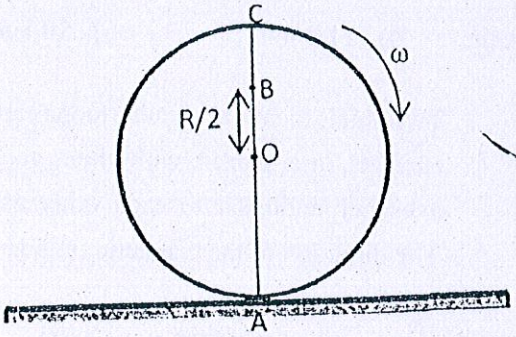
03). The magnitudes of vectors A , B and C are respectively 12, 5 and 13 units and $\vec{A} + \vec{B} = \vec{C}$. The angle between A and B is,

1). Zero 2). $\pi/4$ 3). $\pi/3$ 4). $\pi/2$ 5). π

04). A body of mass m is projected under gravity from the ground, with linear momentum P such that it has the maximum horizontal range. The minimum kinetic energy of the body during its flight is,

1). Zero 2). P^2/m 3). $P^2/2m$ 4). $P^2/4m$ 5). P/m

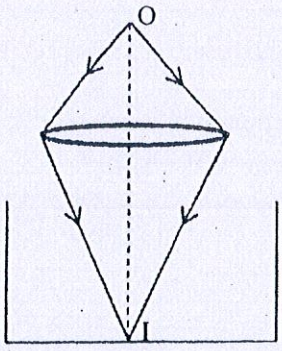
05).



A uniform disk of radius R is rotating about its axis with angular speed ω. It is gently placed on a horizontal surface which is perfectly frictionless. If V_A , V_B and V_C are the linear speed of points A , B and C respectively, then,

1) $V_A = V_B = V_C$ 2). $V_A = V_A > V_C$ 3). $V_A = V_C > V_B$

4). $V_A > V_B = V_C$ 5). $V_A < V_B < V_C$

06). 

A real image of an object is formed by a convex at the bottoms of an empty beaker.
The beaker is now filled with a liquid of refractive index 1.6 to a depth of 8 cm. In order to get the image again at the bottom the beaker should be moved,

1). downward by 2 cm 2). Upward by 2 cm 3). downward by 3 cm
4). Upward by 4 cm 5). downward by 4 cm

07). A person cannot see objects clearly beyond 2 m. An eye specialist prescribes spectacles having a combination of convex lens of focal length 40cm in contact with a concave lens. The power of this concave lens in diopters is,

1). +2 2). + 1.5 3). − 2 4). + 3 5). − 3

08). A ray of light passes through two transparent media with refractive indices 1.67 and 1.5 respectively. The wavelength when it propagates, in a medium of refractive index 1.5 will be (The frequency of light in air is 5×10^{14} Hz) (speed of light in vacuum is $3 \times 10^{8}\ ms^{-1}$)

1). 4×10^{-7} m 2). 4×10^{-14} m 3). 9×10^{-7} m
4). 1.67×10^{-7} m 5). 3×10^{-7} m

09). The distance between an object and its real image formed by a lens is L. If the magnification is M, the focal length of the lens is,

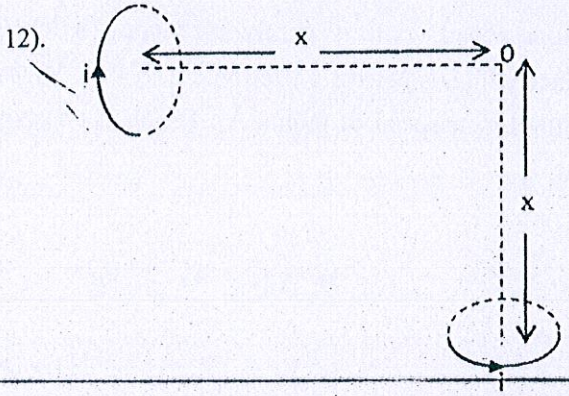
1). $\frac{(M-1)L}{M}$ 2). $\frac{ML}{(M+1)}$ 3). $\frac{(M-1)L}{M^2}$ 4). $\frac{ML}{(M+1)^2}$ 5). $\frac{(M+1)L}{M}$

10). A cylindrical block of wood floats vertically with 80% of its volume immersed in a liquid at 0^0C. When the temperature of the liquid is raised to 62.5^0C, the block just sinks in the liquid. If the cubical expansion of the cube is negligible compared to that of the liquid, the co-efficient of cubical expansion of liquid is,

1). $1 \times 10^{-3}K^{-1}$ 2). $2 \times 10^{-3}K^{-1}$ 3). $3 \times 10^{-3}K^{-1}$
4). $4 \times 10^{-3}K^{-1}$ 5). $5 \times 10^{-3}K^{-1}$

11). A liquid takes 6 minutes to cool form $80^0\ C$ to 50^0C. If the ambient temperature is 20^0C, how long will it take to cool from 60^0C to 30^0C ?

1). 6.1 min 2). 8.5 min 3). 10 min 4). 11.2 min 5). 10.8 min

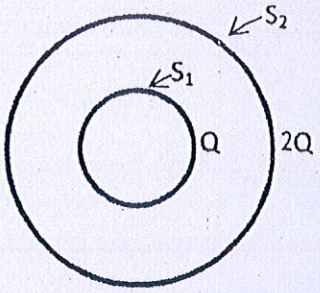
12). 

Two small identical circular loops carry equal currents, are placed with their geometrical axes perpendicular to each other as shown. The direction of the magnetic field at O is,

1). ↑ 2). ← 4). 

4). 

5). 

17). 

S_1 and S_2 are two hollow concentric spheres kept in air enclosing charges Q and 2Q respectively as shown in figure. Consider the following statements.

A). The ratio of electric flux through S_1 and S_2 is 1/3

B). Electric flux through the sphere S_1 will reduce to $1/5^{th}$ of original value if a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air.

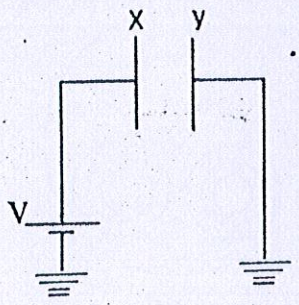
C). Electric potential at a point on the surface S_1 is equal to that on the surface S_2 as the space is equipotential. True statement (s) is / are,

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

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

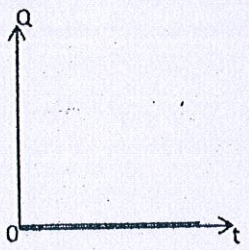
18). Two parallel plates 4 cm apart have a difference of potential of 1600 V. An electron is released from its negative plate simultaneously when a proton is released from the positive plate. Considering that the mass of a proton is 2000 times as that of an electron, find the distance from the positive plate to the point pass each other.

1). 0.02 mm 2). 0.1 cm 3). 1 cm 4). 1.2 cm 5). 2 cm

19). 

One plate (X) of a parallel plate capacitor is connected to the positive terminal of a battery. The negative terminal of the battery and the other plate (y) of the capacitor are earthed as shown.

The graphical variation of charge (q) with time (t) on plate is best expressed,



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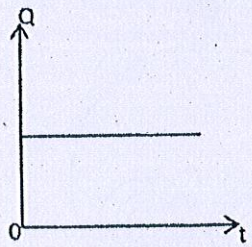

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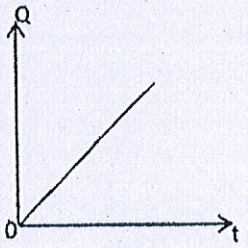

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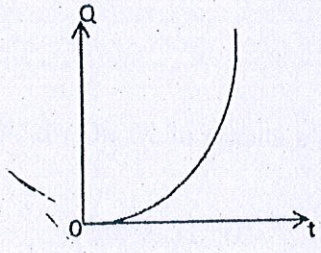

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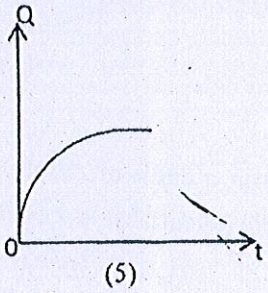


(5)

20). If the coil of a moving coil galvanometer having 10 turns and a resistance of 4.0 Ω is removed and replaced by a second coil having 100 turns and of resistance 160 Ω, the respective factors by which the current sensitivity and voltage sensitivity changes are,

1). 1 and 1 2). 1/10 and 4 3). 1/10 and ¼ 4). 10 and 4 5). 10 and ¼

if an electron and a proton are projected at right angles to a uniform magnetic field with the same linear momentum. The true statement (s) is / are,

1). The electron trajectory will be less curved than the proton trajectory.

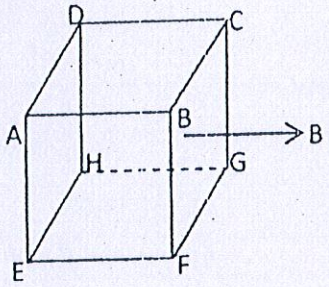
2). The proton trajectory will be less curved than the electron trajectory

3). Both trajectories will be equally curved

4). Both particles will move in straight lines.

5). A conclusion cannot be made since the speeds of the particles are unknown.

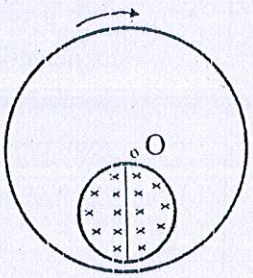
14). Twelve wires of equal lengths 'a' each are connected in the form of a skeleton cube which is moving with a speed $\vec{V}$ in the direction of a magnetic field $\vec{B}$. The emf induced in the arms AB , BC and CG are respectively,

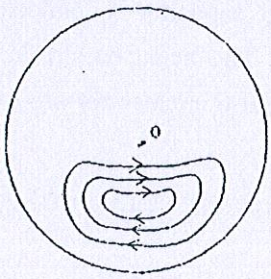


1). 0 , 0 , 0 2). 0 , BaV , BaV 3). 0 , 0 , BaV

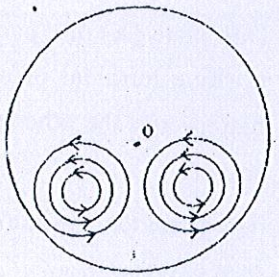
4). 0 , BaV , 0 5). BaV , BaV , BaV

15). A disc rotate in a magnetic field perpendicular to the plane of the disc but confined to a limited portion of its area as shown. The diagram which best expresses the eddy current circulation set up in the disc is,





(1)



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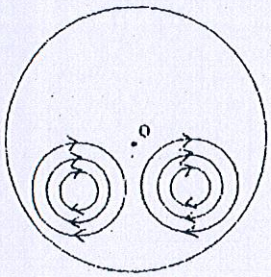

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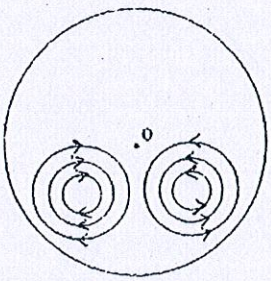

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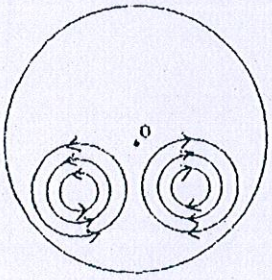


(5)

16). A metal wire is bent in a circle of radius 10 cm. It is given a charge of 20 μC which spreads on it uniformly. The electric potential at its centre is,

1). 0 2). 9×10^6 V 3). 18×10^6 V

4). 9×10^7 V 5). 18×10^7 V

24). A converging lens is used to form an image on a screen. When the upper half of the lens is, covered an opaque screen.

1). Half the image will disappear

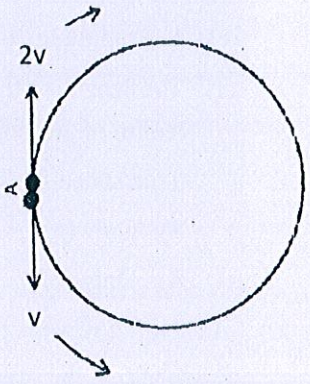
2). Complete image will be formed

3). Intensity of the image will increases

4). Half the image will disappear but intensity will increases.

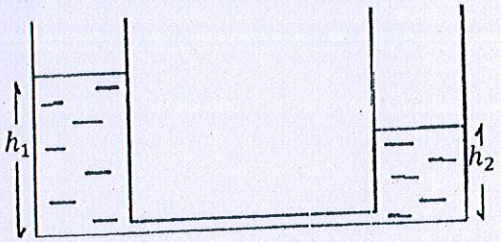
5). Half the image will disappear and intensity will decreases.

25). Two small particles of equal masses start moving in opposite directions from a point A in a horizontal circular orbit. Their tangential speeds are V and 2V, respectively as shown in figure. Between collisions, the particles move with constant speeds. After making how many elastic collisions, other than that at A, will these two particles again reach the point A?



1). 4 2). 3 3). 2 4). 1 5). 5

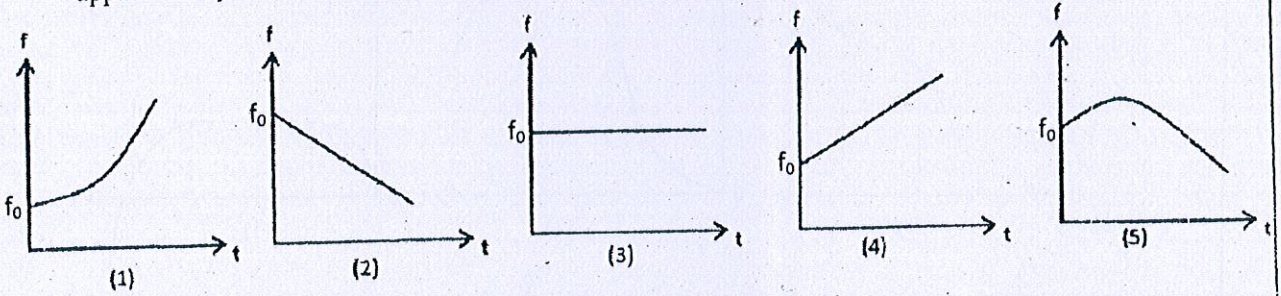
26). Two identical cylindrical vessels, with their bases at the same level, each containing a liquid of density ρ. The height of the liquid in one vessel is h_1 and that in the other is h_2 ($h_1 > h_2$). The area of either base is A. What is the work done by gravity is equalizing the levels when the vessels are interconnected by a narrow horizontal pipe of negligible volume at their bases?



1). $A\rho g (h_1 - h_2)^2$ 2). $A\rho g (h_1 + h_2)^2$ 3). $\frac{A\rho g (h_1 - h_2)^2}{2}$ 4). $\frac{A\rho g (h_1 + h_2)^2}{2}$

5). $A\rho g (h_1 - h_2)$

27). Starting from rest, an observer moves with a constant acceleration towards a stationary source emitting a sound of frequency f_0 which of the graphs shown in figure correctly represent the variation of the apparent frequency f of sound as heard by the observer with time t ?



28). A long straight wire carries a current of 1.5 A. An electron travels with a velocity of 5×10^6 cm s^{-1} parallel to the wire, 10 cm from it, and in the same direction as the current. What force does the magnetic field of the current exert on the moving electron ?

($\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1})

1). 2.4×10^{-20} N 2). 2.4×10^{-18} N 3). $2.4\pi \times 10^{-20}$ N

4). $2.4\pi \times 10^{-18}$ N 5). 2.4×10^{-22} N

A student performed the experiment to measure the speed of sound in air using resonance air-column method. Two resonances in the air – column were obtained by lowering the water level. The resonance with the shorter air-column is the first resonance and that with the longer air-column is the second resonance. Then,

a). The intensity of the sound heard at the first resonance was more than that at the second resonance.

b). The prongs of the tuning fork were kept in a horizontal plane above the resonance tube.

c). The amplitude of vibration of ends of the prongs is typically around 1 cm.

d). The length of the air-column at the first resonance was same what shorter than $1/4^{th}$ of the wave length of this sound in air,

True statement/s is/are,

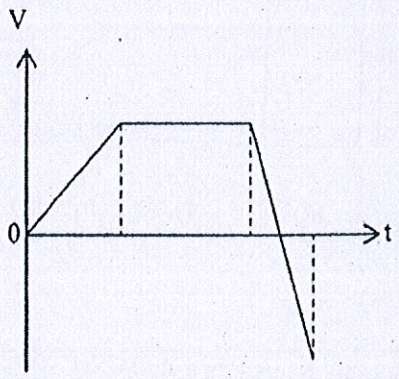
1). Only (a) 2). Only (a) and (d) 3). Only (b) and (d)

4). Only (c) 5). All are true

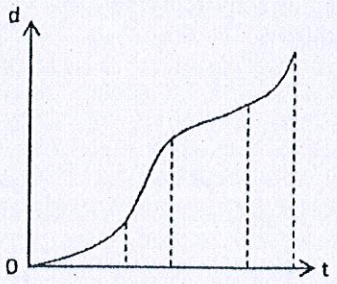
22). A standing wave is produced due to a superposition of the incident wave and the wave reflected from a boundary. It is observed that the amplitude at antinode is 9 times that at node. The percentage of the incident intensity reflected from the boundary is,

1). 36 % 2). 72 % 3). 64 % 4). 81 % 5). 100 %

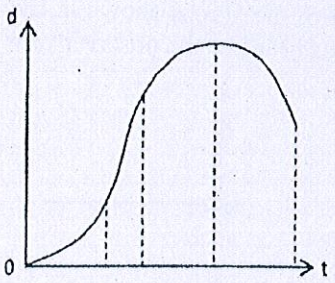
23).



The above graph shows the velocity – time graph for a body. Which of the following graphs represents the corresponding distance – time graph?



(1)



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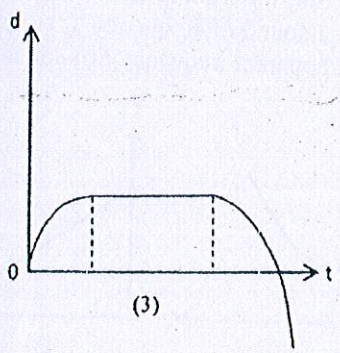

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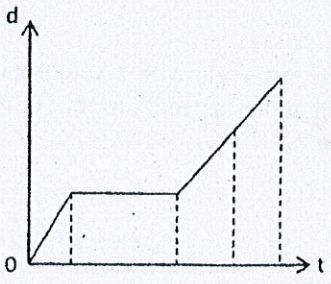

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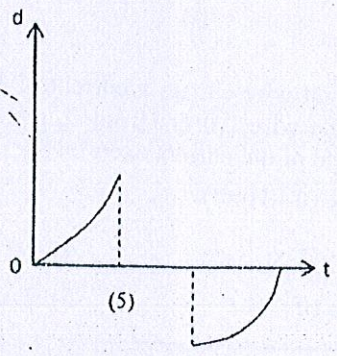


(5)

29. On the earth, spring balances are used to measure the weight of objects and hence determine their mass. This method cannot be used in orbiting space craft. Which one of the following best explains why spring balances cannot be used in orbiting space crafts.

1). The spring balance and the mass have the same acceleration towards the earth, so the spring will not extend.

2). There is no gravity acting on the space craft in orbit around the earth.

3). The reading on the spring balance would vary with the distance from the centre of the earth and hence the spring balance must be continually recalibrated.

4). The resultant force on the mass in a stable orbit is zero.

5). The above method can be used in an orbiting space craft and the statement is incorrect.

30).

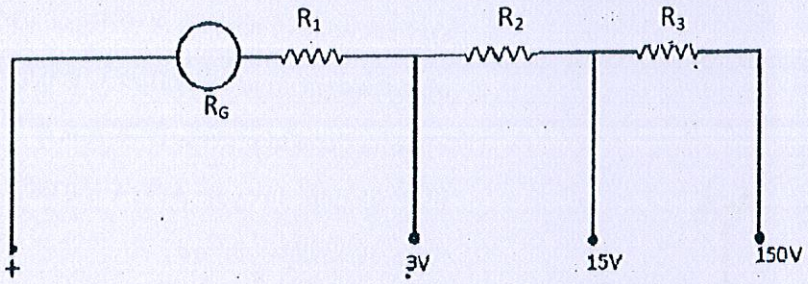
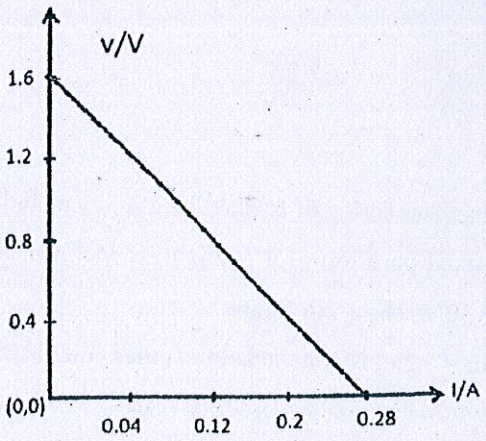


Figure shows the internal wiring of a " three – scale" voltmeter whose binding posts are marked +, 3V, 15V, 150V. The resistance of the moving coil, R_G is 15 Ω, and a current of 1mA in the coil causes it to deflect full scale. The resistances R_1 , R_2 and $R_3$are respectively (in kΩ)

1). 3, 15, 150
2). 2.985, 12, 135
3). 3, 12.985, 13.5
4). 2.985, 12.985, 13.5
5). 2, 12, 13.5

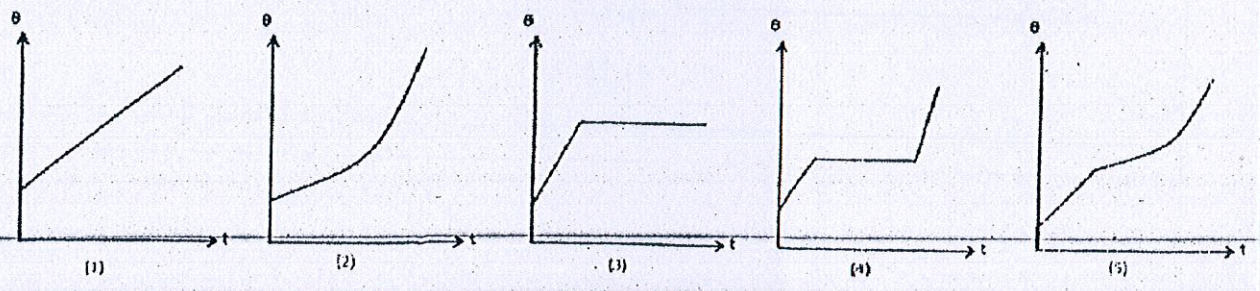
31).



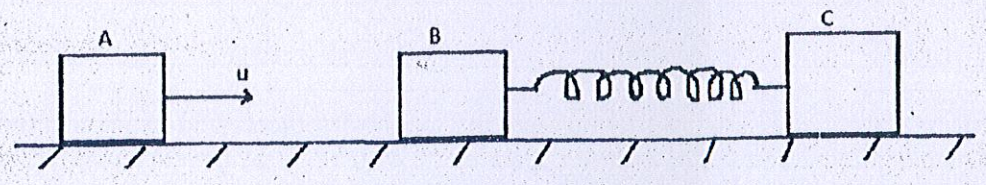
Potential difference across terminals of a cell measured for different currents is expressed graphically as shown. The emf and the internal resistance of the cell are respectively

1). 1.4 V, 0 Ω
2). 1.4 V, 5 Ω
3). 1.4 V, 0.2 Ω
4). 5 V, 0.2 Ω
5). 5 V, 5 Ω

32). Liquid oxygen at 50 K is heated to 350 K under constant pressure of 1 atm. The rate of heating is constant. Which of the following graphs represents the variation of temperature (θ) with time (t) ?



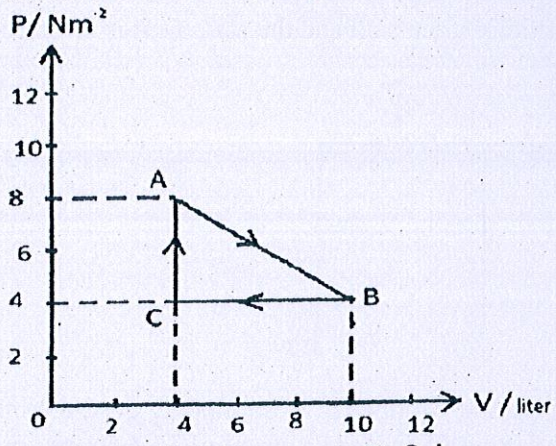
33).



Two blocks B and C of masses 1 kg and 2 kg respectively are connected by a massless elastic spring of spring constant 150 Nm^{-1} and placed on a horizontal frictionless surface as shown in figure. A third block A of mass 1 kg moves with a velocity of 3 ms^{-1} along the line joining B and C and collides with B. If the collision is perfectly elastic and the natural length of the spring is 80 cm, find the minimum separation between blocks B and C.

1). 80 cm 2). 60 cm 3). 20 cm 4). 50 cm 5). 30 cm

34). Shown below is the P – V diagram of a cyclic process ABCD.



Consider the following statements.

a). work done in process A → B is 0.036 J

b). work done in process B → C is 0.024 J

c). work done in process C → A is 0

d). work done in cycle ABCA is 0.06 J

True statement/ s is/ are ,

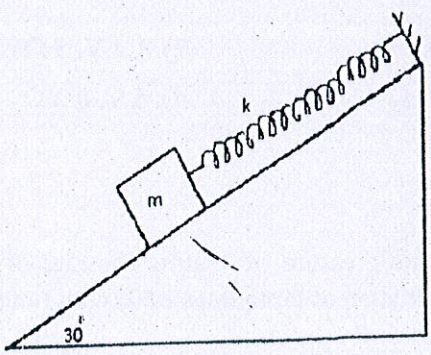
1). Only a, b, and c 2). Only a 3). Only d

4). Only b and c 5). Only c and d

35). An enclosure of volume V contains a mixture of 8g of Oxygen, 14g of Nitrogen and 22g of Carbon dioxide at absolute temperature T. The pressure of the mixture of gas is (R is universal gas constant),

1). $\frac{RT}{V}$ 2). $\frac{3RT}{2}$ 3). $\frac{5RT}{4V}$ 4). $\frac{7RT}{5V}$ 5). $\frac{RT}{5V}$

36).



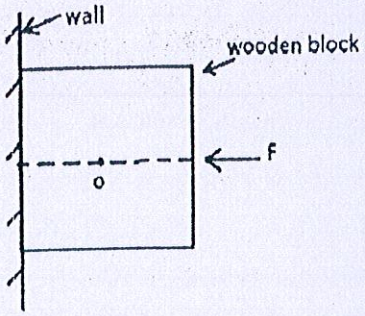
One end of a massless spring of relaxed length 50 cm and spring constant K is fixed on a top of a frictionless inclined plane of inclination $\theta = 30^0$ as shown in figure

When a mass m = 1.5kg is attached at the other end, the spring extends by 2.5cm. The mass is displaced slightly and released. The periodic time (in seconds) of the resulting oscillation will be,

1). $\pi/7$ 2). $2\pi/5$ 3). $\pi/5$

4). $2\pi/7$ 5). $3\pi/7$

A block of mass m is held stationary against a wall by applying a horizontal force F on the block.



Which of the following statements is false ?

1). The frictional force acting on the block F= mg.

2). The normal reaction acting on the block R=F.

3). No net torque acts on the block.

4). R does not produce any torque.

5). No net force acts on the block.

38). A sphere, a cube and a thin circular plate have the same mass and are made of the same temperature. The rate of cooling is,

1). maximum for the sphere and minimum for the plate.

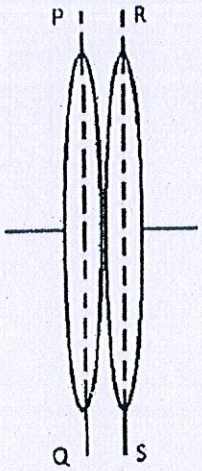
2). maximum for the plate and minimum for the sphere.

3). maximum for the cube and minimum for the sphere.

4). maximum for the plate and maximum for the cube.

5). the same for all three.

39).

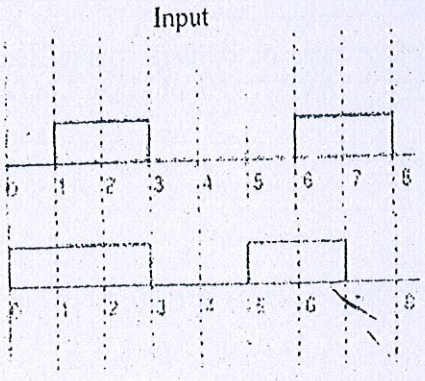


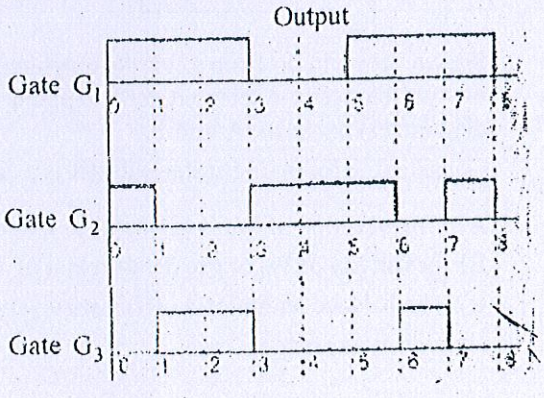
The figure shows an identical equi concave lens system. The power of the combination in diopteres is +1. If the lenses are cut along PQ and RS, the focal length of each half will be

1). 100cm 2). 25cm 3). 75cm

4). 50cm 5). 80cm

40). Two signals A and B shown in the figure are used one by one as the two inputs of three different gates G_1, G_2 and G_3. The output obtained from the three gates are as shown below.

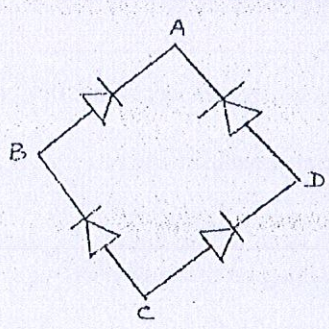




The gates G_1, G_2 and G_3 respectively,

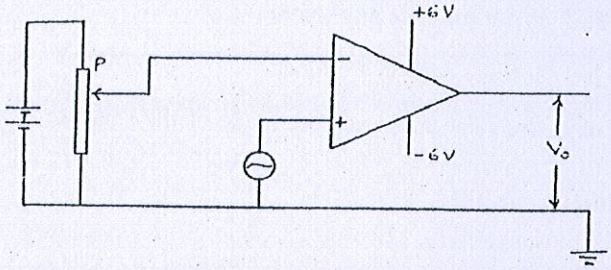
1). AND, OR, XOR 2). OR, NAND, AND 3). OR, AND, NAND

4). XOR, AND, NAND 5). XOR, NAND, AND

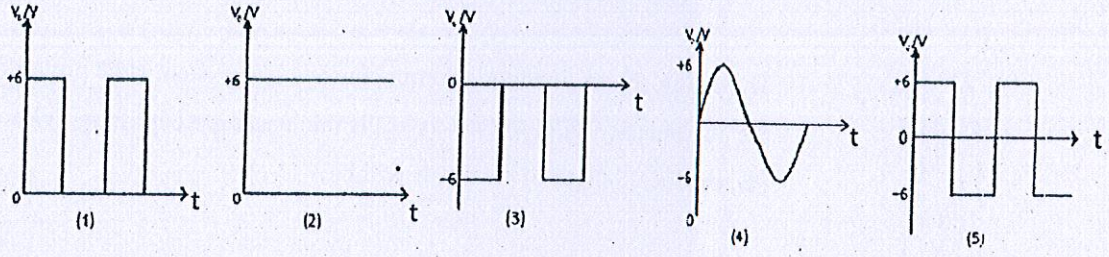
41). 

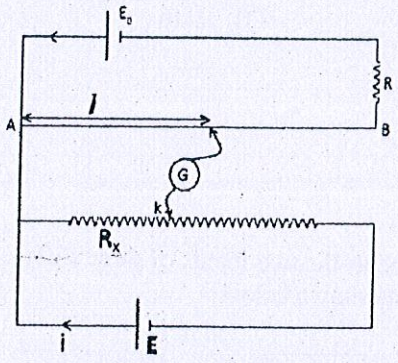
The bridge circuit is shown in figure is to act as a full ... rectifier. The respective connections of the ac input and the dc output are,

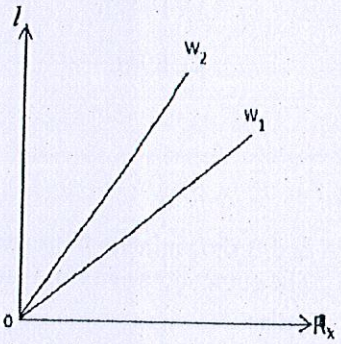
1). A, C and B, D
2). A, C and B, C
3). A, B and C, D
4). B, D and A, C
5). B, C and A, C

42). 

In the op – amp circuit shown above, a sinusoidal emf of 2V (V_{rms}) and frequency 50Hz is applied on the non-inverting input, while the inverting input is held at +2V using the adjustment P. The graph that best expresses the variation of output voltage (V_0) with time (t) is,



43). 



Shown below in diagram (2) is the graphical variation of the balanced length (l) with resistance (R_x) of the variable resistor selected, for two potentiometer wires W1 and W2 each of length 4 m fixed as in diagram (1) between A and B.

Consider the following statements. (R is a fixed resistor)

A). Cross section of W_1 is greater than that of W_2.

B). Resistivity of W_1 is greater than that of W_2.

C). The balance length of a certain wire vary due to the variation of the current (i) when the sliding key (k) moves.

True statement/s is/are,

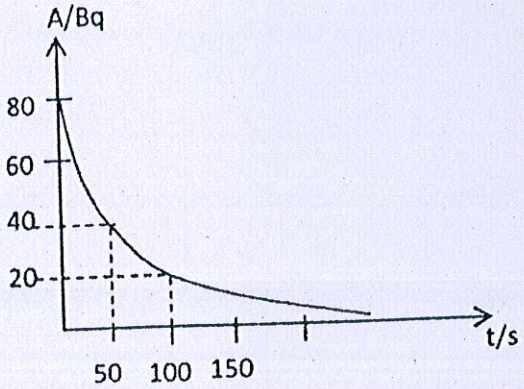
1). A only
2). B only
3). A and C only
4). B and C only
5). All A, B and C

48). If the radii of curvatures at the top end and at the bottom end of a rain drop falling through air at a certain instance are R_1 and R_2 respectively,

1). $R_1 = R_2$ 2). $R_1 < R_2$ 3). $R_1 > R_2$

4). $R_1 \leq R_2$ 5). Data not sufficient.

49). The graph shows how the activity of a radioactive nucleus changes with time. The decay constant of the nucleus is, (s^{-1})



1). 0.0069

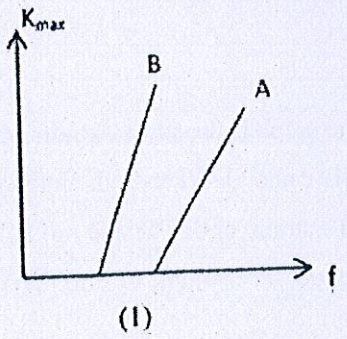
2). 0.014

3). 0.0203

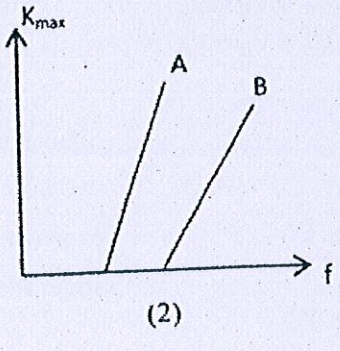
4). 0.041

5). 0.8

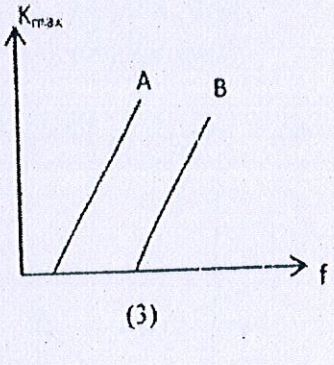
50). A and B are two metals with respective work functions ϕ_A and ϕ_B. If ϕ_A= 1.92 eV ϕ_B= 2.15 eV, the graphical variation that best expresses the variation of maximum kinetic energy of photo electrons with the frequency of incident radiation is,



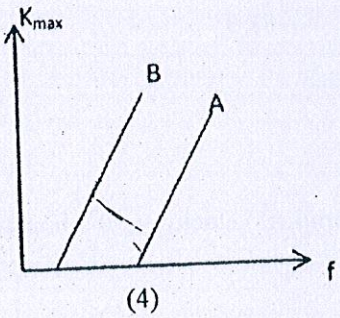
(1)



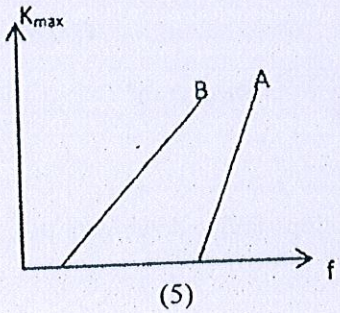
(2)



(3)

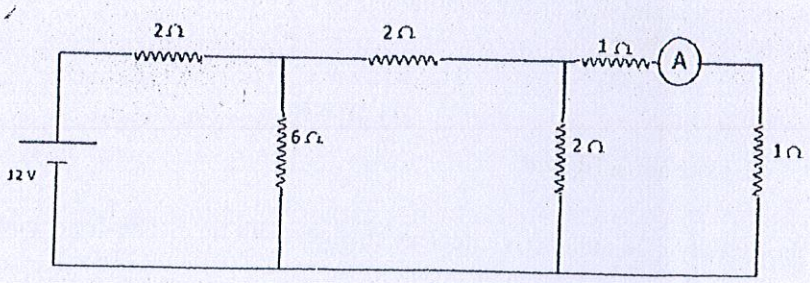


(4)



(5)

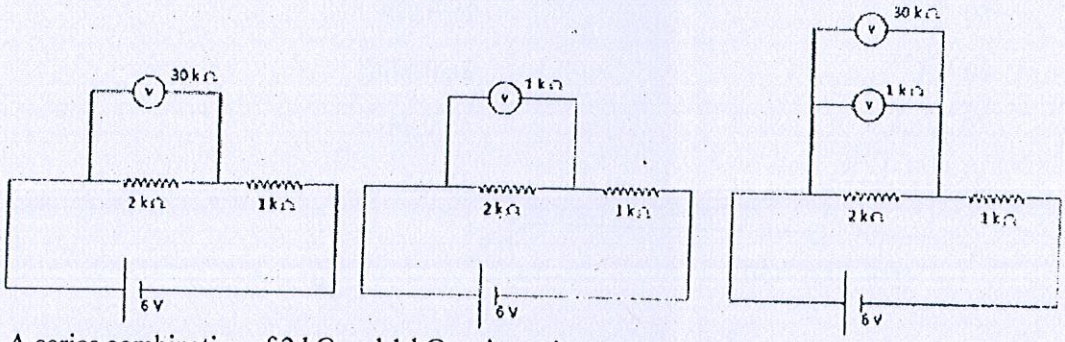
44).



The reading of the ammeter (A) shown in the circuit is,

1). 0.75A 2). 1A 3). 1.5A 4). 2A 5). 3A

45).

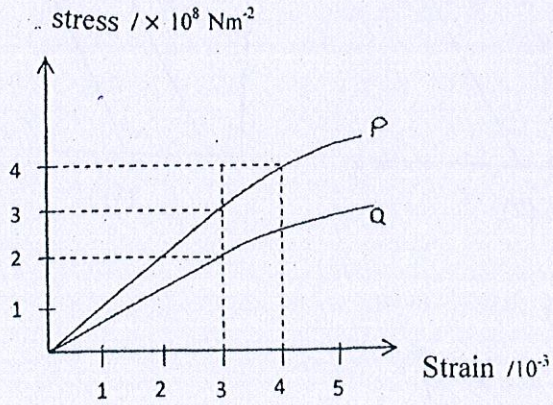


A series combination of 2 kΩ and 1 kΩ resistors is connected across a 6V supply of negligible internal resistance. Two voltmeters with internal resistance 30 kΩ and 1 kΩ when connected across the 2 kΩ resistor id three ways as shown in A, B and C, the respective readings were V_A, V_B and V_C. The correct arrangement of the readings is,

1). $V_A > V_B > V_C$ 2). $V_A < V_B < V_C$ 3). $V_A > V_C > V_B$

4). $V_A > V_B = V_C$ 5). $V_A = V_B = V_C$

46).



Shown in the graph is the stress –strain graph for two materials P and Q. When both materials have experienced a strain of 0.30%, the ratio of the strain energy per unit volume of P to that of Q is,

1). 1 2). 1.5 3). 2

4). 2.5 5). 3

47). Eight identical spherical rain drops falling down with their terminal velocity V, combine to form one big spherical drop. It's terminal velocity will be,

1). V/4 2). V/2 3). 2V 4). 4V 5). 8V

B copies

Ananda College Colombo 10

01 E II

Last Term Test- 2014 June

G.C.E Advanced Level Examination (2014 August)

Physics II | ***Time: Three hours***

Grade : 13 | **Name. : .....**

The paper consists of two parts.

Part A (Structured Essay) – answer ***all*** questions

Part B (Essay) – answer only ***four*** questions

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

Part A – Structured Essay

Answer ***all*** questions in the given space.

1. (a) Define the coefficient of surface tension of a liquid.

.....

.....

(b) If coefficient of surface tension of a liquid is T and the surface tension force acting on length *l* along the liquid surface is F, write the relationship between F, *l* and T.

.....

(c) Using a force diagram explains the statement "a soap membrane can be formed on wire frame kept with its plane vertical".

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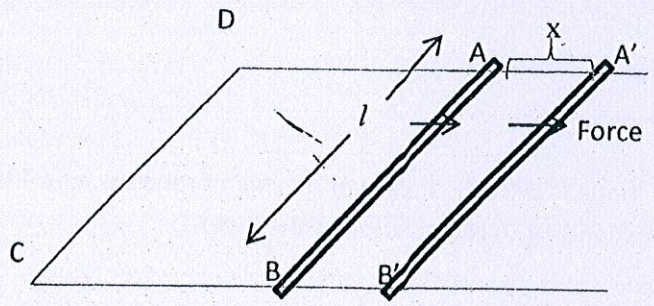
.....

(d)



Shown above is a soap membrane formed in a small frame of wire ABCD kept with its plane horizontal. Wire AB is moved to the position A'B' by applying a constant force. Surface energy on a unit surface area of the soap membrane is e. The distance AA' is x and the length of the wire between the two tracks is *l*.

(i) If the temperature of the membrane during this process is kept constant, what will happen to the work done by the force?

.....

Write an expression for this work done.

.....

(ii) If the mean heat capacity of the membrane is C and if the temperature of the membrane increased by θ during the process, what will happen to the work done by the external force?

.....

Write an expression for this work done

.....

(iii) Work done by the force in parts (i) and (ii) above are w_1 and w_2 and respectively. If $w_1 > w_2$, explain this inequality qualitatively.

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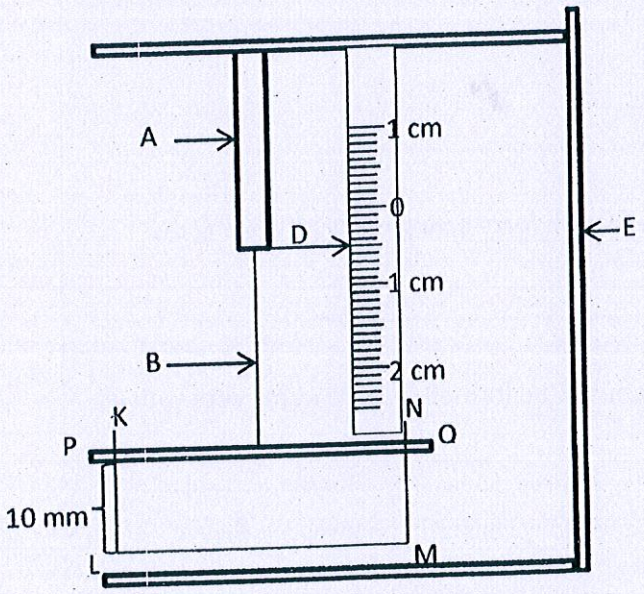
(e) Shown below is an experiment set up by a student to determine the coefficient of surface tension of a soap solution.



A- Light elastic rubber string
B- Light inelastic string
C- Scale with a least count of 1 mm
D- Index
E- Stand
PQ -5 cm long thin wire of mass 100 mg
KLMN – A thin wire frame fixed vertically

The apparatus is set up as shown above and when the wire PQ is not suspended by the string, the index D exist at the position zero in the scale. When the wire PQ is suspended by the string the position of the index D is as shown in the diagram above.

(i) Find the force constant of the rubber string in (N mm^{-1})

.....

.....

(ii) When a soap membrane is formed in the loope PQML, the height of this membrane became 4 mm.

(I) Find the reading in the scale corresponding to the position of the index D.

.....

(II) Find the tension that act in the rubber string.

.....

(III) Find the coefficient of surface tension of the soap solution.

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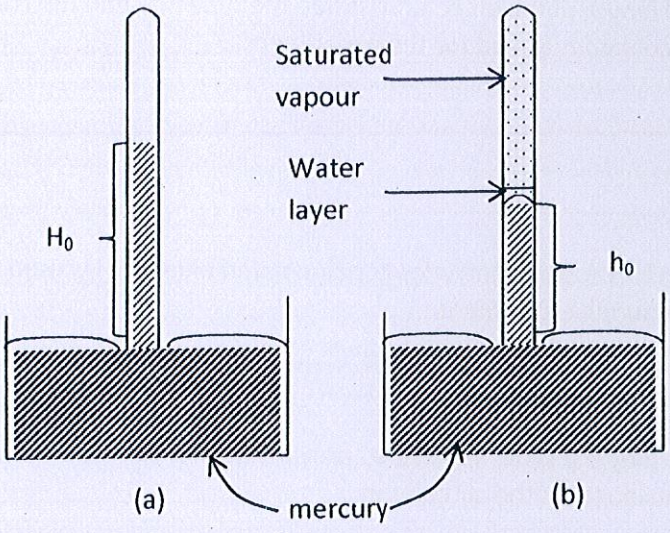


The mercury barometer shown in diagram (a) reads a height H_0 in mercury column. Shown in diagram (b) is a situation after inserting water in to the above barometer.
A layer of water deposit on mercury at this instant and the height from the mercury column is then h_0.

(1) Determine the atmospheric pressure in centimetre of mercury.

.....

State two points which must be corrected but not correct in this situation.

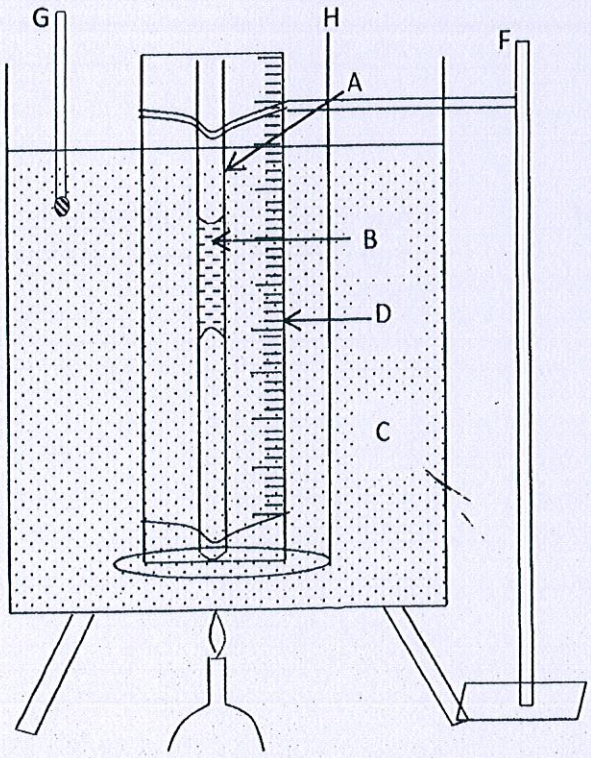
.....

(2) Determine the S.V.P. of water at room temperature

.....

.....

(b)



Shown in the diagram is an apparatus setup to observe the variation of S.V.P of water with temperature.

A- One end closed capillary tube
B- Column of water
C- Water
D- Metruler
E- Bunsen burner n
F- Stand
G- Thermometer
H- Stirrer

(1) The position of the thermometer G is not suitable. State how it can be placed correctly.

.....

(2) If room temperature is θ_r °C and the initial length of the air column inside the tube is l_0, find the constant value of the physical properties of the air column required for the experiment.

.....

.....

.....

.....

(3) In order to obtain more accurate results in this experiment, a longer air column of length l is used in a taller water beaker. State the difficulty you face during experiment.

.....

.....

(4) State a precaution that can be taken regarding the tube, in order to prevent the difficulty mentioned in part (3) above while maintaining the same length in the air column.

.....

.....

(5) Now the apparatus is set-up to find the s.v.p. of water at a temperature θ °C above room temperature. State the method you would follow to confirm that the temperature of water vapour and air inside the tube has reached the correct temperature.

.....

.....

.....

(6) If the lengths of the air column at (room temperature) 30 °C and 50 °C are respectively 20 cm and 22 cm and S.V.P of water at 30 °C is 32 mmHg, find the S.V.P of water at 50 °C .
(Atmospheric pressure is 760 mmHg)

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.....

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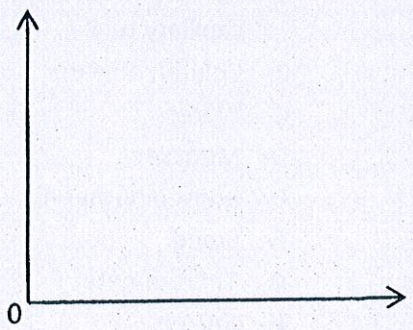
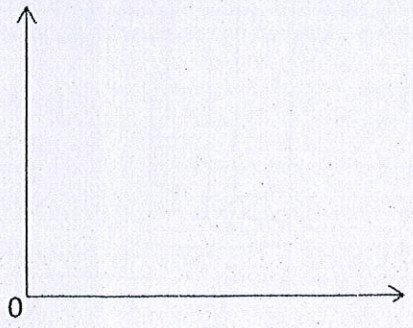
(7)

Draw the graphical variation of s.v.p (P) of water with temperature



Draw the graphical variation of s.v.p. of water with the pressure of gas inside the tube during the e



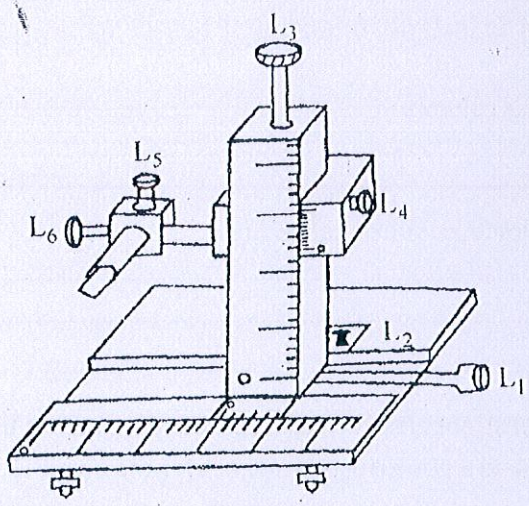


diagram (1)

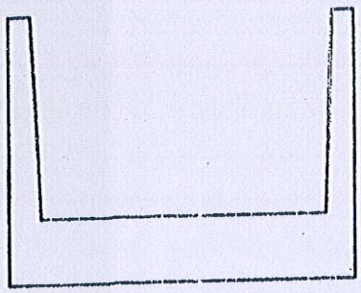


diagram (2)

A student expects to determine the refractive index of the substance of the container shown in diagram (2) using the travelling microscope shown in diagram (1). He uses the uniform horizontal bottom with a considerable thickness and an illuminated point object for this experiment.

(a) Briefly state the procedure he should follow to first level the travelling microscope.

.....

.....

(b) What is the adjustment that must be done in order to get the first reading (R_1)

.....

.....

(c) Which scales must be used to obtain these readings?

.....

(d) Explain briefly how the apparatus must be setup in order to obtain the second reading (R_2). Which screws L_1, L_2, L_3, L_5, or L_6 must be used for this purpose?

.....

.....

.....

(e) What is the next adjustment to obtain the third reading (R_3) in the experiment?

.....

.....

(f) Write expressions for the thickness (t) of the glass bottom and the apparent displacement (d) in terms of R_1, R_2, and R_3

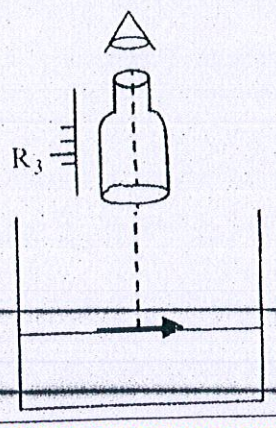
t = ...

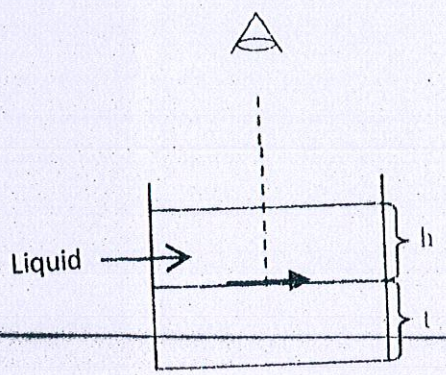
d = ...

(g) If refractive index of glass is n_g, Write an expression for n_g in terms of R_1, R_2 and R_3

.....

(h)





Now he expects to determine the refractive index of a liquid by filling it into this container. If the apparatus is setup as shown above, draw the new position of the microscope (R_4) with respect to the position R_3. Draw two rays to locate the image.

(i) Suggest a method to measure the height (h) of the water column.

.....

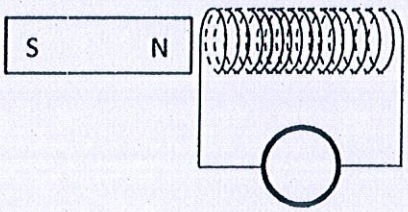
.....

(j) If $R_1 = 4.9$ cm, $R_2 = 5.7$ cm and $R_3 = 7.8$ cm, determine the refractive index of glass (n_g)

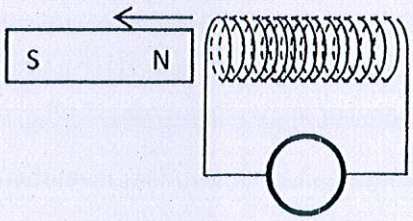
.....

.....

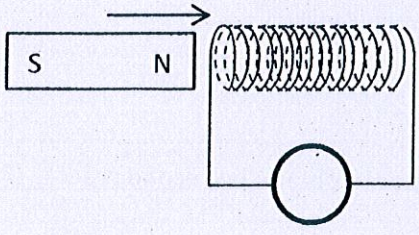
(4) Shown below is an experiment set up by a student to demonstrate electromagnetic induction. He has used a solenoid made of copper wire, a centre zero galvanometer and a powerful bar magnet for the above purpose.



Magnet at rest



Moving the magnet away from a solenoid



Moving the magnet towards the solenoid

(a) Draw the deflecting direction of the pointer of galvanometer corresponding to each of the above situation.

(b) What are the principles which are relevant to above phenomena observed by the student during the above experiments?

.....

.....

(c) State clearly the principle which determines the direction of the current flow.

.....

.....

(d) Suggest three precautions that the student can use to increase the reading of the galvanometer observed above.

.....

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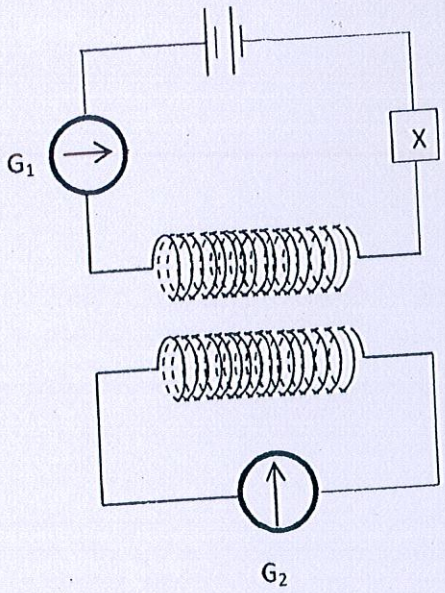
He has setup the following experiment using a battery of e.m.f. 12V and a switch.



(e) What does the student expect to examine from the above experiment set up

.....

(f) Is tap key or plug key more suitable for the switch X? State your answer giving reasons.

.....

.....

(g) When the switch X is closed, explain the observations made about the deflection of the galvanometer G_2 giving reasons.

.....

.....

.....

(h) Number of turns of the coil connected to the battery is 25 and no of turns of the coil connected to the galvanometer G_2 is 5. When switch X is closed, maximum reading of the galvanometer G_1 is 50 mA. Calculate the maximum reading of the galvanometer G_2.(Assume that there is no energy loss)

.....

.....

(i) Student hopes to wind the two solenoids around a soft iron without contacting each other. What is its advantage?

.....

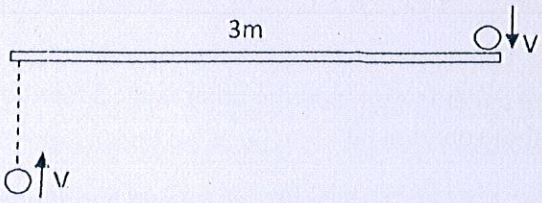
(j) State two ways of losing energy, when the energy supplied to the first circuit by the battery is transferred to the second after using soft iron.

.....

.....

Answer only ***four*** questions.

5) Write the law of conservation of angular momentum.

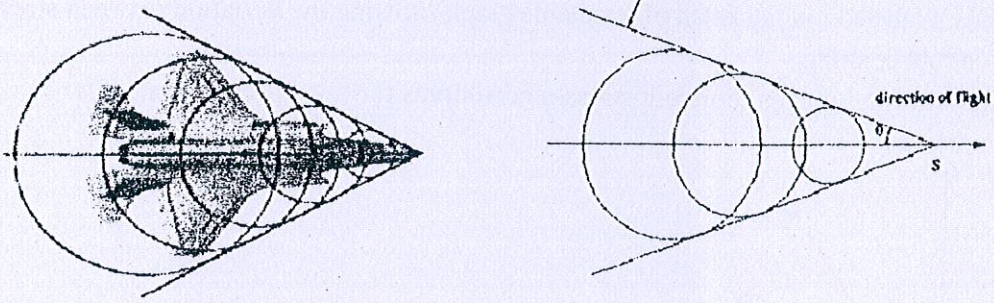


Two children of mass 50kg each, travel towards each other in 2 parallel paths with speeds $10ms^{-1}$. The separation between their paths is 3m. One child carries a light rod of length 3m. During their motion, both children hold on to the rod.

i. Explain the motion of the rod after wards. Show necessary calculations.
ii. If now the separation between the children decreases to 1m as they pull the rod towards each other, explain showing calculations the change in motion of the rod when the separation decreases.
iii. Determine the kinetic energy of the system in the situation (i) and (ii) above and the ratio between the two kinetic energies.
iv. Explain why the value of the ratio of kinetic energies is less than 1.

6) Read the paragraph given below and answer the questions.

The speeds of objects (V_S) which are greater than speed of sound (V) are called supersonic speeds. And the jets that travel with such high speeds are called supersonic jets.
The sound wave fronts emitted by the jet at different positions in such situation, line up in the shape of a cone, which is called the Mach cone. As the waves continue to line up along the cone, the wave fronts undergo a compression and hence will produce shock waves, emitting a loud sound which is called a sonic boom.
Shown below is the lineup of wave fronts and the corresponding Mach cone formed by a supersonic jet.



If the half angle of the Mach cone is θ, then

$$\sin\theta = \frac{\text{speed of sound in air}}{\text{Speed of source}} = \frac{V}{V_S}$$

Also, the Mach number is,

$$\frac{\text{Speed of source}}{\text{speed of sound in air}} = \frac{V_S}{V}$$

When the jet flies with a supersonic speed, the corresponding Mach cone will distribute along with the jet. When the surface of this Mach cone passes a person on the ground he will hear the sonic boom.

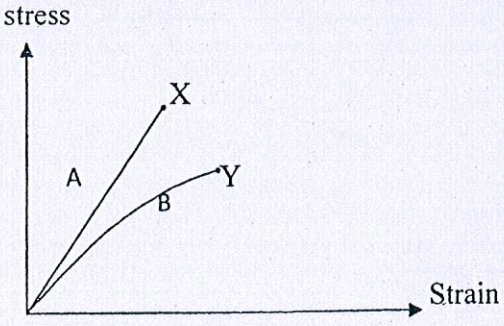
The strength of a sonic boom will depend on factors such as the size of the jet, its speed, the h to the jet from the ground, temperature and the inclination of travel.
Sonic booms can form due to natural causes. One such example is thunder formed in clouds. The massive heat released due to discharge of electric charge from clouds, instantly expand the atmosphere forming shock waves that produce thunder.
A few examples where man produces sonic booms are by supersonic jets, bullets, whips and space crafts.
When a bullet is shot by a rifle, two sounds can be heard during a very short period of time. One of these two sounds is the sound of blast when the bullet is shot, and the other is the sonic boom formed when the bullet travel faster than speed of sound in air.

i. What basic requirements must be fulfilled by a jet in order to produce a sonic boom when traveling?
ii. What requirement must be fulfilled, for a person on ground to hear a sonic boom produced by a jet as such?
iii. State three factors on which the strength of a sonic boom formed by a jet will depend upon.
iv. What can you state about the half angle of the Mach cone when the speed of the jet increases?
v. A sonic boom can be produced by a whip. Explain the formation of a sonic boom when a whip swings.
vi. Write the relationship between the Mach number (M) and the sine of the half angle of the Mach cone.
vii. A jet maintains a speed to have a Mach number of 2.5, travel in a horizontal path at a certain height above the ground. Speed of sound in air is 340 ms^{-1}. At a certain instance the jet fly vertically above an observer on ground. 1 min. and 20 seconds he observes a sonic boom.
   a) Find the speed of the jet.
   b) Find the half angle of the Mach cone.
   c) At what vertical height above the observer does the jet fly?

7)

(i)

a) State Hooke's law with the conditions that should fulfill for its validity.
b) Draw a labeled rough sketch of a suitable graph showing the variation between stress and strain for a rubber string.
c) The following graphs represent stress-strain curves for two different materials.



I. Identify the points X and Y.
II. State giving reasons for the following statements, which material A or B,
   1. obeys Hooke's law
   2. is stronger
   3. has the greater value for Young's modulus.

(ii)

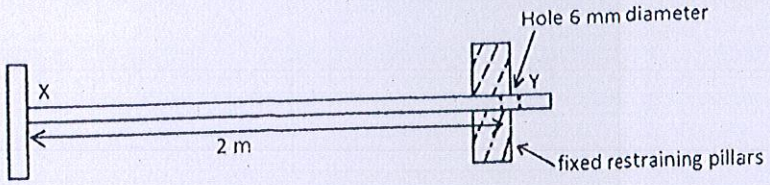


figure (1)

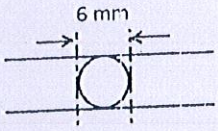


figure (2)

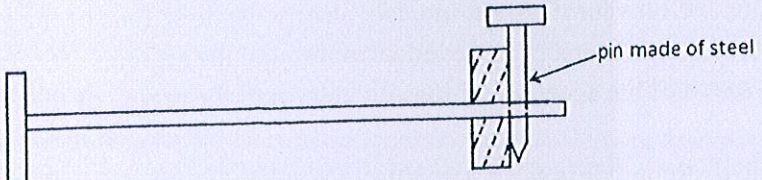


figure (3)

As shown in figure (1), one end X of the steel bar is fixed. The other end Y has a hole of diameter 6mm drilled in it.

When the room temperature is 20°C the distance between the fixed end of the bar and the nearer edge of the hole is 2m as shown in above figure. At this temperature half of the hole shifts out beyond the restraining pillars.

The bar is heated in a constant temperature enclosure until the hole just clears the restraining pillars. A pin, which just fits the hole and made of the material under test, is then inserted through the hole.

a) Calculate the temperature of the enclosure, when the hole just clears the restraining pillars.

b) Given that the bar does not extend beyond its limit of proportionality, calculate the tensile stress in the steel bar when the temperature returns to 20°C.
(Young's modulus for steel = 1.2×10^{11} Pa, Linear expansivity of steel $= 1.5 \times 10^{-6}\ K^{-1}$)

8)

i. A stationary negatively charged particle experiences a force in the direction of the field in which it is placed. State with a reason in each case, whether or not the field is,

a) Magnetic

b) Electric

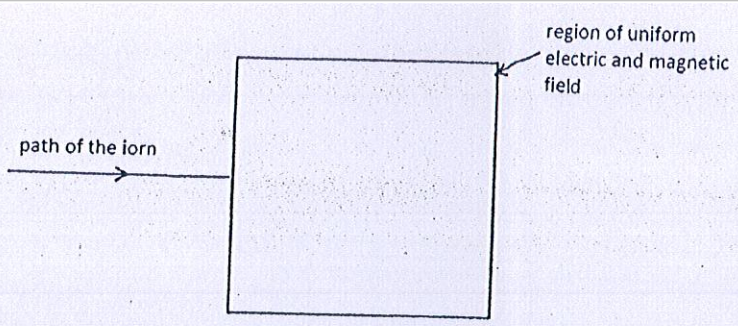
c) Gravitational

ii.

a) Calculate the magnitude and the direction of the electric field strength required to maintain an electron in a fixed position in the gravitational field of the earth, near its surface.
(mass and the charge of an electron are respectively 1.6×10^{-19} C and 9.1×10^{-31} kg)

b) Hence explain why gravitational effects are ignored when considering the motion of electrons in electric field.

iii. An ion of charge +1e is accelerated from rest in a vacuum through a potential difference of 1400 V. They are then injected in to a region of space where there are uniform electric and magnetic fields acting at right angles to the original direction of motion of the ion as shown in figure. (mass of the ion is 3.3×10^{-26} kg)



The electric field has field strength E and the flux density of the magnetic field is B.

a) Copy the figure and on your diagram indicate clearly the directions of the electric and magnetic field so that the ions pass undeflected through the region.

b) Calculate the speed of the accelerated ions on entry into the region of the electric and magnetic field.

c) The electric field strength E is 6.2×10^3 Vm^{-1}. Calculate the magnetic flux density so that the ions are not deflected in the region of the field.

d) If the charge of the above ion is +2e, calculate,

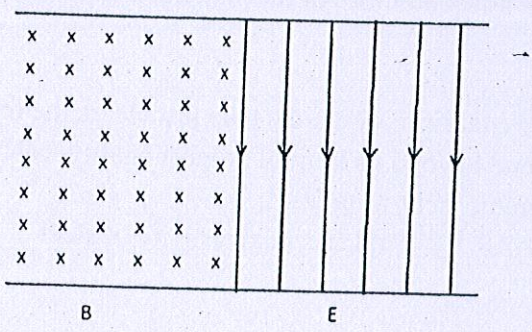
I. The speed of the ion that enter the region of electric and magnetic fields.

II. Determine the path of the ion in the two fields.

iv.

a) Draw the path of the ion entering in part (iii) above if both electric and magnetic fields act in the same direction, perpendicular to the motion of the ion.

b) If the two fields exist as shown below, draw how the ion travels across them.



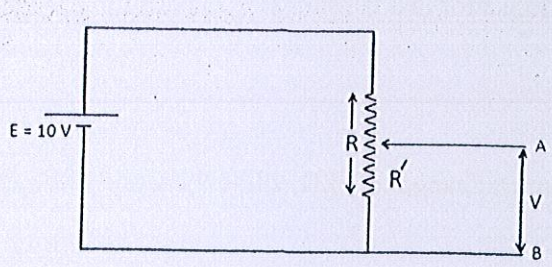
B - magnetic field

E – electrostatic field

9. Answer only (A) or (B)

(A)

(i)



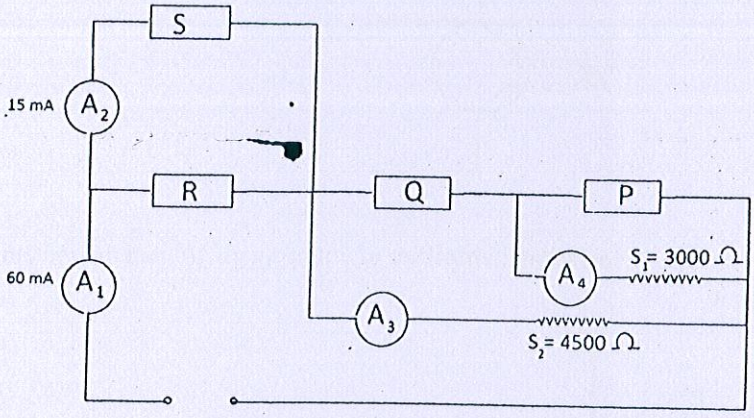
Shown in the diagram is how a rheostat R is used in a circuit designed to obtain a variable potential difference V, by a battery with a negligible internal resistance and emf 10 V.

(a) What is the voltage range that can be obtained for V.

(b) Draw a rough sketch of a graph to express the variation of V with the resistance (R′) between AB.

(c) Explain using a diagram, how the above circuit can be transformed to obtain small potential differences (V), in the range 0 – 1 V between AB without changing the battery.

(ii)



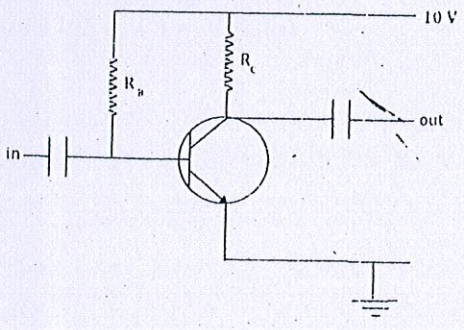
Shown above is an electric circuit fixed across a potential difference of 270 V. A_1, A_2, A_3 and A_4 are four milliammeters with negligible internal resistance. The currents through them are shown in the diagram. P, Q, R and S are 4 electric equipments.

S_1 and S_2 are constant resisters of values 4500 Ω and 3000 Ω respectively

a) Determine the internal resistances of the electrical equipment P, Q, R and S.

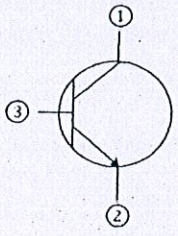
b) Determine the new readings of the four Ammeters when the resistor S_1 is disconnected.

(B) Shown in the diagram is a signal amplification circuit.



(i) What is the type of this transistor?

(ii)



Identify the terminals marked as 1, 2, 3.

(iii) What is the operating mode of this circuit?

(iv) If the current gain (β) of the transistor is $\beta = 100$, $R_C = 25\ \Omega$, $R_B = 5\ k\Omega$ and $V_{BE} = 1\ V$, determine,

(a) The collector current,

(b) Value of V_{CE}.

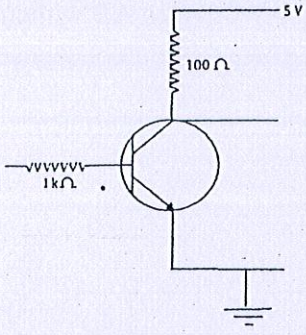
(v) if the value of R_B of above circuit change to 1 $k\Omega$, while the value of R_C remain unchanged, determine

(a) The collector current and

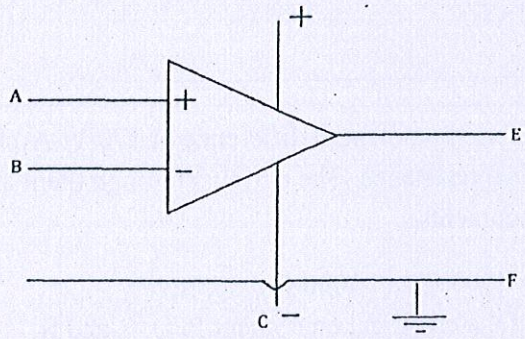
(b) The approximate Value of V_{CE}.

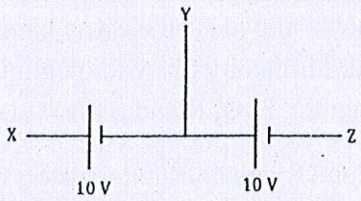
(vi) Draw the output characteristic (I_C Vs. V_{CE}) for the above transistor and mark the region of saturation and region of cutoff.

(vii) If the above circuit is changed as bellow, show that it now operate as a NOT gate.



(viii) The figure shows an operational amplifier of voltage gain 10^5 and the system of cells that supplying the power to it.





(a) Identify the terminals A, B, C, D and E correctly.

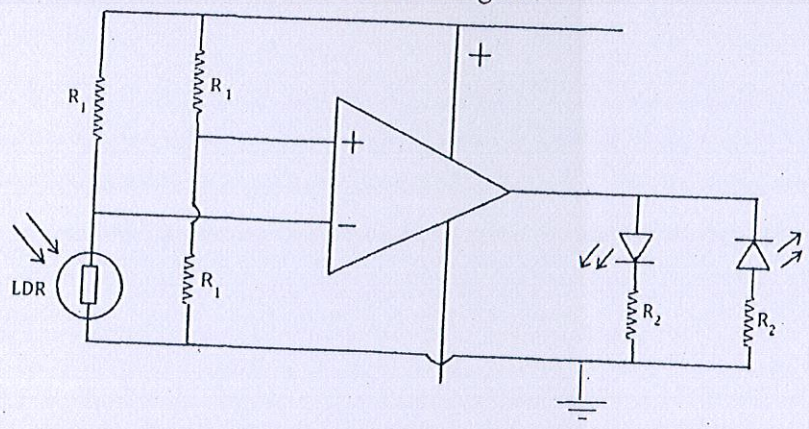
(b) Using the given letter state the positions to which X, Y, Z should be connected.

(c) If $V_A = 0$ V, what must be the value of V_B to transform $V_E = 5$ V?

(ix)Shown below is a circuit constructed by fixing other equipments, to the correctly connected circuit given above.

The resistance of the LDR becomes 100 kΩ in dark and 1 kΩ in bright light.

Find V_A, V_B and identify which LED will glow.



R_1 = 10 kΩ, R_{LED} = 1 kΩ - 100 kΩ

(x) If the value of LED given above is 3 V and 20 mA, find a suitable value for R_2 for current operation of the LED.

10. Answerer only (A) or (B)

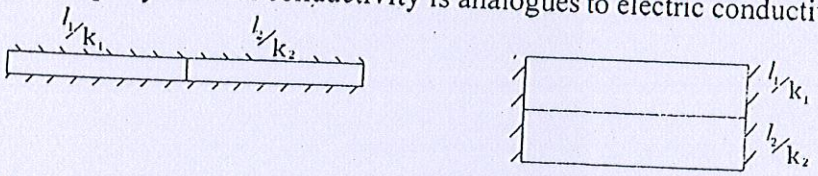
(A) (i)

(a) Show that the rate of conduction of heat along a well lagged uniform rod under a temperature difference is analogues to the rate flow of charge along a uniform conducting rod under a potential difference.

(b) Hence obtain an expression for the thermal resistance of the rod.

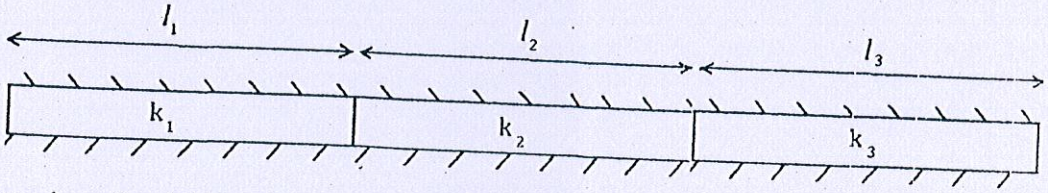
(c) Show that, property thermal conductivity is analogues to electric conductivity.

(d)



Two rods are combined in series and in parallel as shown in the diagrams above. If the thermal resistances of the two rods are R_1 and R_2, write separate expressions of the equivalent thermal resistances for the combined rods.

(ii)



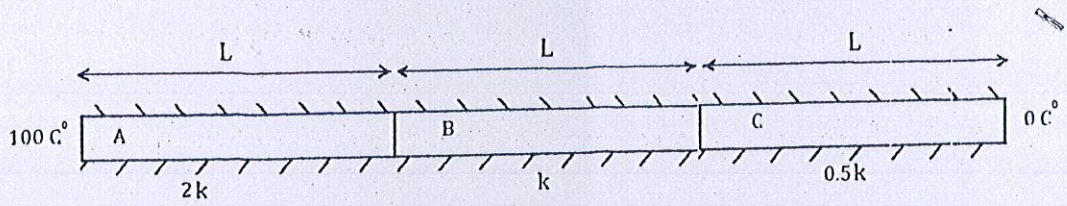
The thermal conductivities of the 3 parts of lengths l_1, l_2 and l_3 of the combined rod are respectively K_1, K_2 and K_3. Draw the graphical variation of the temperature with length from the left corner of the lagged rod, for the following situations.

(a) $K_1 = K_2 = K_3$

(b) $K_1 = K_2 > K_3$

(c) $K_1 = K_3 > K_2$

(iii)



Three uniform rods A, B and C of equal lengths and cross sections are combined in series and are well lagged. Their thermal conductivities are 2k, k, and 0.5k respectively. One end A of this combined rod is maintained at 100 ^{0}C while the other open end at 0 ^{0}C. Determine the temperatures at the two common junctions.

(B)

(i) Distinguish between a nucleon and a neutron.

(ii) Write down a nuclear equation to represent the decay of a free neutron.

(iii) Using the answer in part (ii) above and the data given below, determine the energy released in the decay of a free neutron.

Rest mass of neutron = 1.008665 u
Rest mass of proton = 1.007276 u
Rest mass of electron = 0.000549 u
$C = 3 \times 10^8$ ms^{-1} $\quad$ 1 u = 1.66×10^{-27} kg

(iv) State two physical quantities which cause change of phase of matter but which do not cause a change in the rate of decay of radioactive material.

Radon 220 ($^{220}_{88}Rn$) decay spontaneously with a half-life of 56 s to form Polonium (Po). During this decay, an α particle and a γ ray photon are emitted with energies of 6.29 MeV and 0.55 MeV respectively.

(a) Write down a nuclear equation to represent the decay of a Radon-220 nucleus.

(b) Explain what is meant by half-life.

(c) Calculate the following for this decay.

I. The mass equivalence of the energy released during the decay.

II. The wavelength of the emitted γ ray photon.
(h = 6.63×10^{-34} Js)

(v) The radon in (b) may be found in the air in buildings. For health reasons the safe limit of activity due to the decay of radon is set as 200 Bq per cubic meter of air. Calculate for this safe limit, (take $\lambda = \frac{0.693}{T_{\frac{1}{2}}}$)

(a) the number of radon atoms present per cubic meter of air.

(b) the ratio,

$$\frac{\text{number of radon atoms per cubic meter}}{\text{number of air molcules per cubic mater}}$$

Given that 1 mol of air in the building is contained in 0.024 m^3

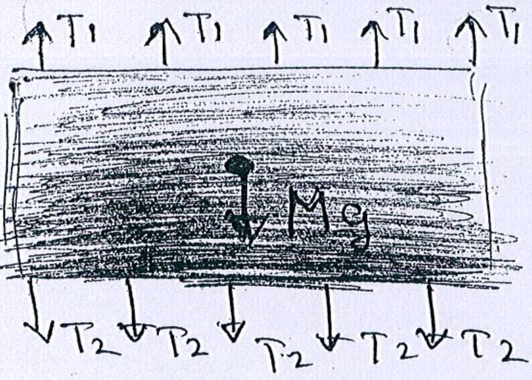
(c) Suggest why the presence of Radon gas in buildings is of environmental importance.

Marking Scheme - Physics. 2014 June - (2014 Aug A/L)

① (a) නිදහස් ද්‍රව පෘෂ්ඨය මත පැලෙන්නු ලෙස ඕනෑම රේඛාවක් මත. එම රේඛාව ලම්බකව ද්‍රව පෘෂ්ඨය තලයේ ඒක දිගකට පවත්නා ක්‍රියාකරන බලය පෘෂ්ඨික ආතතියයි. (01)

(b) $F = lT$ ——— (01)

(c)



පහළ පෘෂ්ඨය මත ජලයේ ද්‍රව පෘෂ්ඨ තිබේ. $\therefore T_1 > T_2$ වේ. සමතුලිතතාවයට $T_1 l - T_2 l = Mg$. (01)

$\therefore$ නිරවද්‍ය ප්‍රකාශය වේ.

(d)(i) සබන් පටලයේ පෘෂ්ඨ දෙකක් ලෙස සලකා වේ. (01)
කාර්යය $W_1 = F \times x = 2 \times e \times lx = 2elx$.

(ii) පටලයේ පෘෂ්ඨික ශක්තියෙහි වැඩිවීම හා උෂ්ණත්වය නියතව තබා ගැනීමට තාපය ලබා දිය යුතුය. (01)
$\therefore$ කාර්යය $W_2 = 2e'lx + CQ$
($\because$ e බොහොදුරට උෂ්ණත්වය මත රඳා පවතී. උෂ්ණත්වය අඩු වූ විට e' ලෙස)

(iii) මෙහි $e > e'$ වේ. (උෂ්ණත්වය අඩු නිසා e' අඩුවේ)
$W_1 > W_2$ වෙයි;
$2elx > 2e'lx + CQ$ බව නිගමනය කළ හැක. ——— (01)

(e)(i) $F = kx$. $100 \times 10^{-6} \times g = k \times 5$ $k = 2 \times 10^{-4}\ N\ mm^{-1}$ ——— (01)

(ii)(1) 11 mm ——— (01)

(2) මෙම අවස්ථාවේ ද්‍රව පෘෂ්ඨය $F = kx$ දුවා
$2 \times 10^{-4} \times 11 = 22 \times 10^{-4}\ N$ ——— (01)

(3) $F = 2lT$ දුවා $12 \times 10^{-3}\ N\ m^{-1}$
$22 \times 10^{-4} = 2 \times c \times 10^{-2}\ T$ $T = 2.2 \times 10^{-2}\ N\ m^{-1}$ ——— (01)

(2) (a) (i) වායු පීඩනය $P = H_0$ (cm Hg)

* Hg වාෂ්ප වීමෙන් වැළකීමට දැවෙන පීඩනය.
* සෘජුවම වායුගෝලීය පීඩනය දැවෙන පීඩනයයි.

(ii) බලයේ සිට වා. පී. $P_0 = (H_0 - h_0)$ cm Hg. —— (01)

(b) (i) උදුන්නවයෙන්ගේ අදියරුන්වන් බලයෙන් ගිලවා —— (01)
තබයි යුතුය.

(ii) වායුගේ පීඩනය $= H_0 - (H_0 - h_0) = h_0$

වායුවෙ $\frac{PV}{T} = K$ $\frac{h_0 \times l_0 a}{(273+0_1)} = K$ (නියතයි) (01)

(iii) බලයේ උදුන්. ඒකාකාරව වැඩිවීම දැකගත හැකි. (01)

(iv) වීජ දණ්ඩ රත්වීම නල තොවන නිසාවෙන් ලෝහ පෙත් වඩාත් වේගයෙන් දිගහැරීම නිසා වායු නලයේ පහළ මට්ටමට ඇදී බැසීමක් සිදුවේ. —— (01)

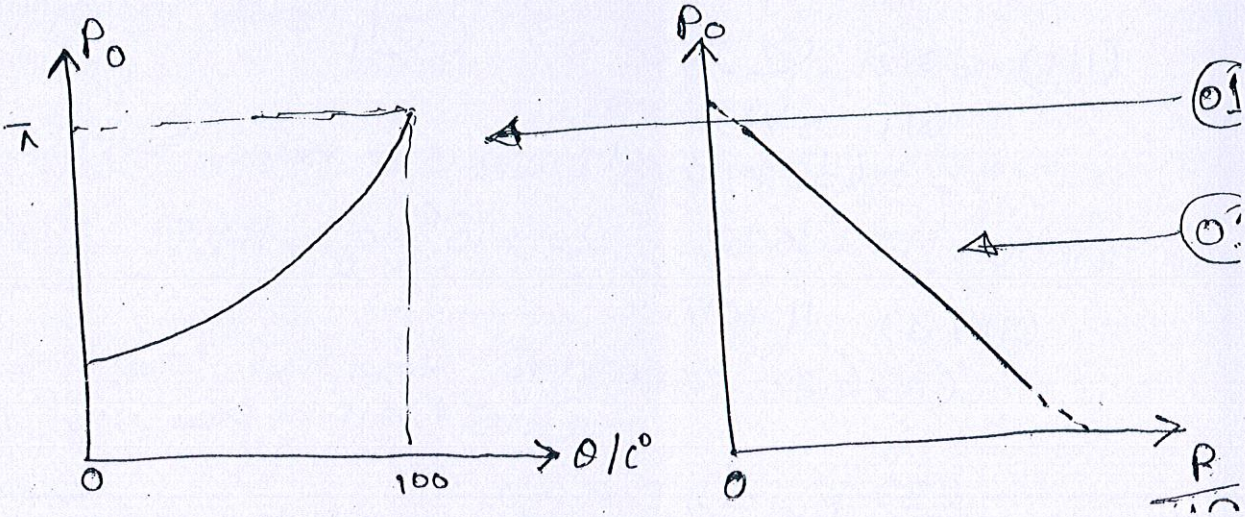
(v) දැඩිල උදුන් තියන වායුව ඒකාකාර ලෙස රත්වීම සඳහා දැවෙන. ලෝහ පෙත් නලයේ සහ තබයි සහ ගොළු සහිත වීම. තිබීම පෙත් කාමර උෂ්ණත්වය ඒකාකාර වීම. —— (01)
කිසි අවස්ථාවක. පෙත්වල ඇලෙන්නේ.

(vi) වායුවට $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$.

$\frac{(760 - 32) \times 20a}{(273+30)} = \frac{(760 - P_{සුළු}) \times 22a}{(273+50)}$ —— (01)

$P_{සුළු} = 54.5$ cm Hg.

(vii)



(a) වේදිකාව මත ස්ප්‍රීතු ලෙවලය තබා S_1 හා S_2 ලෙවල් ඇණ භාවිතයෙන් වේදිකාව තිරස්ව සකසයි. (01)

(b) අන්වීක්ෂය සිරස්ව තබා 'c' පාලිත් වේදිකාව මත ඇති පරිකෙත ලකුණ. එ පැහැදිලිව පෙනෙන තුරු අන්වීක්ෂය පාලනය. (01)

(c) සිරස්ව ඇති ප්‍රධාන පරිමාණය හා වර්නියර් පරිමාණ (01)

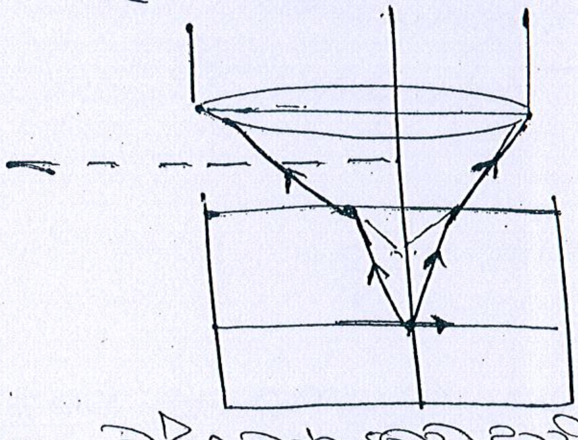
(d) පලකය මත විදුරු බඳුන තබා. පතුල මැදින් පෙනෙන තාත ප්‍රතිබිම්බය පැහැදිලිව පෙනෙන තුරු L_3 හෝ L_4 ඇණ මගින් සීරුමාරු කරන්න. (01)

(e). බඳුනේ පතුල මත. පලකය තබා ඇම පැහැදිලිව පෙනෙන තුරු L_3 හෝ L_4 ඇණ. සකසයි. (01)

(f). $t = R_3 - R_1$
$d = R_2 - R_1$ (01)

(g) $n_g = \frac{\text{සත්‍ය ගැඹුර}}{\text{දෘශ්‍ය ගැඹුර}} = \left(\frac{R_3 - R_1}{R_3 - R_2}\right)$ (01)

(h)



(01)

(i) ජලය මත. පරිකෙත ... R4 ... ලබාගන්නා. R_4 හා R_3 අතුරු h ලබාගන්නා. (01)

(j) $n_g = \frac{R_3 - R_1}{R_3 - R_2} = \frac{7.8 - 4.9}{7.8 - 5.7} = \frac{2.9}{2.1}$ (01)

$n_g = 1.38$ (1.4)

(4) (a) ධාරා නැත (A)

ධාරා ඉවතට N (A) හෝ (A)

ධාරා දෙසට N (A) හෝ (A) (නැමෙයි).

(b). වි. චු. ක්ෂේත්‍රයේ [illegible] සහ ලෝහ [illegible].

(c) දඟරයේ ඇති චුම්. ප්‍රාවය වෙනස්වීම පමණක් වන. දඟරයේ [illegible] ප්‍රේරිත වි. ගා. බලය [illegible].

(d) 1. දඟරයේ පොට ගණන වැඩිකිරීම.

2. චුම්බකයේ චලනයේ වේගය වැඩිකිරීම.

3. දඟරයේ හරස්කඩ වර්ගඵලය වැඩිකිරීම.

4. චුම්බකයේ ප්‍රබලතාව වැඩිකිරීම.

(e) ලෙන්ස් නියමය (ශක්ති සංස්ථිති නියමය)

(f) [illegible] - [illegible]

(g) ද්විතීයික දඟරයේ වි. ගා. බ. ප්‍රාථමිකයට වඩා අඩු [illegible] [illegible]

(h)
$$\frac{I_p}{I_s} = \frac{n_s}{n_p}$$

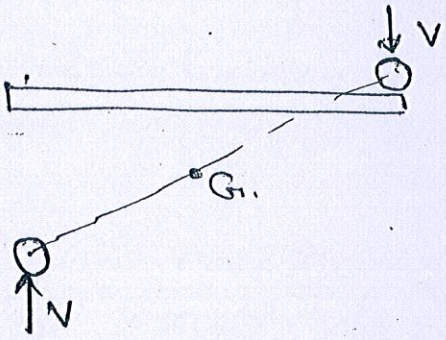
$$I_s = \frac{I_p n_p}{n_s} = \frac{50 \times 25}{5} = 250mA$$

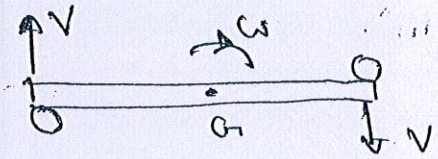
(i) [illegible]

(j) [illegible]

(i) වස්තුවේ ස්කන්ධ කේන්ද්‍රය ප්‍රභවය වටා ඇති ජඩත්වය I වස්තුව වස්තුවේ දළ සම්මිතික අක්ෂය වටා භ්‍රමණය වන විට, සමමිතික දළ සම්මිතික තලය වටා භ්‍රමණය වීම සඳහා සමීකරණය වේ.

$\tau = I\alpha$ ——— (02)





වෙර. පසු

G හරහා යන අක්ෂය වටා $= G$ හරහා. පසු නැවත සමීකරණය

$mv(l/2) + mv(l/2) = [m(l/2)^2 + m(l/2)^2]\omega$ ——— (02)

$\omega = 2v/l = 2\times 10/3 = 20/3$ rad s^{-1} ——— (01)

(ii) වරහරය ශූන්‍ය නිසා, වස්තුව මත, කිසිදු බාහිර විෂමවේගයක් නොවේ. ——— (01)

$\therefore I_1\omega_1 = I_2\omega_2$.

$2m(l/2)^2 \times 20/3 = 2m(l/2)^2 \times \omega_1$ ——— (01)

$(\frac{l}{2})^2 \times \frac{20}{3} = (\frac{l}{2})^2\omega_1 \Rightarrow \omega_1 = 60$ rad s^{-1}. ——— (01)

$\therefore$ කෝන ප්‍රවේගය වැඩි වේ.

(iii) එක් කුඩා කැබැල්ලක චාලක ශක්තිය $= 2\times\frac{1}{2}mv^2 = 2\times\frac{1}{2}\times 50\times 10^2$ ——— (01)

$E_1 = 5000$ J ——— (01)

පසු කුඩා කැබැල්ලක චාලක ශක්තිය $= 2\times\frac{1}{2}m(l/2)^2\omega^2$ ——— (01)

$= 2\times\frac{1}{2}\times 50(\frac{1}{2})^2\times 60^2$. ——— (01)

$E_2 = 45000$ J

$\therefore$ චා. ශ. අනුපාතය $E_1/E_2 = \frac{5000}{45000} = 1/9$ ——— (01)

(iv) කිසියම් වේගයකින් ගමන් කරන වස්තුවක් නිශ්චලතාවයට පැමිණීම සඳහා එහි චාලක ශක්තිය ඉවත් කළ යුතුය. එම නිසා එය ඒකාකාර ප්‍රවේගයෙන් ගමන් කරන්නේ නැත. ——— (02)

(6) (i) ඉහළ ධාරකය බිඳෙන්නේ, එහිදී ගබ්දය වැඩි වීම නිසා

(ii) යානය වේගයෙන් ගමන් කරන විට ඉදිරියෙන් ඇති වන තරංග සංඛ්‍යාත වැඩි වේ. එවිට ඉදිරියෙන් ඇති වන තරංග දිග අඩු වේ. (01)

(iii). ඉහළ ධාරක වීම නිසා, ගබ්දය, ඔබට ඉදිරියෙන් ඇති වන ගබ්දය (සිදුවීම) වැඩි වේ. (02)

(iv). ඉහළ ධාරක ගබ්දය ඔබට ඇසෙන්නේ නැති වේ. එමගින් ඔබට ඉදිරියෙන් ඇති වන ගබ්දය අඩු වේ. (01)

(v) ගබ්දය වේගය අඩු මාධ්‍යයක සිට වේගය වැඩි මාධ්‍යයකට ගමන් කරයි. එවිට තරංග වර්තනය වේ. එවිට ගබ්දය ඔබට ඇසෙන්නේ ඉහළින් ය. එවිට ඔබට ගබ්දය ඇසෙන්නේ නැත. (02)

(vi). $\sin\theta = v/v_s$

එහි දෝෂය $M = v_s/v$

$\therefore \sin\theta = \frac{1}{M}$ (01)

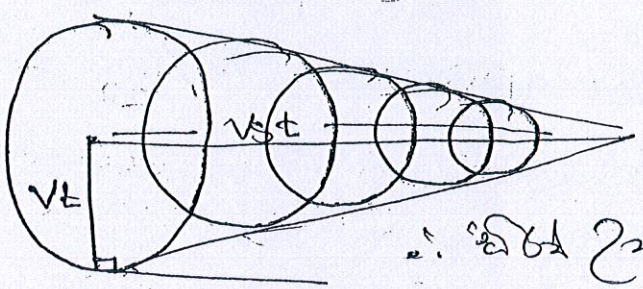
(vii) (a) $M = v_s/v$

$v_s = 2.5 \times 340 = 850\ ms^{-1}$ (01)

(b) $\sin\theta = v/v_s = 340/850 = 0.4$ (01)

$\theta = 23^\circ 35'$ (01)

(c)



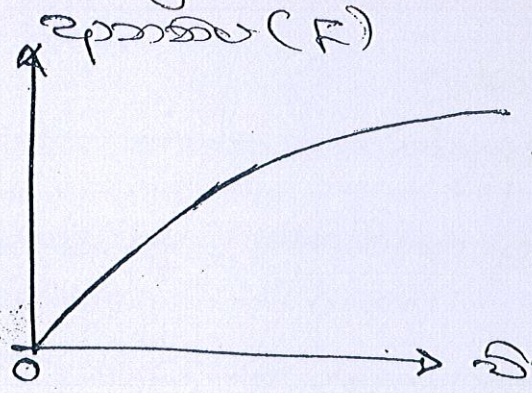
$\therefore$ සිරස් දුර $= vt$

$= 340 \times 80$

$= 27200\ m$ (01)

(i)(a). සාකච්ඡාවකින් පිළිබඳ දැනුම සම්මිතියෙන් යුතුව ඇති ලද මිලෙහි (F) විතතියෙන් (e) රඳා පවතින බව සාකච්ඡාවකින් පෙන්වීම. ——— (02)

(b) බලය (F)



——— (02)

(c) I x - A දුරෙහි ඡේදය ලෙස. ——— (01)

y - B දුරෙහි ඡේදය ලෙස ——— (01)

II (1) A ——— (01)

(2) A ——— (01)

(3) A ——— (01)

(ii) (a). $\Delta l = l \alpha . \Delta \theta$ බවට පරිවර්තනය ——— (01)

$3 \times 10^{-3} = 2 \times 1.5 \times 10^{-6} \Delta \theta$ ——— (01)

$\Delta \theta = 1000\ ^{\circ}C$

$\therefore$ රුහුල් කළ අග උෂ්ණ. $= 1020\ ^{\circ}C$ වේ. ——— (01)

(b). $Y = \frac{Fl}{Ae}$ ලබා. ——— (01)

$\frac{F}{A} = \frac{Ye}{l} = \frac{1.2 \times 10^{11} \times 3 \times 10^{-3}}{2}$ ——— (01)

$= 1.8 \times 10^{8}\ N m^{-2}$.

නිවැරදි පිළිතුරෙහි දැඩි දෝෂය $= 1.8 \times 10^{8}\ N m^{-2}$ ——— (01)

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(8) (i) (a) ඉලෙක්ට්‍රෝන කදම්භය දිගේ වලනය වීමට ඉඩ දීම. ——— (01)

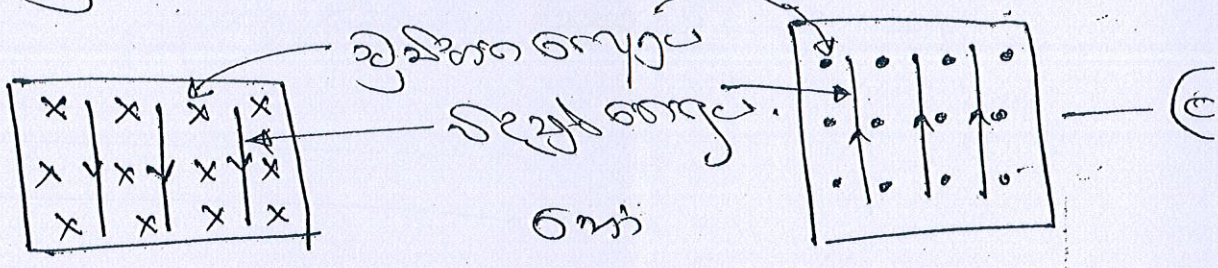
(b) ඉලෙක්ට්‍රෝන කදම්භය මත ක්‍රියා කරන බල අන්‍යෝන්‍ය වශයෙන් එකිනෙක අවලංගු වීම. ——— (01)

(c) ඉලෙක්ට්‍රෝන කදම්භය බල රේඛා දිගේ වලනය වීම. ——— (01)

(ii)(a) $Eq = mg$ $\downarrow E = \frac{9.1\times10^{-31}\times10}{1.6\times10^{-19}} = 5.69\times10^{-11}\,NC^{-1}$ (නිවැරදි) ——— (02)

(b) ඉලෙක්ට්‍රෝන කදම්භය මත ක්‍රියාකරන බල අවලංගු වීම නිසා ඉලෙක්ට්‍රෝන කදම්භය මත බලයක් ක්‍රියා නොකරයි. ——— (01)

(iii)(a)



——— (03)

(b) $\frac{1}{2}mv^2 = qV$

$v = \sqrt{\frac{2qV}{m}} = \sqrt{\frac{2\times1.6\times10^{-19}\times1400}{3.32\times10^{-26}}}$ ——— (03)

$v = 1.16\times10^5\,ms^{-1}$ ——— (01)

(c) $Eq = BqV$ ——— (01)

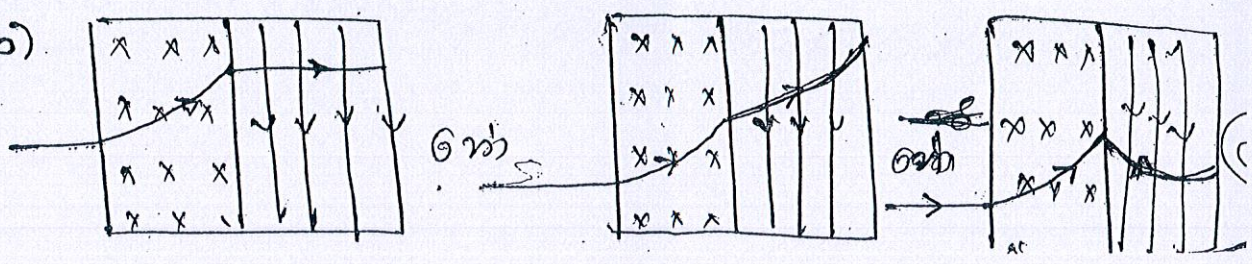
$B = E/V = \frac{6.2\times10^3}{1.16\times10^5} = 0.053\,T.$ ——— (01)

(d)(I) වේගය $= \sqrt{2}\times1.16\times10^5\,ms^{-1} = 1.64\times10^5\,ms^{-1}$ ——— (01)

(II) දෛශිකයේ දිශාව. ($\longrightarrow$). ——— (01)

(iv)(a) ඉලෙක්ට්‍රෝන වලින ($\sim\sim\sim$). ——— (01)

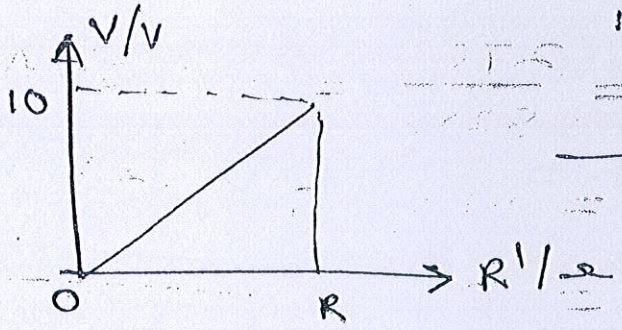
(b)



——— (02)

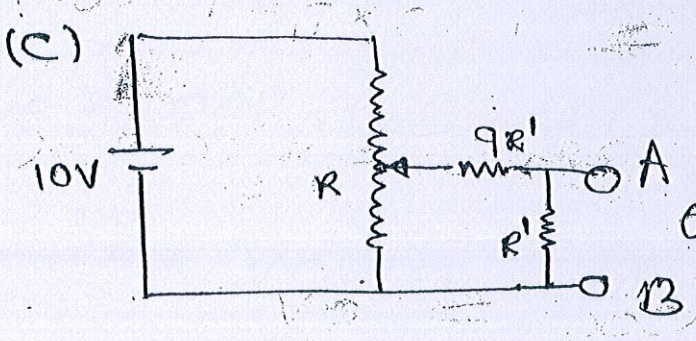
① (A) (i) (a) 0 — 10 V ——— (01) (5)

(b)

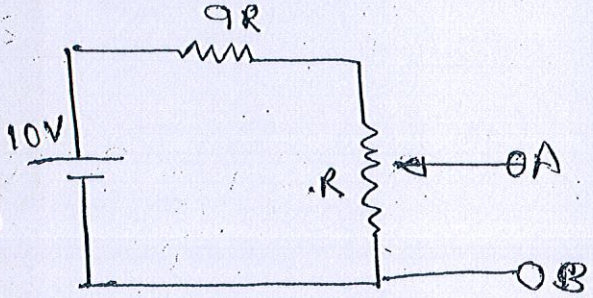


——— (01)

(c)



ඔහෙ



ලබාදී ඇති R' හා 9R' ප්‍රතිරෝධ සම්බන්ධ කර ඒවා 9R ප්‍රතිරෝධයට සමාන්තරගත කිරීම ——— (02)

(ii) (a) $S_1 = 4500\Omega$, $S_2 = 3000\Omega$ බලා ඇති බැවින්

$V_{S_2} = (10\times10^{-3}) \times 3000 = 30V$ ——— (01)

$\therefore V_P = 30V$ වේ.

P හි ප්‍රතිරෝධය $R_P = V/I = \frac{30}{30\times10^{-3}} = 1000\Omega$ ——— (01)

$V_{S_1} = (20\times10^{-3}) \times 4500 = 90V$.

$\therefore V_Q = 90 - 30 = 60V$.

$\therefore$ Q හි ප්‍රතිරෝධය $R_Q = V/I = \frac{60}{40\times10^{-3}} = 1500\Omega$. ——— (01)

$\therefore$ S හා R හා සමාන්තර R' වේ; $R1 = \frac{(270-90)}{60\times10^{-3}}$

$= 3000\Omega$.

$\therefore$ S හි ප්‍රතිරෝධය $R_S = \frac{(270-90)}{15\times10^{-3}} = 12000\Omega$ (01)

R හි ප්‍රතිරෝධය $R_R = \frac{180}{\quad} = 4000\Omega$ (01)

(b) සමාන්තර පථ සඳහා ප්‍රතිරෝධය = 750 + 1500 + 3000
= 5250 Ω.

∴ A_1 හරහා ධාරාව = $\frac{270}{5250}$ = 51.43 mA

A_2 හරහා ධාරාව = $51.43 \times \frac{1}{4}$ = 12.86 mA.

A_3 හරහා ධාරාව = 0.

A_4 හරහා ධාරාව = $51.43 \times \frac{1}{4}$ = 12.86 mA

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(11)(a) S_1 = 3000 Ω සහ S_2 = 4500 Ω බවත්,

ඉහත රූපයේ පරිදි,

$V_{S_1} = (20 \times 10^{-3}) \times 3000 = 60V$

$V_{S_2} = (10 \times 10^{-3}) \times 4500 = 45V$.

∴ P හි ප්‍රතිරෝධය $R_P = \frac{45}{30 \times 10^{-3}} = 1500 \Omega$.

Q හි " $R_Q = \frac{45}{40 \times 10^{-3}} = 375 \Omega$

R හි " $R_A = \frac{(270 - 60)}{45 \times 10^{-3}} = 4667 \Omega$

S හි " $R_S = \frac{210}{15 \times 10^{-3}} = 23333 \Omega$

(b) S_1 හා සමාන්තරගත පථයේ සමක ප්‍රතිරෝධය = (3889 + 375 + 1800) Ω
= 6064 Ω.

∴ A_1 හරහා ධාරාව = $V/R = \frac{270}{6064} = 44.52$ mA

A_2 හරහා ධාරාව = $44.52 \times \frac{1}{4} = 11.13$ mA

A_3 හරහා ධාරාව = 0.

A_4 හරහා ධාරාව = $44.52 \times \frac{1}{4} = 11.13$ mA

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(1) (B) (i) npn. ——— (01)

(ii) ① - සංග්‍රාහකය, ② විමෝචකය, ③ - පාදම (පාදය) ——— (01)

(iii) පොදු විමෝචක (එමිටර්) වින්‍යාසය. ——— (01)

(iv) (a) I_b සෙවීම $(10-1) = I_b \times 5 \times 10^{3}$

$I_b = \frac{9}{5} \times 10^{-3} A$ $\quad I_c = \beta I_b = 100 \times \frac{9}{5} \times 10^{-3}$

$I_c = 0.18A = 180 mA$ ——— (01)

(b) R_C සඳහා $V = IR$ $\quad V = 1.8 \times 10^{-1} \times 25 = 4.50V$

$\therefore V_{CE} = (10 - 4.5)$
$= 5.5V$ ——— (01)

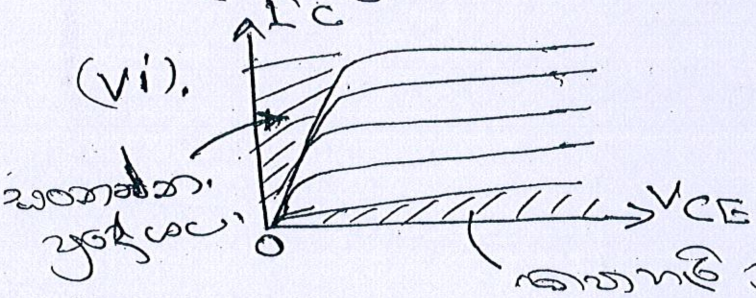
(v) (a) $I_b = V/R = \frac{9}{1000} = 9 \times 10^{-3} A$

$\therefore$ මෙසේ ලැබෙනවා $I_c = \beta I_b = 100 \times 9 \times 10^{-3} = 900 \times 10^{-3} A$ ——— (01)

නමුත් $V = IR$, I_C උපරිම වනුයේ $10 = I \times 25$ $\quad I_C = 400mA$ ——— (01)

$\therefore I_C = 400mA$ වේ.

(b) ට්‍රාන්සිස්ටරය සංතෘප්ත නිසා $V_{CE} \simeq 0$ වේ ——— (01)

(vi). 

——— (01)

(vii). ප්‍රදානය 0V විට, $I_b = 0$, $I_c = 0$ වේ.

$V_{CE} = 5V$ වේ. තාර්කික මට්ටම 1 වේ.

ප්‍රදානය 5V නම්, (තාර්කික මට්ටම 1 වේ).

I_b සැලකිය යුතු (විශාල) වෙයි.

I_C ද විශාල වෙයි. එවිට $V_{CE} = 0$.

හෝ ($I_b = 4/1000A$, $I_C = 100 \times 4/1000 A$ ද. විය හැකි.

උපරිම $I_C = 5/100$ ද නිසා. ට්‍රාන්සිස්ටරය

සංතෘප්ත වේ $\therefore V_{CE} = 0$ වේ). ——— (01)

හෝ

ප්‍රදානය	ප්‍රතිදානය
0 V නම් (0)	$V_{CE} = 5V$ (1)
5V නම්	$V_{CE} = 0V$

(VIII) (a) A - අඛණ්ඩතාව නොමැති විචලනය
B - අඛණ්ඩතාව විචලනය
C - විද්‍යුත් සෘණාග්‍රය (-)
D - විද්‍යුත් ධනාග්‍රය (+)
E - ප්‍රතිදානය — (01)

(b) X - D
Y - E හෝ
Z - C

X - ධනාග්‍ර විද්‍යුත් ඝනත්වය.
Y - ඇලෙන අඛණ්ඩතාව
Z - සෘණාග්‍ර විද්‍යුත් ඝනත්වය. — (01)

(c) $(V_A - V_B) \times 10^5 = V_E$
$0 - V_B \times 10^5 = 5$ $V_B = -5 \times 10^{-5} V$. — (01)
හෝ ර.ට අදාළ සම්මත සම්කරණය

(IX) අදාළ වෝල්ටීයතා, $V_A = 5V$, $V_B = \frac{1 \times 10}{11} = 0.9V$
$V_{out} = (5 - 0.9) \times 10^5 = 4.1 \times 10^5 V$. නමුත් — (01)
සංතෘප්තතාව ය. $\therefore V_{out} = +10V$.
$\therefore$ ප්‍රතිදාන වෝල්ටීයතාව ධන දිශාවට.
(එනිසා LED දැල්වෙනු ඇත).

(X) $V = IR$
$(10 - 3) = 20 \times 10^{-3} R$ $R = 350\Omega$. — (01)

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5. (A) (i) (a) විදුලි සන්නය $V = IR$, $Q = It$ බව,

$\left(\frac{dQ}{dt}\right) = \frac{1}{R}(dV)$ —— (1) —— 01

තාප සන්නය $\left(\frac{dQ}{dt}\right) = \frac{KA}{l}(d\theta)$ —— (2) —— 01

(1) හා (2) සමීකරණ ලබාගනිමු.

(b) (1), (2) න්, $\frac{1}{R} = \frac{KA}{l}$ $R = \frac{l}{KA}$

∴ තාපය ගුණාංකය $(1/KA)$ වේ. —— 01

(c) $R = \rho l/A$, $\sigma = 1/\rho$ —— 01

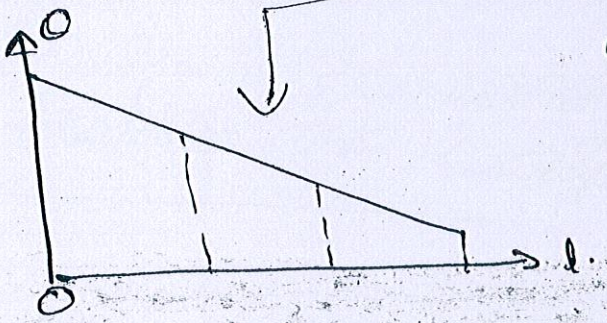
වි. ගුණ $R = \rho l/\sigma A$

තාපය ගුණ $= l/KA$ ∴ $K = \sigma$ වේ. —— 01

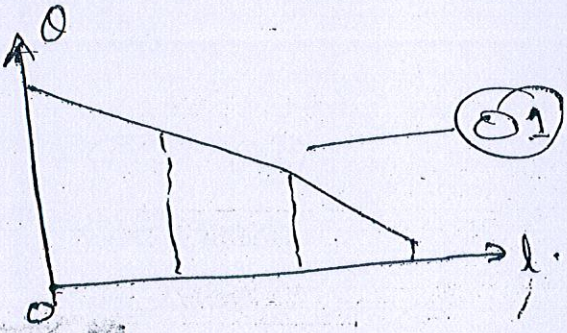
(d) $R = R_1 + R_2$ —— 01

$R = R_1 + R_2$ —— 01

(ii) (a)



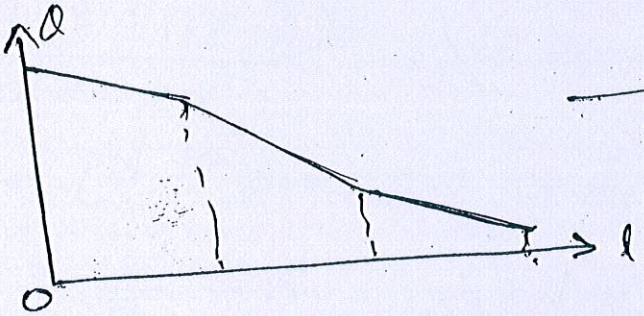
(b)



—— 01

—— 01

(c)



—— 01

(iii) A දණ්ඩෙන් $\dot{Q} = 2KA\left(\frac{100 - \theta_1}{l_1}\right)$ —— (1) —— 01

B දණ්ඩෙන් $\dot{Q} = KA\left(\frac{\theta_1 - \theta_2}{l}\right)$ —— (2) —— 01

C දණ්ඩෙන් $\dot{Q} = 0.5KA\left(\frac{\theta_2 - 0}{l}\right)$ —— (3) —— 01

(1), (2) හා (3) න්.

$\theta_1 = 85.7^\circ C$ —— 01

$\theta_2 = 57.1^\circ C$ —— 01

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(10)(B).(i) නිදහස් නියුට්‍රෝනයක් , ආදර්ශයෙන් හා ප්‍රතිඵලයෙන් දැක්වෙන සමීකරණය ලියා දක්වමු.

(ii) $^{1}_{0}n \longrightarrow {}^{0}_{-1}\beta + {}^{1}_{1}p$ ———— (5)

(iii). ස්කන්ධ හානිය $(\Delta m) = 1.008665\ u$
$- (0.000549\ u + 1.007276$
$= 0.00084\ u$ ———— (5)

$\therefore$ ශක්තිය $E = (\Delta m)c^2$.
$= (0.00084 \times 1.66 \times 10^{-27})(3 \times 10^8)^2$ ———— (5)
$E = 1.25 \times 10^{-13}\ J$ ———— (5)

(iv). (අ) ක්ෂයවීම, ඇල්ෆා ———— (5)

(අ) $^{220}_{86}Rn \longrightarrow {}^{216}_{84}Po + {}^{4}_{2}\alpha + \gamma$ ———— (5)

(ආ) වායන ජීවිතාවධිය නොවෙනස්ව (ස්ථිරව) පවතින බැවින් වයස නිර්ණය කළ හැකි කාලය. ———— (5)

(c).(I) $E = mc^2$.
$m = E/c^2$ $= \frac{(6.29 + 0.55) \times 10^6 \times 1.60 \times 10^{-19}}{(3.00 \times 10^8)^2}$ ———— (5)

$m = 1.22 \times 10^{-29}\ kg$ ———— (5)

(II) $E = hc/\lambda$ $\lambda = \frac{hc}{E}$.
$= \frac{(6.63 \times 10^{-34}) \times (3 \times 10^8)}{0.55 \times 10^6 \times 1.6 \times 10^{-19}}$ ———— (5)

$= 2.26 \times 10^{-12}\ m$. ———— (5)

(v). $A = \lambda N$
$\lambda = \frac{0.693}{T_{\frac{1}{2}}}$.

$\therefore A = \frac{0.693}{T_{\frac{1}{2}}} N$. ———— (5)

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