Enu

දේවි බාලිකා විද්‍යාලය - කොළඹ

DEVI BALIKA VIDYALAYA - COLOMBO

Final Term Test - September 2020

Grade 13

භෞතික විද්‍යාව I Physics	01 E I	පැය දෙකයි Two hours

Note

- This questions paper consists of 50 questions.
- Answer all the questions.
- In each of the questions 1 to 50, pick one of the alternatives (1), (2), (3),(4),(5) which is correct of most appropriate.
- Mark on the number corresponding to your choice in the answer sheet provided.
- Further instructions are given on the back of the answer sheet, follow them carefully.

$g = 10 Nkg^{-1}$

Enu

01) Dimentions of moment of inertia are,

(1) ML^{-2} (2) ML^{2} (3) $M^{2}L$ (4) MLT^{-1} (5) $M^{2}L^{2}$

(02) Consider the following statements made regarding an electromagnetic wave,

A) Electromagnetic waves are a type of transverse waves,

B) They are electric and magnetic waves which vibrate at a high speed in two parallel planes.

C) Speed of electromagnetic waves are the same in any media,

The false statement/s would be,

(1) Only A (2) Only A and B (3) Only B and C

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

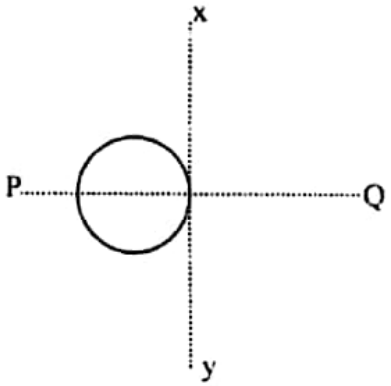
(03) A power wheel of moment of inertia of 0.001 kgm^{2} is fixed to the rear wheel of a toy car. It starts accelerating on a table at a rate of 150 rounds per minute. If the decelerating force acting on the car is 0.25 N, the distance the toy car traveled before coming to a rest is,

(1) 4.93 m (2) 1.23 m (3) 2.47 m (4) 3.09 m (5) 6.02 m

(04) A mass of 0.1 kg is suspended from one end of a string of 0.8 m and the other end of it, is tied to a ceilling. The mass is slowly released at a position where the stretched string is horizontal. The mass collieds and combines with another mass of 0.3 kg at the lowest position of the path. The maximum height reached by the combined object would be,

(1) 0.8 m (2) 0.5 m (3) 0.08 m (4) 0.05 m (5) 0.2 m

(05) Consider a circular ring rotating around different axes as shown in the diagram. If the moment of inertia of the ring when it rotates around xy axis is I_1, PQ axis is I_2 and around an axis which is perpendicular to the plane of the ring and which goes through Q is I_3,



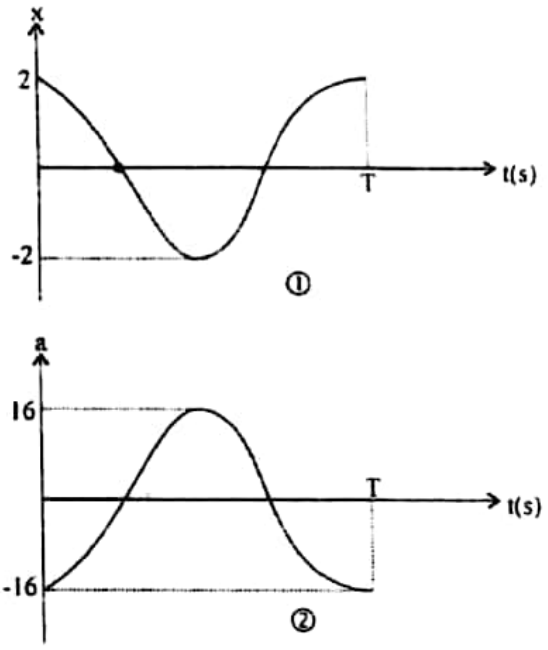
(1) $I_3 > I_2 > I_1$ (2) $I_1 > I_2 > I_3$

(3) $I_2 > I_1 > I_3$ (4) $I_3 > I_1 > I_2$

(5) $I_2 > I_3 > I_1$

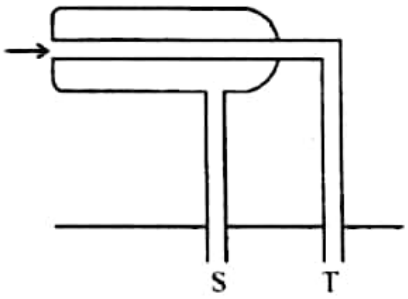
Enu

(06) Variation of displacement (x) and acceleration (Q) with time (t) of a particle moving in simple harmonic motion is shown by the graphs ① and ② respectively. The maximum velocity the particle abtains (Vmax) and its period (T) are,



	V_{max} (ms^{-1})	T(s)
(1)	2	2π
(2)	3	6π
(3)	6	$2\pi/3$
(4)	9	$2\pi/9$
(5)	18	$\pi/9$

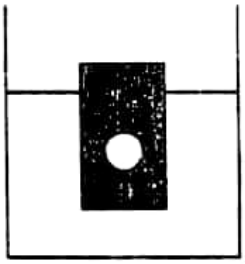
(07) A Pitot tube is kept in a liquid flow as shown in the diagram. Its T and S ends are connected to a manometer and H is the difference between the liquid levels. Velocity of the liquid flow is V_0 and the densities of liquids in the flow and the manometer are p and d respectively, V_0^2 is equal to,

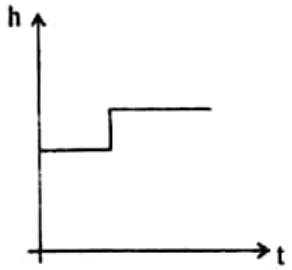


(1) dpgH (2) pg H/d (3) dg H/p

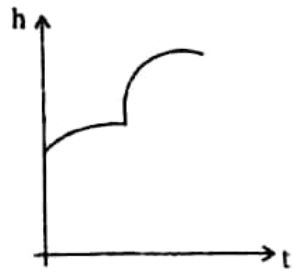
(4) 2pg H/d (5) 2d Hg/p

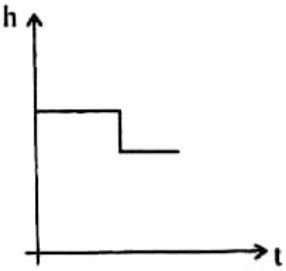
(08) The following diagram shows an ice cube with an air bubble floating in a water container. The graph which correctly shows the variation of water level (h) with time (t) would be,



(1)


(2)


(3)


(4)


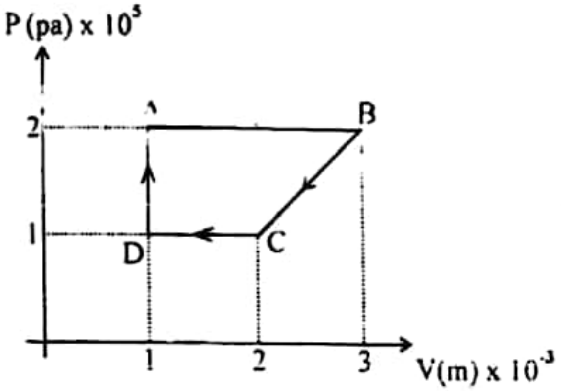
(5)


(09) When two tuning forks are vibrated simultaneously, 3 beats can be heard. They resonate with a sonometer wire at lengths of 27 cm and 28 cm. The frequencies of the two tuning forks are,

(1) 42 Hz, 39 Hz (2) 81 Hz, 78 Hz (3) 83 Hz, 80 Hz

(4) 84 Hz, 81 Hz (5) 97 Hz, 84 Hz

(10) Variation of pressure (p) with volume (V) of a gas is shown below. Total work done during the process is,



(1) +150 J (2) 300 J

(3) 400 J (4) -150 J

(5) -300 J

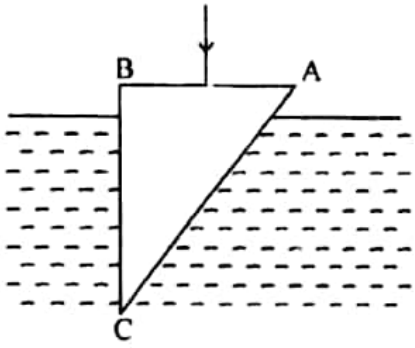
(11) Light travels through a glass block of width (d) and refractive index (n). If the velocity of light in air is c, the time taken for light to travel through the glass block is,

(1) cdn (2) $\frac{d}{cn}$ (3) $\frac{cn}{d}$ (4) $\frac{dn}{c}$ (5) $\frac{d}{c}$

(12) A small spherical object A is solwly inserted into a measuring cylinder with 400 ml of water. Water level rose upto 470 ml and A was completely immersed in water. Now a liquid of relative density 12, which is immiscible with water was poured into the measuring cylinder. A was lifted up and was still completely immersed in water. Liquid level now is at 870 ml. Mass of A would be,

(1) 70g (2) 76g (3) 77g (4) 84g (5) 100g

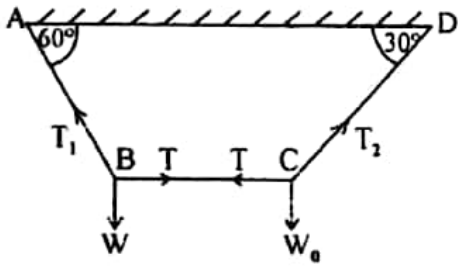
(13) Refractive index of a glass prism ABC is 1.5. It was inserted into water which has a refractive index of 4/3 as shown in the diagram. A ray incident s normally to the AB surface. For it to refract into water from AC surface,



(1) $\sin\theta > \frac{8}{9}$ (2) $\sin\theta = \sqrt{\frac{3}{2}}$ (3) $\sin\theta \leq \frac{2}{3}$

(4) $\sin\theta \geq \frac{3}{2}$ (5) $\sin\theta \leq \frac{8}{9}$

(14) In the diagram shown below AB, BC and CD are three light strings. N is attached to B and W_0 is attached to C. The system is in equilibrium in a vertical plane. Consider the following relationships,



(A) $T_1 = \sqrt{3}\ T_2$ (B) $W = 3W_0$

(C) $W = \sqrt{3}\ W_0$

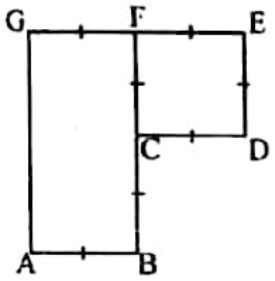
of these the true statement/s is/are,

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

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

(15) Figure shows a wooden plank with uniform density. Its weight is 300 g. It is kept vertically by the AB edge. The maximum weight that can be hung from D without toppling the plank is,

(1) 25 g
(2) 100 g
(3) 50 g
(4) 75 g
(5) 300 g



AB = CD = GF
BC = CF

(16) When a copper nail heated upto 112°C is dropped into a coolant solvent of 500 ml at temperature 28°C, the final temperature of the mixture was 84°C. When 5 identical copper nail heated upto 108°C are dropped into the same solvent of volume of 1*l* at 30°C, the final temperature of the mixture would be, (Assume that there is no heat exchange with the environment and the heat capacities of the containers are negligible)

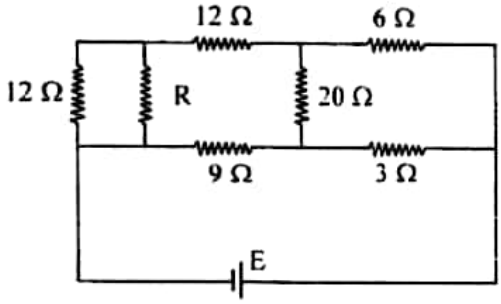
(1) 54 °C (2) 68 °C (3) 85 °C (4) 95 °C (5) 98 °C

(17) A gas of ratio of principal specific heat capacities r = 5/3, kept at constant pressure is heated. The percentage of energy spent to increase the internal energy of the gas from the supplied heat would be,

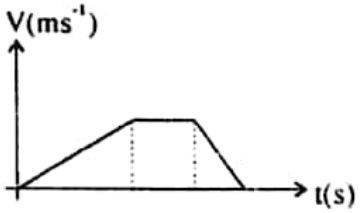
(1) 20% (2) 40% (3) 50% (4) 60% (5) 80%

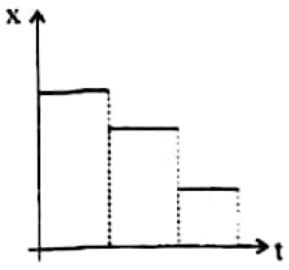
(18) In the following circuit, 20 Ω resistor does not produce any heat. The value of R, could be,

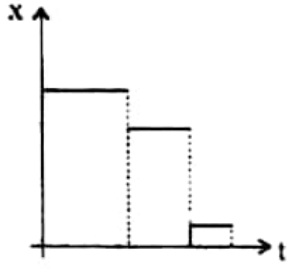
(1) 0 Ω (2) 4 Ω
(3) 6 Ω (4) 9 Ω
(5) 12 Ω

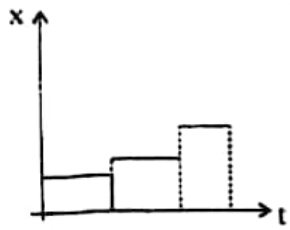


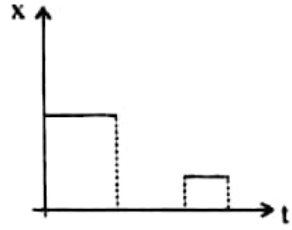
(19) The velocity - time graph for an elevator moving up is given below. A weight is kept on a Pan balance inside it. The graph which correctly shows the variation of the reading of the scale (x) with time (t) is.

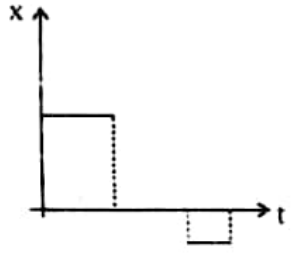


(1)


(2)


(3)


(4)


(5)


(20) Maximum strain of a steel wire used in a crane to pull up goods is 10^{-3}. Radius of the wire is 4mm and the young's Modulus for steel is $2 \times 10^{11}\ Nm^{-2}$. The maximum weight which can be lifted by the crane would be,

(1) 102.53 kg (2) 512.65 kg (3) 1005.7 kg

(4) 1025.3 kg (5) 2050.6 kg

(21) Consider a satellite orbitting the Earth. Due to an energy loss caused by air resistance, the satellite is unable to stay on the same orbit. Consider the following statement about its motion thereafter.

(1) The satellite comes to an orbit with a smaller radius very fast by a vertical path.

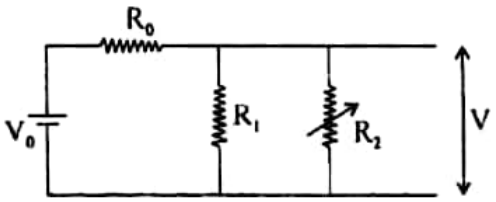
(2) The satellite comes to an orbit with a smaller radius slowly by a vertical path.

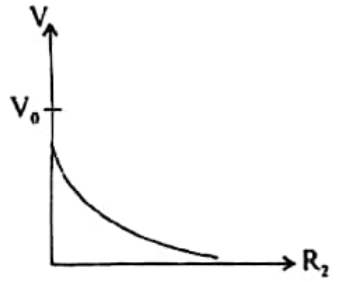
(3) Moves away from Earth in a spiral path.

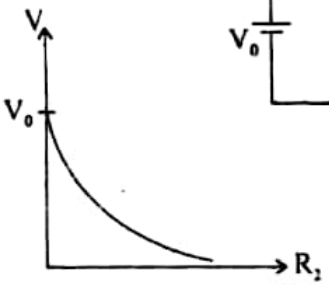
(4) Comes to an orbit with a smaller radius by a spiral path increasing its moving velocity.

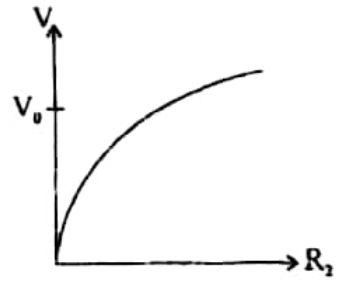
(5) Comes to an orbit with a smaller radius by a spiral path decreasing its moving velocity,

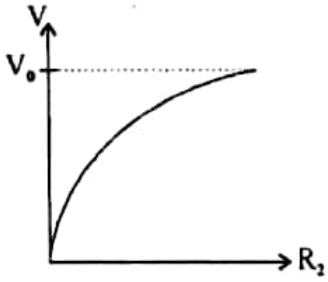
(22) In the given circuit V_0 is the voltage of a battery with a negligible internal resistance. Variation of V with R_2 is best depicted by.

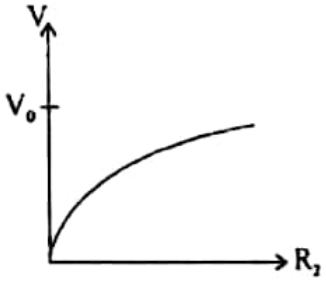


(1)


(2)


(3)


(4)


(5)


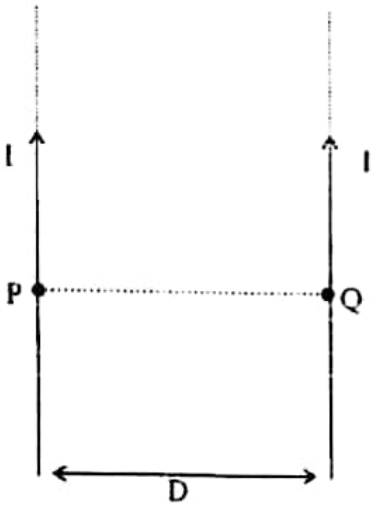
(23) A string of mass M and length l is under a tension of T. When t = 0, the string vibrates at its fundamental making stationary waves and the displacement of nodes and antinodes at this instance is zero. The value of t, at the next instance when the displacement of nodes and antinodes are zero, would be,

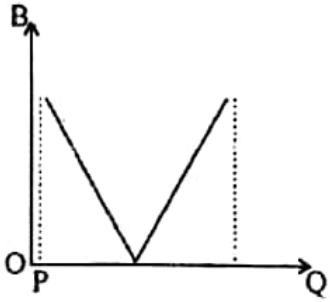
(1) $\frac{1}{2l}\sqrt{\frac{Tl}{M}}$ (2) $2l\sqrt{\frac{Tl}{M}}$ (3) $l\sqrt{\frac{m}{Tl}}$ (4) $2l\sqrt{\frac{m}{Tl}}$ (5) $4l\sqrt{\frac{m}{Tl}}$

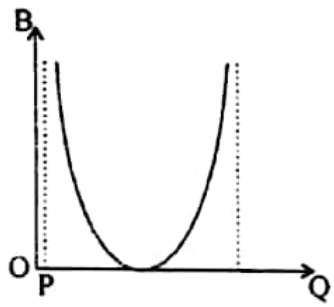
(24) When the magnetic flux density is B, current density is J, free electron concentration is n, the force acting on an electron entering the magnetic field perpendicular to it would be,

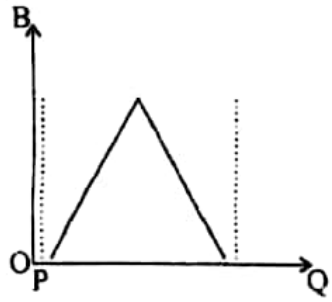
(1) $\frac{B}{Jn}$ (2) $\frac{Jn}{B}$ (3) $\frac{BJ}{n}$ (4) $\frac{B}{J}$ (5) $\frac{Bn}{J}$

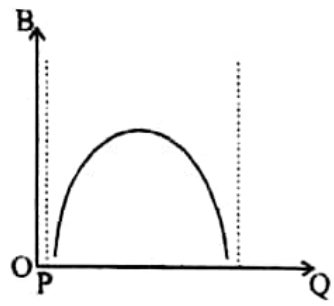
(25) Two thin wires carrying a current I to the same direction are kept parallel to each other with a distance of D in between them as shown in the diagram. The graph which best depicts the magnitude of the resultant magnetic flux density (B) from P to Q along the PQ axis would be,

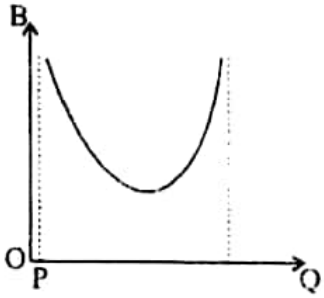


(1)


(2)


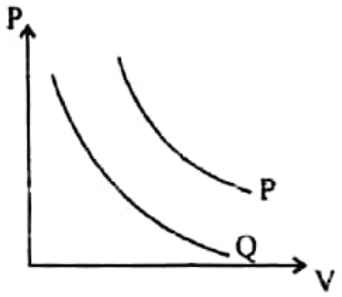
(3)


(4)


(5)


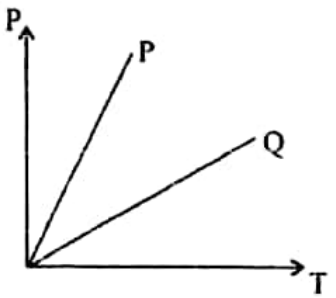
(26) Consider the following graphs of a P sample of ideal gas with mass 2 m, Q sample of ideal gas with mass m,

At Constant temperature



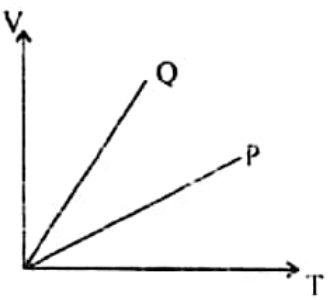
(A)

At Constant volume



(B)

At Constant pressure



(C)

(1) Only A (2) Only B (3) Only B and C

(4) Only A and B (5) All A, B, C

(27) When a transistor is in a circuit,

A) If npn, E - B junction should be forward biased.

B) If pnp, E - B junction should be backward biased.

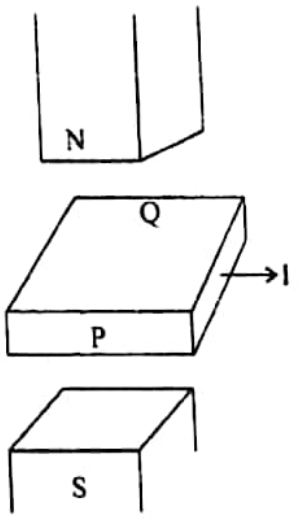
C) Whatever the transistors type is, E-B junction should be forward biased and B - C junction should be reverse biased.

of these the true statement/s is/are,

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

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

(28) Figure depicts a setup which is used to demonstrate to the Hall's effect. When a constant current (I) flows as shown,



A) a potential difference is generated between P and Q

B) if the magnetic flux density is increased the Hall's current is also increased.

C) Hall's voltage is decreased when the thickness of the metallic block reduced.

of these the true statement/s is/are,

(1) Only A (2) Only C

(3) Only A and B (4) Only B and C

(5) All A, B. C

(29) Consider the following statements made regarding the experiments of calorimetry.

A) In the experiment of determining the specific heat capacity of lead shots using mixture method, the value obtained would be less than the accurate value due to heat loss to the surrounding when mixing lead shots with water.

B) In the experiment of determining the latent heat of fusion of ice, the calculated value would be less than the actual value due to floating of ice cubes on water surface.

C) In the experiment of determining the latent heat of vaporization of water the calculated value would be greater than the actual value, due to heat radiation caused by the steam generator towards the calorimeter,

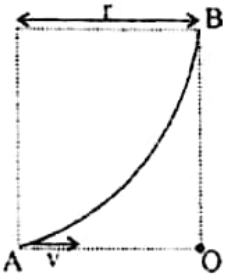
of these the true statement/s is/are,

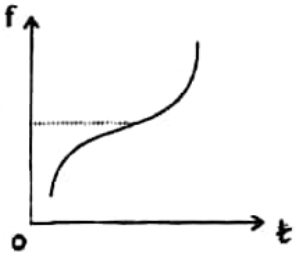
(1) Only A (2) Only B

(3) Only A and B (4) Only B and C

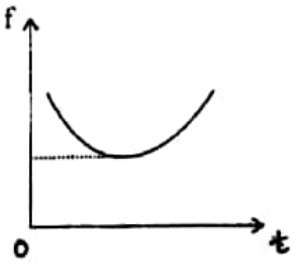
(5) All A, B, C

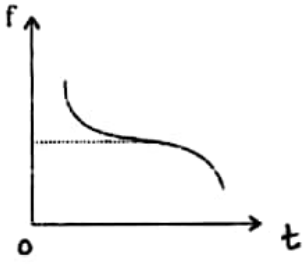
(30) A motor vehicle travels sounding its horn of uniform frequency f_0, from A to B along a circular path as shown in the figure. Which of the following graphs best represent the frequency of sound heard by a stationary observer at the point O?

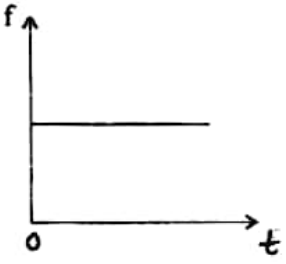


(1)


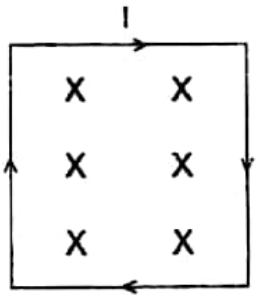
(2)


(3)


(4)


(5)


(31) Current I flows in a square loop of side length a. Magnetic flux density at the centre of the loop is,



(1) O

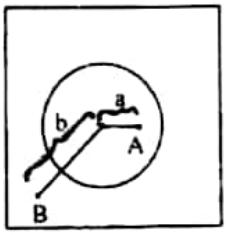
(2) $\frac{\mu_0 I}{\pi a}$

(3) $\frac{\gamma_0 I}{a}$

(4) $\frac{2\sqrt{2}\mu_0 I}{\pi a}$

(5) $\frac{4\mu_0 I}{\pi a}$

(32) A charge q is kept on the centre of a spherical cavity of radius r, in a block of metal. The electrostatic feild intensity of the points A and B is,



(1) $\frac{a}{4\pi\varepsilon_0 a^2}, \frac{a}{4\pi\varepsilon_0 b^2}$

(2) $\frac{a}{4\pi\varepsilon_0 a^2}, \frac{q}{4\pi\varepsilon_0 r^2}$

(3) $0, \frac{a}{4\pi\varepsilon b^2}$

(4) $\frac{a}{4\pi\varepsilon_0 a^2}$

(5) 0 , 0

(33) A half of a closed container is filled with water as shown in the figure 2/3 volume of water is removed by the tap so that the temperature inside the container remains constant. Consequently,

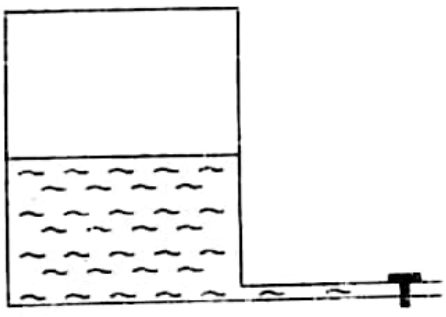
(1) Relative humidity inside the container increases.

(2) Relative humidity inside the container decreases.

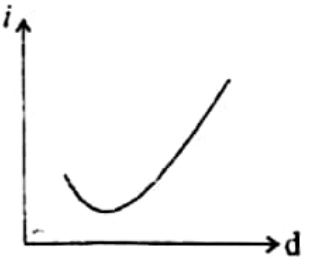
(3) Absolute humidity inside the container increases.

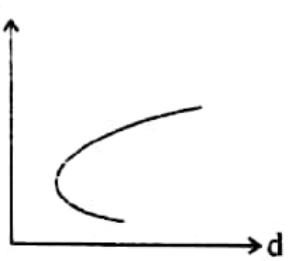
(4) Absolute humidity inside the container decreases.

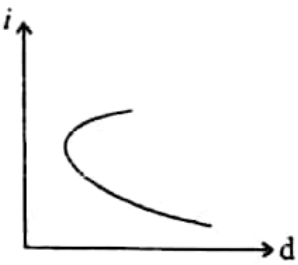
(5) Absolute humidity inside the container remains unchanged.

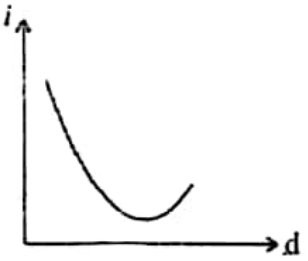


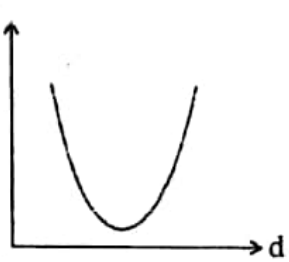
(38) A ray of light falls onto a face of a prism with on angle of incident i and emerges from it deviating through the prism at an angle d. The variation of i vs d is best represented by,

(1) 

(2) 

(3) 

(4) 

(5) 

(39) Consider the statements made regarding the photo electric effect.

A) Photo electric emmision occurs when the frequency of light falling, exceeds the threshold frequency.

B) Existance of a threshold frequency can be explained only in the wave form of light.

C) The kinetic energy of emmitted electrons in photo electric effect depends on the intensely of falling light.

The true statement/s is/are,

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

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

(40) The diameter of the filament of a bulb of power 100W is 0.40 mm. When the wire is completely unfolded its length is 30 cm. Temperature of the filament when the bulb is lighted is 2170 K. (Surface emissivity of tangston is consider $2170^4 = 2.217 \times 10^{13}$, $\sigma = 5.67 \times 10^{-8}\ \omega\ m^{-2} K^{-4}$)

(1) 2.1×10^3 (2) 1.7×10^2 (3) 2.21 (4) 0.21 (5) 0.17

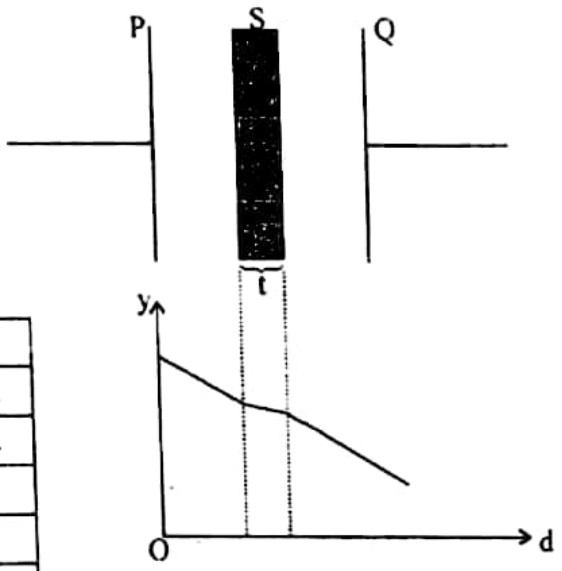
(41) A radioactive element $^{220}_{86}X$ decays to a new element $^{A}_{Z}S$, after two α - emissions and two β emissions. Values of A and Z would be,

(1) A-218 Z-84 (2) A-216 Z-84 (3) A-212 Z-82

(4) A-216 Z-82 (5) A-212 Z-84

(42) A capacitor is connected to a DC current. A plate S of thickness t is kept in between the two plates P and Q as shown in the figure. The graph depicts the variation of a physical quantity (y) with distance (d),

Which of the following choice is correctly represent "S" and "Y" ?



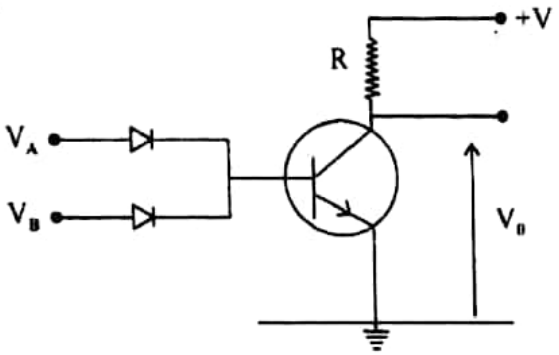
	s	y
(1)	metal	Electric field intensity.
(2)	Insulating material	Electric field intensity.
(3)	Insulating material	Potential gradient
(4)	metal	Potential
(5)	Insulating material	Potential

(43) Which of the following logic gate is most suitable for the oircuit shown in the figure ?

(1) OR (2) AND

(3) NOR (4) NAND

(5) EX-OR



(44) In an experiment of determing the focal length of a lens a set of readings were obtained for the object distance (u) and the corresponding image distance (v). When the graph is plotted, which of the following two variables represent a straight line ?

A) v and u between B) 1/v and 1/u between

C) uv and u+v between

(1) Only A (2) Only B

(3) Only A and B (4) Only B and C

(5) All A, B, C

(45) Range of vision of a person who is short - sighted, is 200 cm t 20 cm. In order to see distant object clearly the type of lens be should wear and the new vision range would be,

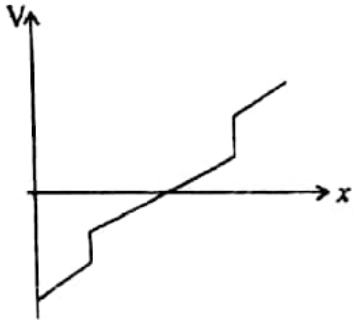
(1) Convex / α - 20 cm (2) Concave / α - 18.38 cm

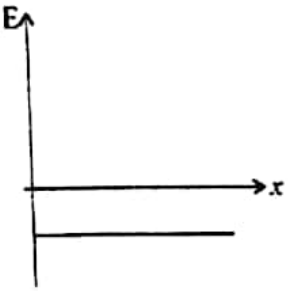
(3) Concave / α - 22.22 cm (4) Convex / α - 20.22 cm

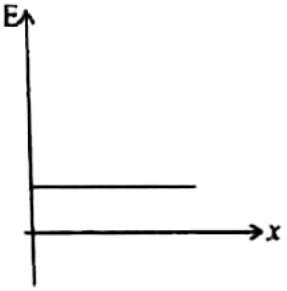
(5) Concave / α - 20 cm

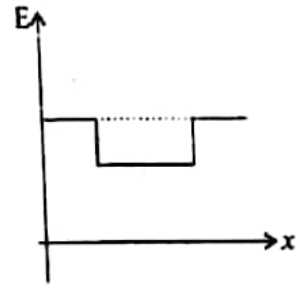
(46) Variation of electric potential (V) with the distance (d) in a certain area is shown in the graph.

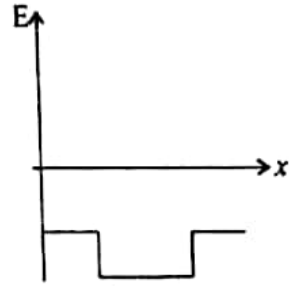
Which of the following graphs best represent the behaviour of electrostatic field intensity (E) with the distance (x),

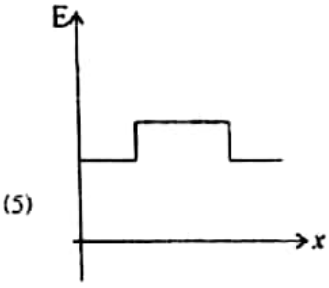


(1)


(2)


(3)


(4)


(5)


(47) Two electrostatic chargers +Q and q are kept on two adjoining vertices of a square. If the resultant force on +Q is zero,

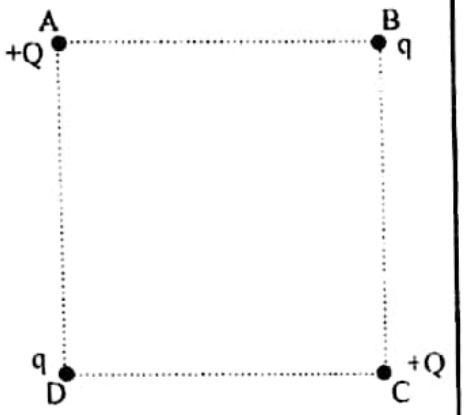
(1) $Q = \sqrt{2}q$

(2) $Q = -\sqrt{2}q$

(3) $Q = 2\sqrt{2}q$

(4) $Q = -2\sqrt{2}q$

(5) $Q = -2q$



(48) A cylindrycal vesslle of cross sectional area A contains water upto a height of H. There is a hole of cross section a on the bottom of it. Time taken to drop the water level from a height H_1 to H_2 is,

(1) $\frac{g}{2}(\sqrt{H_1} - \sqrt{H_2})$

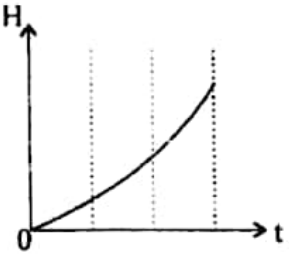
(2) $\frac{A}{a}\sqrt{\frac{2}{g}}(\sqrt{H_1} - \sqrt{H_2})$

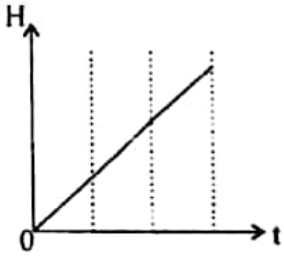
(3) $\frac{a}{A}\sqrt{\frac{g}{2}}(\sqrt{H_1} - \sqrt{H_2})$

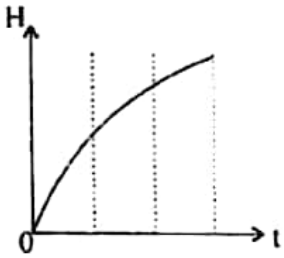
(4) $\frac{a}{A}\sqrt{\frac{2}{g}}(\sqrt{H_1} - \sqrt{H_2})$

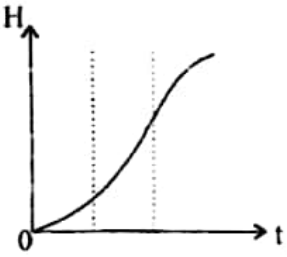
(5) $\frac{a}{A}\sqrt{\frac{g}{2}}(\sqrt{H_1 - H_2})$

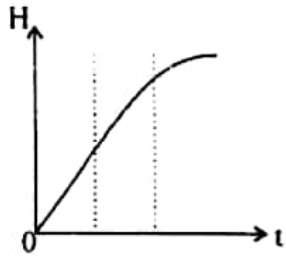
(49) A partical at test starts moving up words from the bottom of deep vessle which contains a viscous liquid. After attaining the terminal velocity the practical comes out and reaches its maximus height in the atmosphere. Consider there is no energy loss. The graph which represent the variation of the distance (H) and the time (t) of the entire motion is,

(1) 

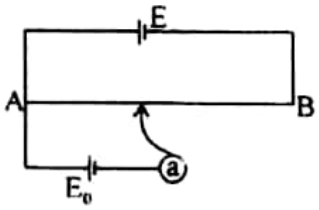
(2) 

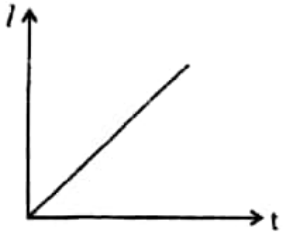
(3) 

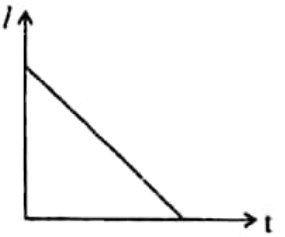
(4) 

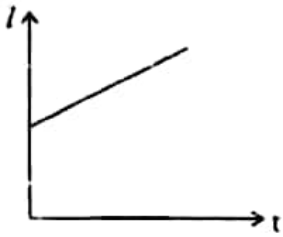
(5) 

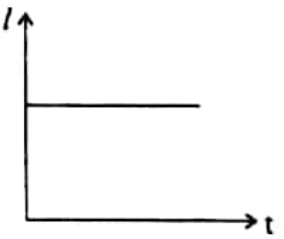
(50) In the circuit shown E m E of E_0 is a constant and d the Emf of the driven cell decrees with time (t). The variation of balancing length (l) and time (t) is approximately represented by,



(1) 

(2) 

(3) 

(4) 

(5) 

Enu

දේවි බාලිකා විද්‍යාලය - කොළඹ

DEVI BALIKA VIDYALAYA - COLOMBO

Final Term Test - September 2020

Grade 13

භෞතික විද්‍යාව II Physics II	01 E II	පැය තුනයි Three hours

Enu

Name : ..... Class : ..... Index No. : .....

Important :

* *The question paper consists of 19 pages.*
* *The question paper comprises **Part A** and **Part B**. The time allocated for both part is 3 hours.*
* *Use of Calculators is not allowed.*

Part A - Structured Essay (9 pages)

Answer all the questions on this paper itself. The space provided is sufficient for your answers and that extensive are not expected.

Part B - Essay (10 pages)

*This part contains eight questions. Use the papers supplied for this purpose. At the end of the time allocated for this paper, tie the two papers so that **Part A** is on top of **Part B** before handing them over to the Supervisor.*

*You are permitted to remove **only** **Part B** of the question paper from Examination hall.*

For Examiner's use only

For the second paper		
Part	Question Nos.	Marks
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9A	
	9B	
	10A	
	10B	
Total		

Final Marks

In numbers	
In words	

Enu

Part A - Structured Essay

Answer all questions on this paper itself.

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

(01) A toy cart is shown in the figure ①. Its front side A is made of paper and a small spherical object is placed inside the cart.

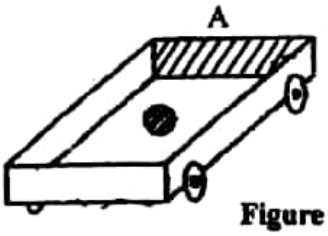
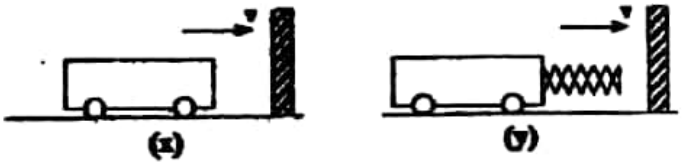


Figure ①

Figure ②

Figure ② shows a model of a buffer which can be used in the cart. It is light and able to retract.

The toy cart is made to move horizontally as shown in figure (x) and (y). It hits a vertical barrier at both situations with same velocities and comes to rest without bouncing.



(a) (i) What will happen to the spherical object in the cart when it hits the barrier as in the figure (x)?

.....

.....

(ii) Find the impulse acting on the cart if it takes 0.2 s to hit the barrier at a velocity of $v = 15ms^{-1}$ (Suppose that the mass of the cart is 1 kg and neglect the mass of the spherical object inside the cart.)

.....

.....

.....

(iii) What is the rate of loss of mechanical energy of the cart ?

.....

.....

(b) Compare the time taken by the cart to come to rest after hitting the barrier at (y) with that of (x). Explain the reason.

.....

.....

.....

.....

(c) (i) Compare the rate of change of momentum at the collisions of (x) and (y).

.....

.....

.....

(ii) The collisions of (x) and (y) can be used to justify a law in mechanics. Express this law.

.....

.....

.....

.....

(d) Is it a suitable method to make the front buffer of a motor car as shown in figure (y)? Explain your answer.

.....

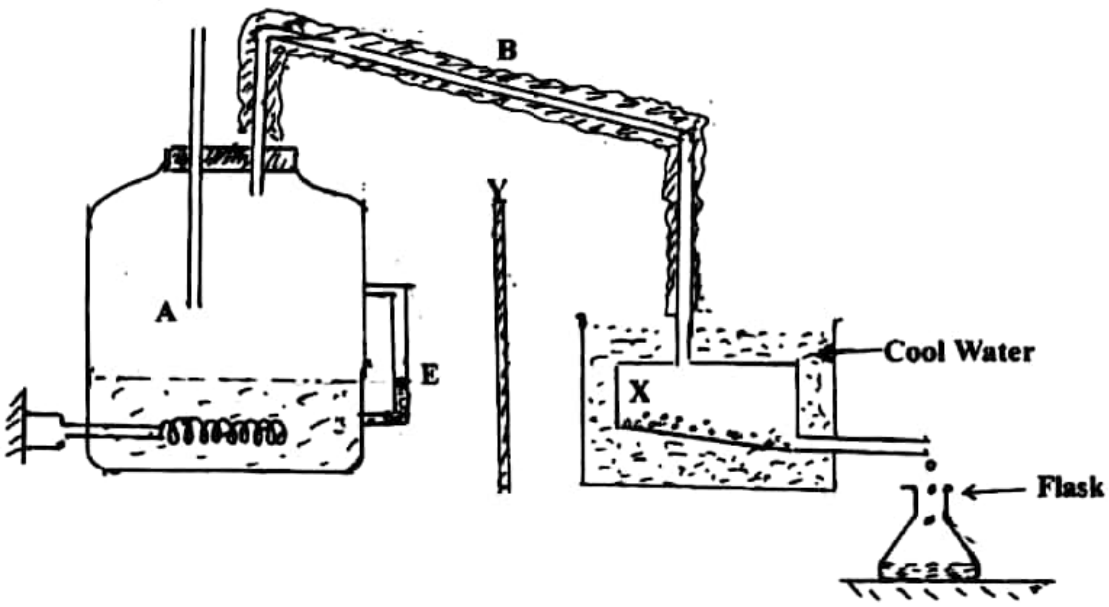
.....

.....

.....

20

(02



An experimental setup arranged to determine the specific latent heat of vaporization (L) of water in the laboratory is shown in the figure. Water is boiled by heater and steam produced passes through the tube B. Then steam is condensed inside a metal chamber immersed in cool water. Some consecutive readings for mass of water (m) callected into the flask during equal time intervals (t) is obtained.

(a) Name two items necessary for this experiment in addition to the items shown in the figure.

(i) ..... (ii) .....

(b) What is the purpose of part (E).

.....

(c) State three problems which arise due to keeping tube A as shown in the figure.

(i) .....

(ii) .....

(iii) .....

(d) Correct the position of tube (A) in the diagram itself.

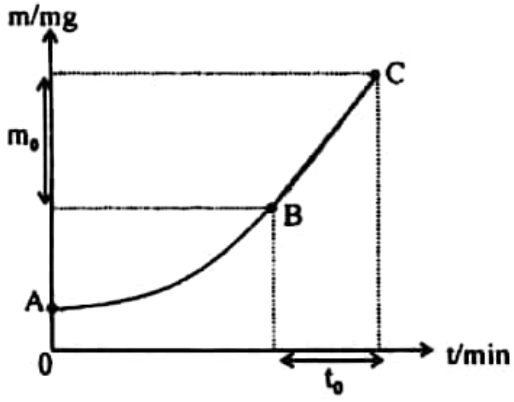
(e) Name (y) and state the purpose of it.

.....

(f) When arranging the tube (B) the factors given below should be considered. Explain the reason.

(i)	lagging the tube	
(ii)	Inclining the tube	

(g) Variation of the mass of water (m) collected in the flask with time (t) is shown in the figure below.



(i) State the reasons for the shapes of part AB and part BC of the graph.

AB = ...

BC = ...

(ii) Write down the rate of producing steam in terms of the quantities shown in the graph.

.....

(iii) Write down the rate of emitting heat when steam is condensed, in terms of above (ii) and L.

.....

.....

(iv) Write down an expression in order to determine L if the terminal potential difference of heater is V and its resistance is R. (Assume that the efficiency of the heater is 80% , R = 8 kΩ)

.....

.....

.....

(v) What is the assumption you made in (iv) above ?

.....

20

(03) (i) Explain how a stationary wave is formed inside a closed tube, when a vibration is made at one end.

.....

.....

.....

(ii) What is meant by the resonance of an air column inside a tube ?

.....

.....

(iii) Suppose that the velocity of sound in air has to be determined experimentally by means of the resonance method.

A tube (with uniform cross section) open at both ends, a set of tuning forks, a tall jar and all the other items necessary for the experiment are provided.

(a) What is the requirement of using a jar filled with water ?

.....

.....

(b) What are the measurements to be obtained in this experiment ?

.....

(iv) Draw the experimental set up with all the necessary items to carry out this experiment. Label the items.

(v) Draw the wave form inside the tube when taking measurements in the above diagram.

(vi) Write down the main experimental steps that should be followed to obtain the necessary measurements.

.....

.....

.....

.....

.....

(vii) What is the other quantity which can be obtained by this experiment in addition to the velocity of sound in air?

.....

(viii) Write down the relationship between the velocity of sound in air and the measurements obtained in this experiment.

Rearrange the equation in a suitable manner to plot a graph.

Draw the rough sketch of the expected graph in the given axes. Name the axes.

(ix) Frequencies of the given set of tuning forks are 256 Hz, 320 Hz, 480 Hz, 384 Hz and 420 Hz.

(a) Which tuning fork should be used first ? Explain the reason.

.....

.....

.....

.....

(b) Is it possible to get readings for all the tuning forks given above, if the length of the given tube is 40 cm ? Explain with suitable calculations. (Assume that the velocity of sound in air is 340 ms^{-1})

.....

.....

.....

.....

.....

(x) Suppose that this experiment is done in a surrounding filled with H_2 gas only. What can be expressed about the gradient of the graph? Is it greater or less than the graph in (viii)? Explain your answer.

.....

.....

.....

.....

20

(04) You are asked to determine the emf of a cell and its internal resistance using a potentiometer.

The potentiometer and the other items are provided.

(a) (i) Define the potential gradient of a potentiometer.

.....

.....

.....

(ii) You have to determine the potential gradient experimentally. A western cadmium cell of emf (E_s) 1.02 V is provided for this. Name the other items necessary for this experiment.

1. ..... 4. .....

2. ..... 5. .....

3. ..... 6. .....

(iii) Draw the circuit diagram of the relevant circuit that you would set up for this purpose. Show all the items using the symbols.

in (iii) above.

(iv) Obtain an expression for the potential gradient as shown in the circuit. Identify the symbols.

.....

.....

(v) What is the reading obtained from the circuit? How would you obtain it?

.....

.....

.....

.....

(b) (i) Rearrange the above circuit and draw it to determine the internal resistance (r) of a cell of emf E.

.....

.....

.....

.....

.....

(ii) You are provided a resistance box in addition to above items. What is its requirement?

.....

.....

(iii) The balance length *l* does not change with the different values of R even if the circuit is connected properly. What would be the reason?

.....

.....

(iv) A suitable graph has to be used to determine the internal resistance r and emf E of the cell. Obtain an expression for a graph in terms of k, *l* and R.

.....

.....

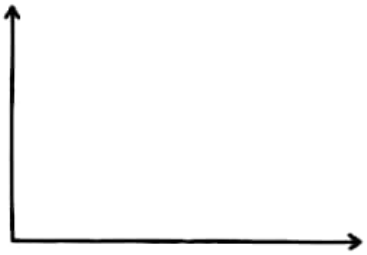
.....

.....

.....

.....

(v) Draw a rough sketch of the expected graph. Label the axes.



in dependant variable .....

dependant variable .....

(vi) How would you determine the internal resistance (r) from the above graph?

.....

.....

.....

(c) If the emf of E is higher than that of the cell, used in the potentiometer, could this experiment be carried out ? Explain your answer.

.....

.....

.....

20

දේවි බාලිකා විද්‍යාලය - කොළඹ
DEVI BALIKA VIDYALAYA - COLOMBO

Final Term Test - September 2020

Grade 13

භෞතික විද්‍යාව II Physics II	01	E	II

Part B - Essay
Answer 02 questions only.

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

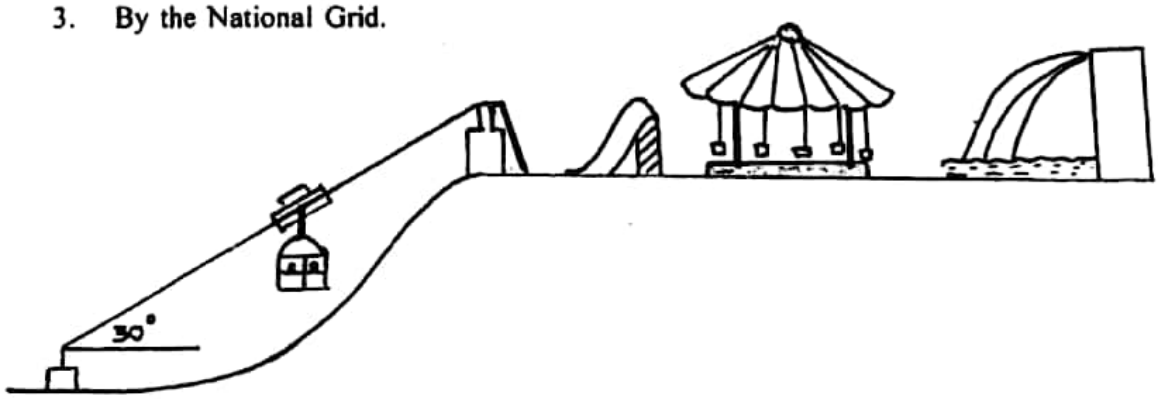
(05) Energy consumption and production at a Theme Park built for amusement is given below.

Consumption

1. For lighting, air conditioning and to operate other equipment.
2. To operate the cable car for entering the theme park.
3. To pump water to a swimming pool from a water reservoir below.

Production

1. By a solar panel system built on the rooftop of a building.
2. By a small hydro electric power plant.
3. By the National Grid.



(a) (i) The cable car meant for entering the theme park travels upwards at a velocity of 2 ms^{-1} with 4 people inside each weighing 60 kg. Calculate the power needed to operate the car. Mass of the cable car is 100 kg and its cable makes an angle of 30° with the horizontal. The resistant force acting against the movement of the cable car is directly proportional to its velocity. The proportionality constant is 300 N/ms^{-1}

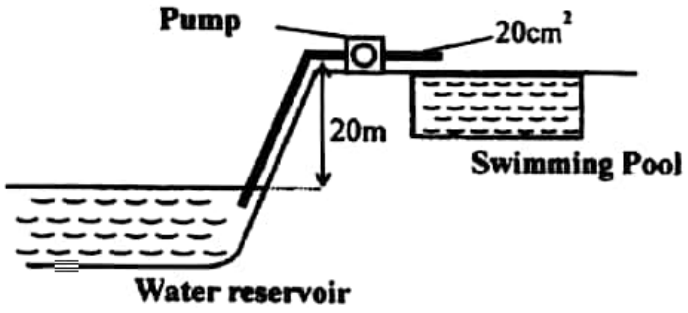
(ii) Efficiency of the electric motor used to operate the car is 80%. Calculate the electric power of the motor.

(b) (i) If water is pumped to the swimming pool at a rate of 3000 cm^3s^{-1}. calculate the power consumed at this instant.

Water reservoir is located 20 m below the swimming pool. The cross sectional area of the tube which pumps water is 20 cm^2

(ii) If the efficiency of the water pump is 70%. Calculate the power consumption of the pump.

(iii) If 4 kw of energy is consumed for lighting and other necessities. Calculate the total power consumption of the theme park.



(c) Sunlight falls on the solar panels located on the rooftop at a rate of 2 kWm^{-2}. There are 6 solar panels located on the roof, each with an area of 1.5 m^2, producing electricity with 20% of efficiency. Calculate the power of the solar panels.

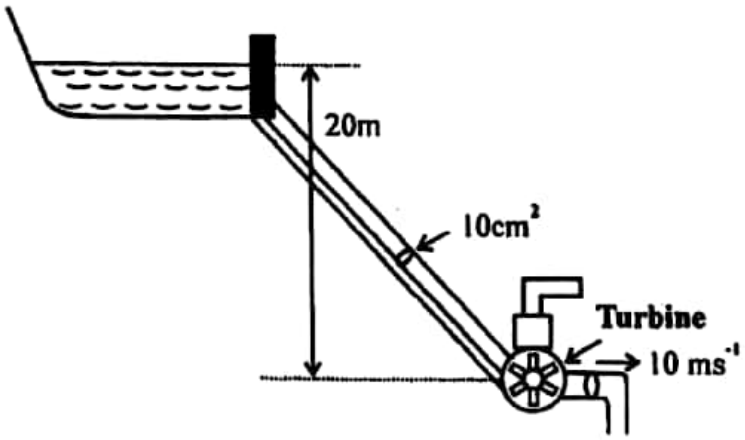
(d) Water is supplied to the small hydro-electric power plant by a reservoir 20 m above it. Cross sectional area of the tube carrying water to the plant is 10 cm^2. After the turbines are rotated by the water which falls down, the water flows out at a velocity of 10 ms^{-1}.

(i) Calculate the velocity of the water flowing towards the turbines.

(ii) Calculate the mass of water per second.

(iii) Assuming the energy loss for heat when water hits the turbines and to create turbulent motion of water is negligible, calculate the work done on the turbines per second.

(iv) If the efficiency of the turbine is 80%, calculate its power.



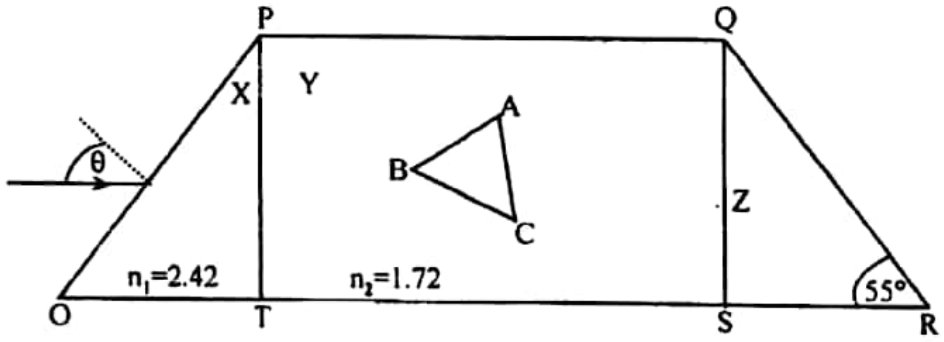
(e) (i) What is the total production of power at the theme park ?

(ii) Calculate how much power is obtained from the National Grid for the consumption of the theme park.

(06) (a) Identify total internal reflection and critical angle.

(b) State the requirements for total internal reflection.

(c) A cross section of an ornament is shown below. Its different parts have different refractive indices as shown in the diagram. A cavity filled with air is in the middle and it has the shape of a equilateral prism.



(i) Angle of prism of the prism X is 60°. Write down the range of incident angle of a ray on the surface OP so that it emerges to the medium y.

(ii) Does a ray of light made to incident on the surface OP at an angle of 60°, emerge from the surface ST? Explain.

(iii) (a) The angle of minimum deviation of a light ray which enters the prism along BC is D. Refractive index of glass of medium y is n_2.

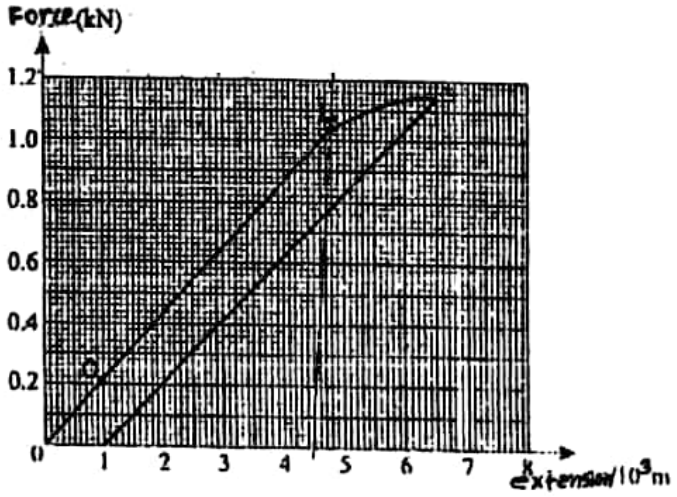
(i) Draw the ray diagram relevant to the above situation.

(ii) Obtain an expression for n_2. Identify the other symbols used.

(iii) Find the angle of minimum deviation relevant for the above diagram.

(iv) A ray of light emerging from the surface AC is refracted through the part Z and emerges in a perpendicular direction to the surface QR. If the refractive index of part Z is 1.9, find the angle of incident on it.

(07) The graph of force vs extension for a steel wire is shown in the figure below. Length of the wire is 1.2 m and cross sectional area is $1.2 \times 10^{-6} m^2$. Tension of the wire is increased from zero gradually and then it is decreased upto zero.



(a) Calculate the Young's modulus for steel using the part OL of the graph shown.

(b) Why is the graph obtained when the load is removing, displaced from the graph obtained when the wire is loading?

(c) Show the area of the graph relevant to the heat energy loss in the whole process of loading wire and removing load.

(d) A rail made of above steel is heated upto 40°C and fixed at both ends. Its length is 20 m and cross sectional area is $8 \times 10^{-3} m^2$. When the rail cools upto 15°C, calculate,

(i) Tensile strain of the rail

(ii) Tensile stress of the rail

(iii) Energy stored in the rail

(Linear expansivity of steel is $12 \times 10^{-6} K^{-1}$)

(e) Find the amount of heat energy to be supplied to the rail in order to increase its temperature from 15 °C to 40 °C. Density of steel is 7800 kgm^{-3} and specific heat capacity is 500 $Jkg^{-1}k^{-1}$.

(f) Explain why this amount of heat energy is different form energy obtained in (c) above.

(08) (a) (i) Write down the equation for the magnetic flux density at a point near a current carrying conductor, expressed by Bio - savart law.

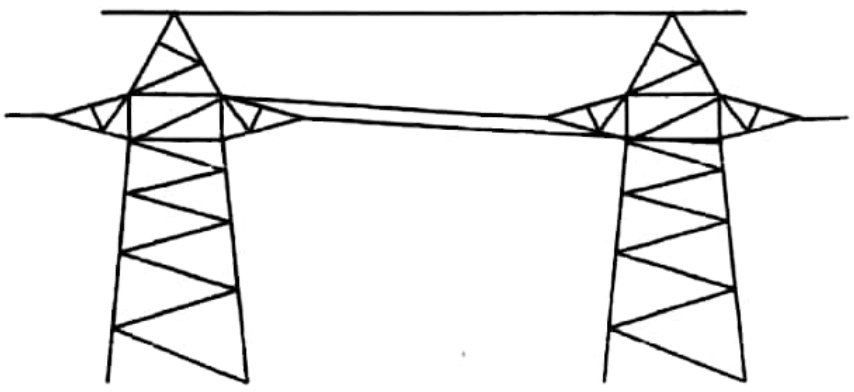
Identify each term.

(ii) Write down an expression for the flux density B of a point at a distance "a" from a infinitely long straight wire, carrying a current I. (Suppose that the permeability of the medium the wire is placed is μ)

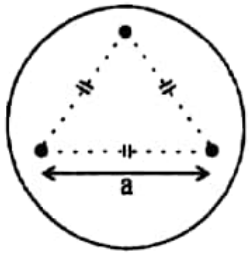
(iii) A force is produced between two infinitely long straight wires which lie parallel at a distance 'a' apart and carry currents I_1 and I_2 in the same direction. Is it an attractive force or repulsive force ? Show that the force per unit length F on one wire by the other is $F = \frac{\mu I_1 I_2}{2\pi a}$

(μ is the permeability of the medium which the wires are placed.)

(b)



Same current of I flows towards the same direction in three high transmission wires, which go through the vertices of equilateral triangle as shown in the figure. The separation between each two wires is 'a' and the permeability of the medium is μ.



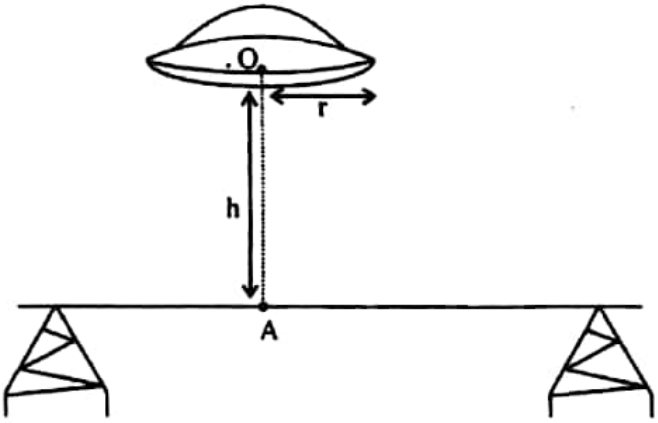
(i) Obtain an expression for the resultant force per unit length on one wire.

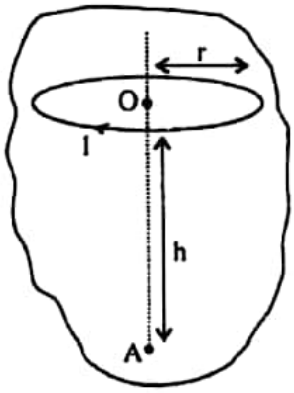
(ii) Write down an expression for the force on one wire between two towers if the distance between the towers is l.

(iii) Calculate the force on one wire if each wire is carrying a current 500A. Separation between two wires, a = 1 m and distance between the two towers l = 100 m. ($\mu = 42 \times 10^{-7}$ Wb A^{-1} m^{-1})

(iv) Magnetic flux density of 1×10^{-4} T is exerted downward due to a UFO (Unidentified Flying Object) which is vertically above the top wire. Calculate the new force on the part of the wire.

(c) The UFO is at a height h above the top wire and it has a circular shape of radius r





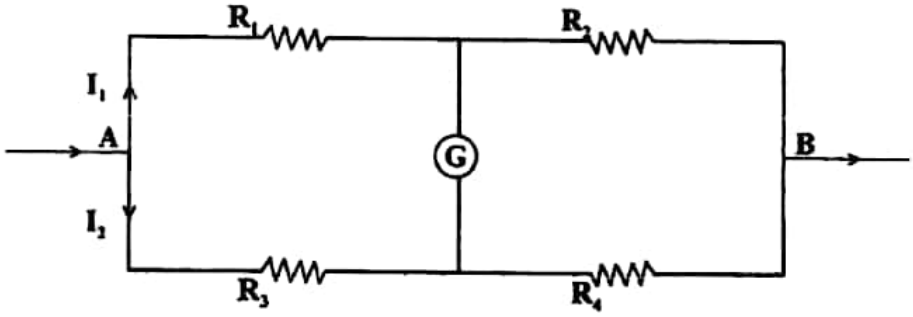
(i) Suppose that the UFO is a circular loop carrying a current I. Obtain an expression for magnetic flux density B, at a point A vertically below the centre O of the loop.

(ii) Calculate the current I which the UFO should carry to make a flux density of 1×10^{-4} T downward. h = 20 m, r = 15 m, $\mu = 4\pi \times 10^{-7}$ WbA^{-1}m^{-1} (Suppose $\pi = 3$)

(09) Answer either part (A) or part (B)

(A) (i) Explain the equivalent resistance of a system of resistances ?

(ii) A part of a wheaston - bridge circuit is shown in the figure.



(a) Show that $\frac{R_1}{R_2} = \frac{R_3}{R_4}$ when the galvanometer reading is zero.

(b) If $R_1 = 800\Omega$, $R_2 = 400\Omega$, $R_3 = 400\Omega$ and $R_4 = 200\Omega$, find the equivalcnt resistance between A and B.

(c) Prices of some resistors are as follows.

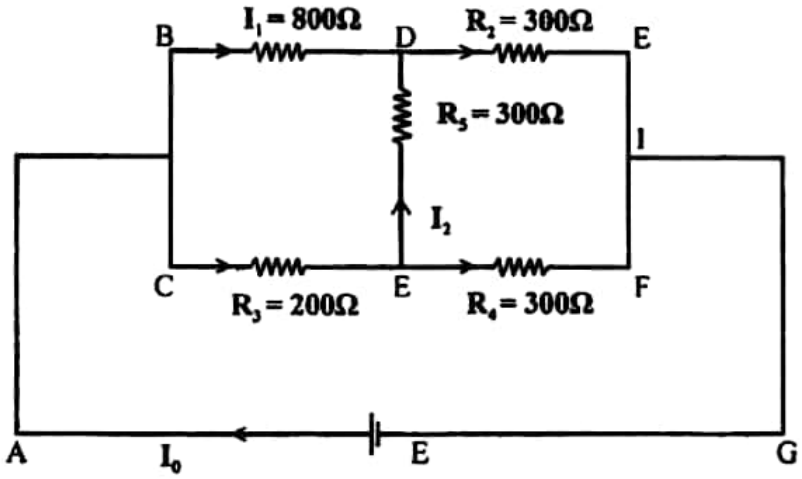
$200\Omega \rightarrow$ Rs. 5.00	$600\Omega \rightarrow$ Rs. 2.00
$400\Omega \rightarrow$ Rs. 7.00	$800\Omega \rightarrow$ Rs. 4.00

Draw a circuit equivalent to the above circuit in (b) which can be built with a lowest price.

(d) Suppose that plenty of 1600Ω resistors are provided. Calculate the minimum number of resistors needed to build an equivalent circuit for the circuit in (b) above.

(iii) State Kirchoff's laws.

(iv)



The equivalent resistance of the circuit above is to be determined using Kirchoff's law. For this a cell with emf E and negligible internal resistance is connected to the circuit and the current I_0, I_1, I_2 are flown.

(a) Write down expressions for the current flows through R_2, R_3 and R_4 in terms of I_0, I_1 and I_2.

(b) Show that $16I_1 + 6I_2 = 5I_0$, by using Kirchoff's law to the circuit BEFC.

(c) Show that $10I_1 - 3I_2 = 2I_0$, by using Kirchoff's law to the circuit BDEC.

(d) Obtain expressions for I_1 and I_2 in terms of I_0 by using (b) and (c) above.

(e) Calculate the ratio $\frac{E}{I_0}$ by using Kirchoff's laws for the circuit ABEG and using I_1 and I_2 above.

(f) Show that the value obtained in (e) above is the equivalent resistance of the circuit shown above.

(B) (a) (i) Describe the characteristics of a mechanical switch.

(ii) Explain the function of the following components as a switch.

1. Diode
2. Transistor

(b) The function of the transistor in the following circuit is as a switch.

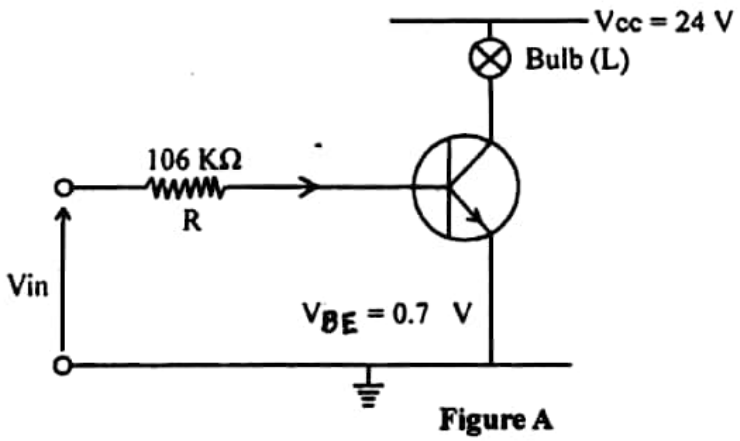


Figure A

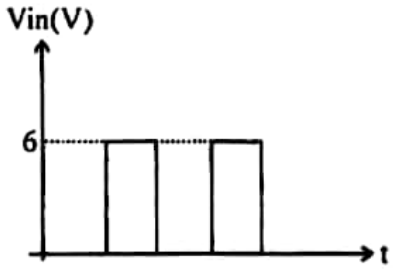


Figure B

(i) Sketch a graph of input current (I_B) with time (t), when the input shown by figure (B) is used as the input for the circuit shown by figure (A).

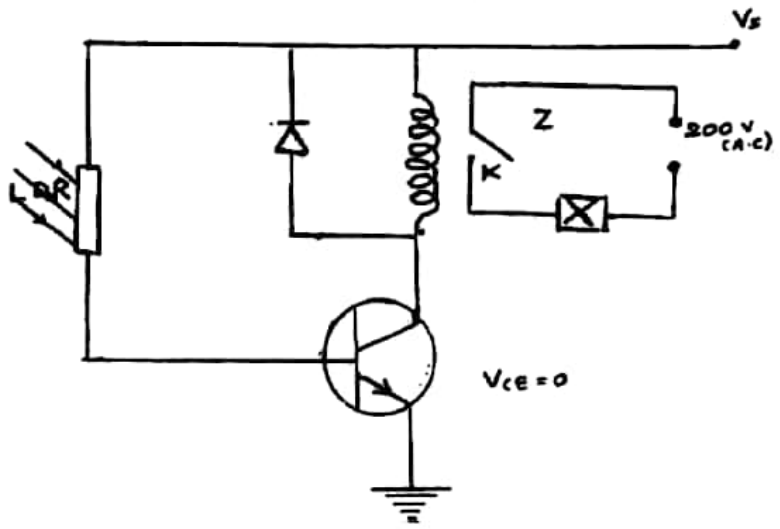
(ii) Bulb (L) is quantified as 20 mA, 2.4 V. What is the power of the bulb ?

(iii) When the bulb is lit at the above instance, what is the current consumed from the supply ?

(iv) What is the current gain of the transistor ?

(v) Explain the region that the transistor operates in the above instance.

(c) The following circuit is designed to switch on the lights at a factory at 6.00 p.m. and switch off at 6.00 a.m.



The circuit depicts a relay switch which is made by coiling a copper wire around a soft iron bar. The iron bar turns into a magnet when current flows through the copper coil. Due to the magnetic field created, the key on the circuit Z is pulled towards the iron bar, and the circuit is activated. The key (K) is also made of soft iron.

When a 9v is supplied to the transistor, it operates in the active region with a current gain (β) of 200.

(i) What is the purpose of using a diode in this circuit?

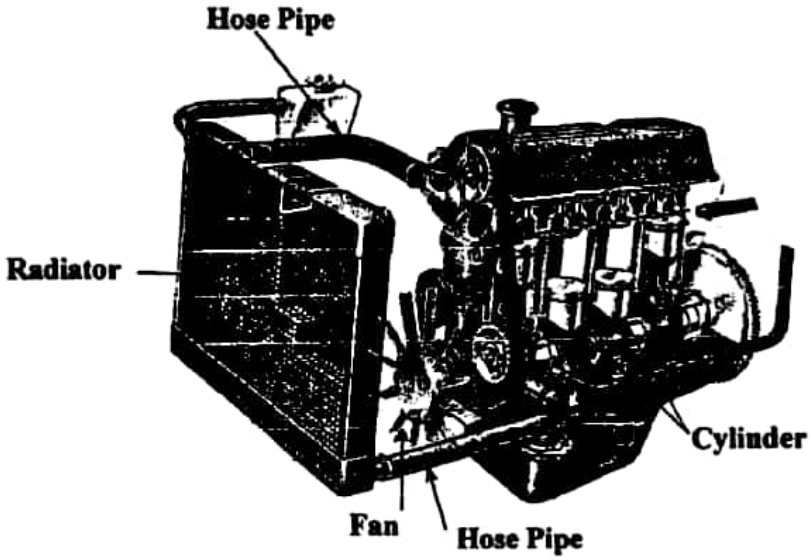
(ii) When a 90 mA of collecting current is given, relay switch is activated and the bulb is lit. What is the resistance of the LDR then ?

(iii) When a 60 mA of collecting current is given, relay switch is deactivated and the bulb is switched off. What is the resistance of the LDR then?

(iv) If the intensity of light is inversely proportional to the resistance of the LDR what is the ratio between the intensities of light when the bulb is switch off and switched on?

(10) Answer either part (A) or part (B)

(A)



A motor vehicle gets energy by burning fuel to run its engine. Work done by the expansion of gas is used for this.

The above diagram depicts several parts of an engine which are related to the cooling mechanism of a radiator.

The boiling point of fuel (diesel) is raised upto 450°C by causing air in the cylinders to a sudden compression by blocking air with a piston. Self combustion takes place immediately after the piston in the cylinder reaches its top level. This happens when diesel spray mixes with gas at 450°C. Thereby the air expands and that force is used to move the piston down. Burnt air is emmited in the next step. Here a certain amount of heat is absorbed into the inner wall of the cylinder and to the other parts. Consider that temperature of inner walls reaches to 280°C due to this.

The outer surface of the cylinder is surrounded by water. When the engine functions that water heats upto 80°C. The hot water is directed to a radiator which is connected with the engine by hose pipe. The water that runs through the radiator is cooled upto 30°C by means of a fan. The fan maintains a temperature of 25°C around the radiator. Water that is cooled to 30°C is added again to the part of water which is around the cylinder. This type of cycle takes place when an engine runs.

(i) The air trapped in the cylinder heats upto 450°C. But, why does not the inner wall of the cylinder get to that temperature ?

(ii) Why does the air heats upto 450°C in the sudden compression ?

(iii) Consider the heat conductivity of the metal of which the cylinder is made, is $2Wm^{-1}°C^{-1}$ and the effective area of heat conduction is 0.0625 m^2, thickness of the cylinder wall is 0.5 cm. Find the rate of heat conduction across the cylinder walls.

(iv) If the engine consists of 4 pistons as shown in the figure, what is the rate of heat conduction to the water around the cylinder across the cylinder walls ?

(v) Find the rate of volume of water at 30°C to be supplied to maintain the temperature of water at 80°C around the cylinder? (specific heat capacity of water is 4000 $Jkg^{-1}°C^{-1}$)

(vi) A temperature of 25°C is maintained around the environment due to the steady air flow that is coming form the fan, which is located in front of the radiator. Find the minimum area that the radiator should have in order to cool water upto 30°C by receiving water at 80°C. (co-efficient of surface emmision of the radiator is 0.8 $Wm^{-2}°C^{-1}$)

(vii) State an essential property of the metal that is used to manufacture radiators.

(viii) Explain the measures taken to manufacture radiators having a large area of this nature.

(ix) The speed of the fan reduces due to slipping off the belt due to loosening. In such situation what will happen if the temperature around the radiator is about 30°C. Explain.

B (a) (i) What are the factors which affect the rate of emission of radiation from an object?

(ii) Explain, what is meant by a black body.

(iii) State Stefan's law for black body radiation and write down the relevant equation.

(b) Suppose that temperature of earth is T_e , radius of the sun is R_s ,temperature of the sun T_s radius of the earth is R_e and the distance between the sun and the earth is R.

(Stefan's constant is σ)

(i) Write down an expression for the power radiated by the sun in terms of the above quantities.

(ii) Write down an expression for the intensity of sun's radiation incident on the earth surface, in terms of the above quantities. (Assume the area of incident as the cross sectional area of the earth)

(iii) Show that the temperature built on the earth due to the sun's radiation is

$$T_e = T_s \left(\frac{R_s}{2R}\right)^{1/2}$$

(iv) Calculate the temperature of the earth. Suppose that the temperature of the sun is 6000 K, radius of the sun is 7×10^8m distance to the earth from the sun is 1.5×10^{11}m.

(c) The outer surface of a satellite is plated with caesium. When light rays incident, its surface is charged due to emission of photo electrons. The surface is plated by cesium so that the electrons are liberated at the mean wave length 550 nm of the visible light. Work function of cesium is 1.93 eV

(i) Find the maximum kinetic energy and maximum velocity of the photo electrons emitted.

(ii) Calculate de Broglie wave length for cesium.

(iii) Calculate stopping potential for cesium at the above situation.