ICSE Board

Class X Physics

SCIENCE Paper - 1

Board Question Paper 2014

(Two hours)

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during the first 15 minutes.

This time is to be spent in reading the Question Paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section I** is compulsory. Attempt **any four** questions from **Section II.
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION I (40 Marks)

*Attempt **all** questions from this Section.*

Question 1

(a) A force is applied on (i) a non-rigid body and (ii) a rigid body. How does the effect of the force differ in the above two cases? [2]

(b) A metallic ball is hanging by a string from a fixed support. Draw a neat labelled diagram showing the forces acting on the ball and the string. [2]

(c) (i) What is the weight of a body placed at the centre of the earth?

(ii) What is the principle of an ideal machine? [2]

(d) Is it possible to have an accelerated motion with a constant speed? Explain [2]

(e) (i) When does a force do work?

(ii) What is the work done by the moon when it revolves around the earth? [2]

Question 2

(a) Calculate the change in the Kinetic energy of a moving body if its velocity is reduced to $1/3^{rd}$ of the initial velocity. [2]

(b) State the energy changes in the following devices while in use:

(i) A loud speaker.

(ii) A glowing electric bulb. [2]

(c) (i) What is nuclear energy?

(ii) Name the process used for producing electricity using nuclear energy. [2]

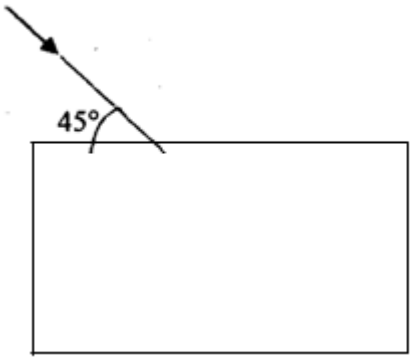
(d) State one important advantage and disadvantage each of using nuclear energy for producing electricity. [2]

(e) (i) The conversion of part of the energy into an undesirable form is called _____.

(ii) For a given height h, _____ the length l of the inclined plane, lesser will be the effort required. [2]

Question 3

(a) Draw the diagram given below and clearly show the path taken by the emergent ray.



[2]

(b) (i) What is consumed using different electrical appliances, for which electricity bills are paid?

(ii) Name a common device that uses electromagnets. [2]

(c) (i) A ray of light passes from water to air. How does the speed of light change?

(ii) Which colour of light travels fastest in any medium except air? [2]

(d) Name the factors affecting the critical angle for the pair of media. [2]

(e) (i) Name a prism required for obtaining a spectrum of Ultraviolet light.

(ii) Name the radiations which can be detected by a thermopile. [2]

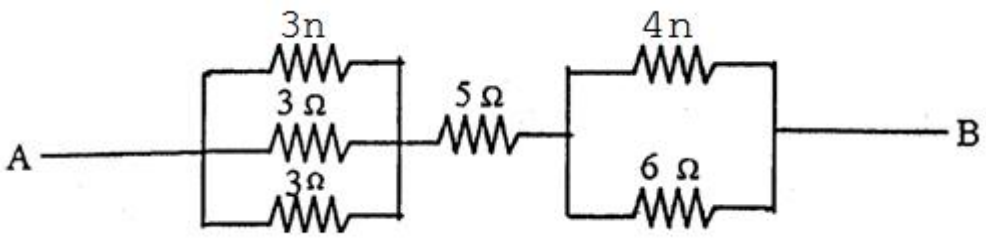
Question 4

(a) Why is the colour red used as a sign of danger? [2]

(b) (i) What are mechanical waves?

(ii) Name one property of waves that do not change when the wave passes from one medium to another. [2]

(c) Find the equivalent resistance between points A and B



[2]

(d) 50 g of metal piece at 27°C requires 2400 J of heat energy so as to attain a temperature of 327 °C . Calculate the specific heat capacity of the metal. [2]

(e) An electron emitter must have _____ work function and _____ melting point. [2]

SECTION II (40 Marks)

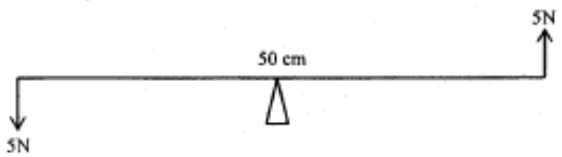
*Attempt any **four** questions from this Section*

Question 5

(a) (i) A man having a box on his head, climbs up a slope and another man having an identical box walks the same distance on a levelled road.

Who does more work against the force of gravity and why?

(ii) Two forces each of 5N act vertically upwards and downwards respectively on the two ends of a uniform metre rule which is placed at its mid-point as shown in the diagram. Determine the magnitude of the resultant moment of these forces about the midpoint. [4]



(b) (i) A body is thrown vertically upwards. Its velocity keeps on decreasing. What happens to its kinetic energy as its velocity becomes zero?

(ii) Draw a diagram to show how a single pulley can be used so as to have its ideal M.A= 2. [3]

(c) Derive a relationship between mechanical advantage, velocity ratio and efficiency of a machine. [3]

Question 6

(a) (i) Light passes through a rectangular glass slab and through a triangular glass prism. In what way does the direction of the two emergent beams differ and why?

(ii) Ranbir claims to have obtained an image twice the size of the object with a concave lens. Is he correct? Give a reason for your answer. [4]

(b) A lens forms an erect, magnified and virtual image of an object.

(i) Name the lens.

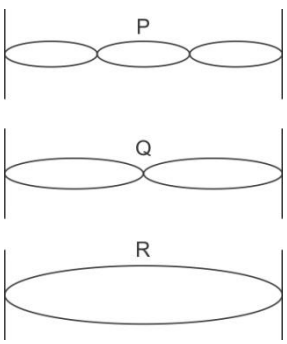
(ii) Draw a labelled ray diagram to show the image formation. Define the power of a lens. [3]

(c) (i) Define the power of a lens.

(ii) The lens mentioned in 6(b) above is of focal length 25cm. Calculate the power of the lens. [3]

Question 7

(a) The adjacent diagram shows three different modes of vibrations P, Q and R of the same string.



(i) Which vibration will produce a louder sound and why?

(ii) The sound of which string will have maximum shrillness?

(iii) State the ratio of wavelengths of P and R. [4]

(b) A type of electromagnetic wave has wavelength 50 $\mathring{A}$.

(i) Name the wave.

(ii) What is the speed of the wave in vacuum?

(iii) State one use of this type of wave. [3]

(c) (i) State one important property of waves used for echo depth sounding.

(ii) A radar sends a signal to an aircraft at a distance of 30 km away and receives it back after 2×10^{-4} second. What is the speed of the signal? [3]

Question 8

(a) Two resistors of 4Ω and 6 Ω are connected in parallel to a cell to draw 0.5 A current from the cell.

(i) Draw a labelled circuit diagram showing the above arrangement.

(ii) Calculate the current in each resistor. What is an Ohmic resistor? [4]

(b) (i) What is an Ohmic resistor?

(ii) Two copper wires are of the same length, but one is thicker than the other.

(1) Which wire will have more resistance?

(2) Which wire will have more specific resistance? [3]

(c) (i) Two sets A and B, of three bulbs each, are glowing in two separate rooms. When one of the bulbs in set A is fused, the other two bulbs also cease to glow. But in set B, when one bulb fuses, the other two bulbs continue to glow. Explain why this phenomenon occurs.

(ii) Why do we prefer arrangements of Set B for house circuiting? [3]

Question 9

(a) Heat energy is supplied at a constant rate to 100g of ice at 0 °C. The ice is converted into water at 0° C in 2 minutes. How much time will be required to raise the temperature of water from 0 °C to 20 °C? [Given: sp. heat capacity of water = 4.2 J g^{-1} $°C^{-1}$, sp. latent heat of ice = 336 J g^{-1}]. [4]

(b) Specific heat capacity of substance A is 3.8 J $g^{-1}K^{-1}$ whereas the specific heat capacity of substance B is 0.4 J g^{-1} K^{-1}

(i) Which of the two is a good conductor of heat?

(ii) How is one led to the above conclusion?

(iii) If substances A and B are liquids then which one would be more useful in car radiators? [3]

(c) (i) State any two measures to minimize the impact of global warming.

(ii) What is the Greenhouse effect? [3]

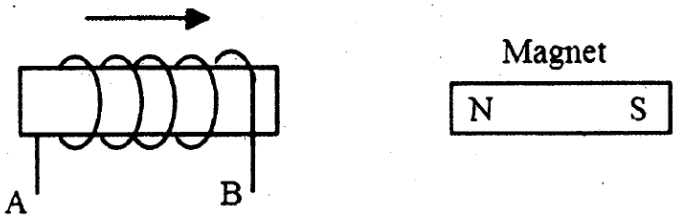
Question 10

(a) (i) Name two factors on which the magnitude of an induced e.m.f. in the secondary coil depends.

(ii) In the following diagram an arrow shows the motion of the coil towards the bar magnet.

(1) State in which direction the current flows, A to B or B to A?

(2) Name the law used to come to the conclusion.



[4]

(b) A nucleus $_{11}Na^{24}$ emits a beta particle to change into Magnesium (Mg)

(i) Write the symbolic equation for the process.

(ii) What are numbers 24 and 11 called?

(iii) What is the general name of $^{24}_{12}Mg$ with respect to $^{24}_{11}Na$? [3]

(c) In a cathode ray tube state:

(i) the purpose of covering cathode by thorium and carbon.

(ii) the purpose of the fluorescent screen.

(iii) how is it possible to increase the rate of emission of electrons. [3]

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Class X Physics

SCIENCE Paper - 1

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1.

(a) When a force is applied on a non rigid body, then the body comes into motion along with a small deformation. The acceleration **a** of the body is less than the calculated value i.e. $\mathbf{a} = \frac{\mathbf{F}}{\mathbf{m}}$. It is because some part of force is utilized to deform the body (where **F** is the force applied on the body of mass **m**).

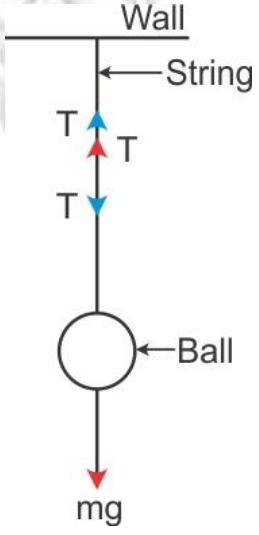
When a force is applied on a perfectly rigid body, then the body comes into motion with no deformation. The acceleration **a** of the body can be calculated from $\mathbf{a} = \frac{\mathbf{F}}{\mathbf{m}}$.

(b) When a metallic ball is hanging by a string from a fixed support, the forces acting on the string are: (represented by blue coloured arrows in the diagram)

1) Tension **T** applied by wall acting vertically upward.
2) Tension **T** applied by ball acting vertically downward.

The forces acting on the ball are: (represented by red coloured arrows in the diagram)

1) Tension **T** applied by string acting vertically upward.
2) Gravitational pull (**mg**) acting vertically downward.



(c)

(i) Weight of the body at the centre of the earth is zero, since **g** is zero.

(ii) An ideal machine takes energy in one form and converts into another form without any energy losses. The work output is equal to the work input.

(d) Yes, it is possible to have accelerated motion with a constant speed. For e.g. in a uniform circular motion, the body moves with constant linear speed with a constant centripetal acceleration acting towards the centre of the circle.

(e)

(i) A force does work whenever there is a displacement in the direction of force applied.

(ii) The work done by moon is zero since the displacement during one complete revolution is zero.

2.

(a)

Let the inital kinetic energy be $E_1 = E$

Now, the kinetic energy is directly proportional to the square of the velocity.

$K.E \alpha v^2$

$\therefore$ Final kinetic energy = $E_2 = \frac{1}{9}E$

Hence, the change in kinetic energy is given as,

$\Delta E = E_1 - E_2$

$= E - \frac{1}{9}E$

$= \frac{8}{9}E$

(b) (i) electrical energy to sound energy.

(ii) electrical energy to light and heat energy.

(c) (i) The energy released/required during disintegration of a nucleus is called nuclear energy.

(ii) Nuclear fission

(d) Advantage: A very small amount of nuclear fuel (such as uranium-235) can produce a tremendous amount of energy.

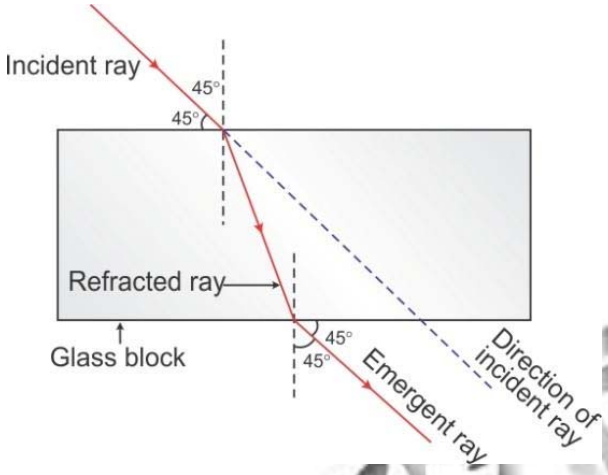
Disadvantage: The waste obtained from the nuclear plants causes environmental pollution.

(e) (i) dissipation of energy

(ii) more

3.

(a) The path of the emergent ray will be parallel to the incidence ray extended. This is according to Snell's law.



(b)

(i) Electrical energy

(ii) Fan, motors

(c)

(i) The speed of light increases as it passes from water to air.

(ii) The red colour of light will travel the fastest in any medium.

(d) Factors affecting the critical angle are:

1. **Colour (or wavelength) of light:** The refractive index of a transparent medium is most for violet light and least for red light; therefore, the critical angle for a pair of media is least for violet light and most for red light. Thus, the critical angle increases with increase in wavelength of light.

2. **Temperature:** On increasing the temperature of the medium, its refractive index decreases, so the critical angle for that pair of media increases. Thus, the critical angle increases with increase in temperature

(e) (i)Quartz prism is used to obtain a spectrum of UV light.

(ii)Infrared radiations can be detected by thermopile.

4.

(a) In the visible light, the wavelength of red light is longest, the light of red colour is scattered least by the air molecules of the atmosphere and therefore the light of red colour can penetrate to a longer distance. Thus, red light can be seen from the farthest distance as compared to the other colours having the same intensity. Hence, it is used for danger signal so that the signal may be visible from the far distance even in fog, etc.

(b) (i)The waves which travel in the medium through the vibrations of the medium particles about their mean positions are called mechanical waves.

(ii) The frequency of the waves does not change when the waves travel from one medium to another.

(c)

As shown in the circuit diagram all the 3 Ω resistors re connected in parallel.

$$\frac{1}{R_1} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3}$$

$$R_1 = 1\ \Omega$$

Resistors 4 Ω and 6 Ω are connected in parallel.

$$\frac{1}{R_2} = \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$$

$$R_2 = \frac{12}{5}\ \Omega$$

Now, R_1, R_2 and 5 Ω are connected in series.

$$R_{AB} = 1 + \frac{12}{5} + 5 = \frac{42}{5} = 8.4\ \Omega$$

(d) The heat energy required to change the temperature of a substance is

$$Q = mc\Delta T$$

$$\therefore c = \frac{Q}{m\Delta T} = \frac{2400}{50 \times (327 - 27)} = \frac{2400}{50 \times 300} = 0.16\ J\ g^{-1}\ {}^{\circ}C^{-1}$$

(e) low, high

5.

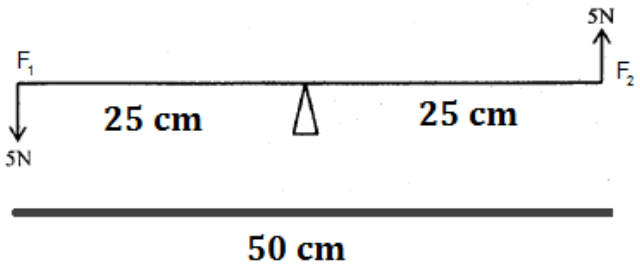
(a) (i) A man climbing up a slope does more work against force of gravity.

Work done by the force of gravity is

$$W = Force \times displacement$$
$$= Weight \times height$$
$$= mg \times h$$

When a man is climbing up a slope, h increases. Therefore, work against force of gravity is more.

(ii)



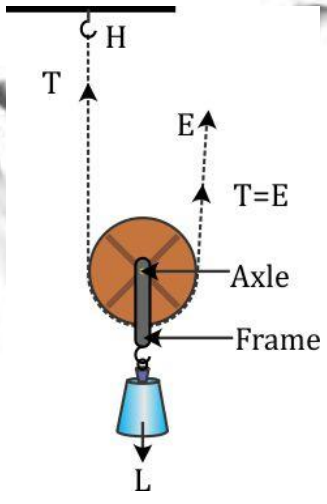
Moment of force $F_1 = 5 \times 25 = 125$
Moment of force $F_2 = 5 \times 25 = 125$
Since both the forces are acting in anticlockwise direction, the resultant moment of force is the sum of the two moments.
∴ Resultant moment of force = 125 + 125 = 250

(b) (i)

Kinetic energy is $K = \frac{1}{2}mv^2$

Therefore, if velocity becomes zero, kinetic energy also reduces to zero.

(ii) A single movable pulley can be used to have M.A = 2. It is shown below.



The load L is balanced by the tension in two segments of the string and the effort E balances the tension T at the free end, so

L = T + T = 2T and E = L

Therefore, the mechanical advantage is

$$M.A. = \frac{L}{E} = 2$$

(c) Let a machine overcome a load L by the application of an effort E, in time t. Let the displacement of effort be d_E and the displacement of load be d_L.

$$\text{Work input} = \text{Effort} \times \text{displacement of effort}$$
$$= E \times d_E$$
$$\text{Work output} = \text{Load} \times \text{displacement of load}$$
$$= L \times d_L$$
$$\text{Efficiency} = \eta = \frac{\text{Work output}}{\text{Work input}}$$
$$\eta = \frac{L \times d_L}{E \times d_E} = \frac{L}{E} \times \frac{d_L}{d_E}$$

Now, we know that

$$\frac{L}{E} = \text{M.A.}$$
$$\frac{d_E}{d_L} = \text{V.R.}$$

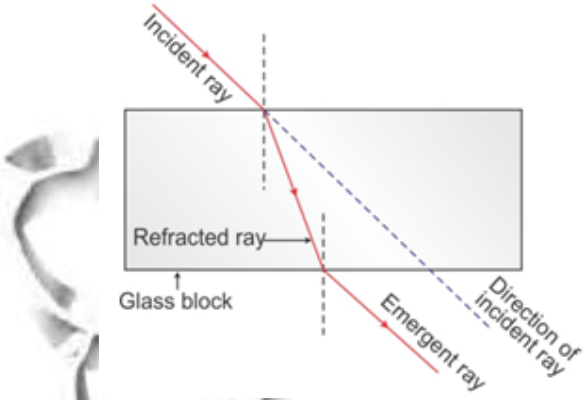
Thus, we get

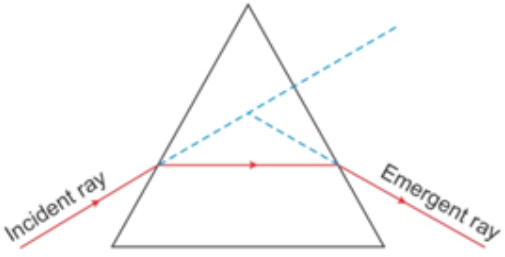
$$\eta = \frac{\text{M.A.}}{\text{V.R.}}$$
$$\text{M.A.} = \text{V.R.} \times \eta$$

Thus, the mechanical advantage of a machine is equal to the product of its velocity ratio and efficiency.

6.

(a) (i) In case of a rectangular glass slab, emergent rays of light are always parallel to the direction of incident rays.



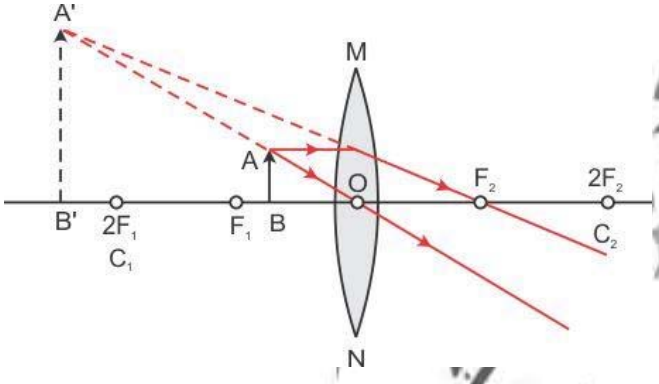


When a light ray passes through a prism, it bends towards the base of the prism. Hence, incident ray and emergent ray are not parallel to each other as they are in case of a glass slab.

(ii) No, he is not correct.
Reason: Magnified image of an object cannot be formed by a concave lens ever. Because, no matter where the object is placed in front of a concave lens, it always forms a virtual, erect and diminished image of the object.

(b) (i) Convex lens
When object is placed between focus F and optical centre O of a convex lens, it forms a magnified, virtual and erect image on the same side of the lens.

(ii)



(c)
(i) Power of a lens: The power of a lens is a measure of the degree of convergence and divergence of light rays falling on it.
The power of a lens is defined as the reciprocal of its focal length. It is represented by the letter P. The power P of a lens of focal length f is given as

$$P = \frac{1}{f}$$

The SI unit of power is dioptre (D).

(ii) Focal length of a convex lens is always positive.
Given: f = +25 cm

$$\therefore P = \frac{1}{f} = \frac{1}{25}$$

$$P = +0.04 \text{ D}$$

7. (a)
(i) The loudness or softness of a sound is determined by the amplitude (or intensity) of the wave. In this case the amplitude of R is greater than the amplitude of other vibration modes. Hence, the vibration R will produce more sound than the other two. Louder sound corresponds to the wave of larger amplitude.

(ii) Shrillness or Pitch of a note depends on the wavelength or frequency of wave and here the vibration P has more frequency than others. If f is the principle frequency, then

Frequency (P) = 3 f

Frequency (Q) = 2 f

Frequency (R) = f

Hence P has more shrillness than others.

(iii) If the frequency of vibration of R = f, frequency of vibration of Q = 2f, and that of P = 3 f.

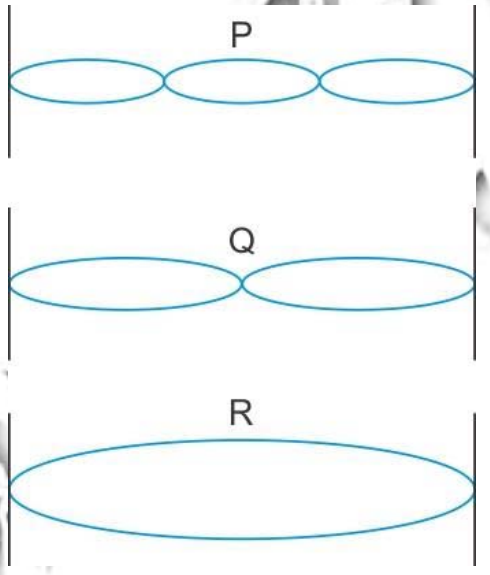
Ratio $\frac{f_P}{f_R} = \frac{3}{1}$

$f_P : f_R = 3:1$

As $f \alpha \frac{1}{\lambda}$ Hence $\frac{\lambda_P}{\lambda_R}$ = 1:3

OR (Another method)

From figure we can say that 3 vibration of P corresponds to 1 vibration of R



i e $3\lambda_P = 1\lambda_R$

$\therefore \frac{\lambda_P}{\lambda_R} = \frac{1}{3} = 1:3$

Therefore, ratio of wavelength of P and R is 1:3.

(b)

i. An electromagnetic wave having wavelength 50 Å is X rays. They have wavelength in the range of 0·1 Å to 100 Å.

ii. Speed of an electromagnetic wave (here X-ray) in vacuum is $3x10^8$ m/s.

iii. Since, they are stopped by bones, they are used for the detection of fracture in bones, teeth etc., and for diagnostic purposes such as CAT scan in medical science.

(c)

i. The waves used for echo depth sounding are ultrasonic waves (frequency above 20000 Hz). The important property of such type of a wave is that they travel undeviated through long distances and that they can be confined to a narrow beam. They are not easily absorbed in a medium.

ii. Given $t = 2 \times 10^{-4}$

$d = 30\ km = 30 \times 10^3\ m$

Speed of the signal = ?

Let 'd' be the distance of aircraft from the radar, then the total distance travelled by the wave in coming and going back = 2 d.

$$\text{Velocity of wave, } V = \frac{\text{(Total distance travelled, 2d)}}{\text{Time taken, t}}$$

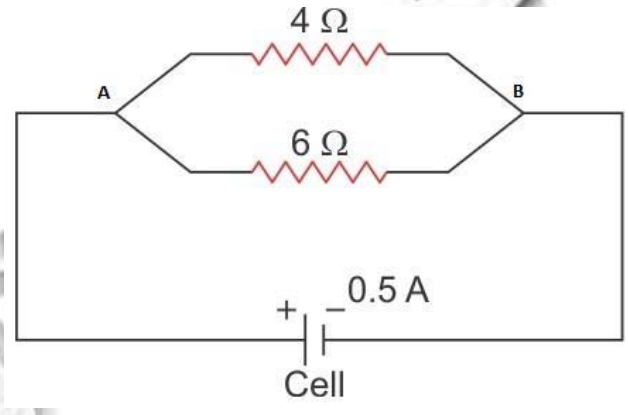
$$= \frac{(2 \times 30 \times 10^3)}{2 \times 10^{-4}}$$

$$= 3 \times 10^8\ m/s$$

8.

(a)

i. The parallel combination of two resistors 4 Ω and 6 Ω that draws a current of 0.5 A from the cell is as shown below.



ii. In parallel combination of resistors potential difference across each resistor is same as the potential difference across the terminals of the battery.

Here current drawn from cell, I = 0.5 A

The effective resistance $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

Here $R_1 = 4\Omega$ and $R_2 = 6\Omega$

$$\therefore \frac{1}{R} = \frac{1}{4} + \frac{1}{6} = \frac{5}{12}$$

$$\therefore R = \frac{12}{5} = 2.4\ \Omega$$

So potential difference across the terminal A and B, V can be obtained using ohm's law as

$V = I R$

$V = 0.5 \times 2.4$

$= 1.2$ V

So, current across resistor 1 i.e., 4 Ω is, $I_1 = \frac{V}{R_1} = \frac{1.2}{4} = 0.3$ A

And current across resistor 2 i.e., 6 Ω is, $I_2 = \frac{V}{R_2} = \frac{1.2}{6} = 0.2$ A

(b)

i. Ohmic resistors: The resistors which obey Ohm's law are called ohmic resistors or linear resistances. Eg: all metallic conductors like silver, aluminium, etc.
For such resistors, a graph plotted for the potential difference V against current I is a straight line and the value of resistance R is the same irrespective of the value of V or I.

ii. Resistance of a wire is directly proportional to the length (l) of the wire and inversely proportional to the area of cross-section of the wire.

$R \propto \frac{l}{A}$

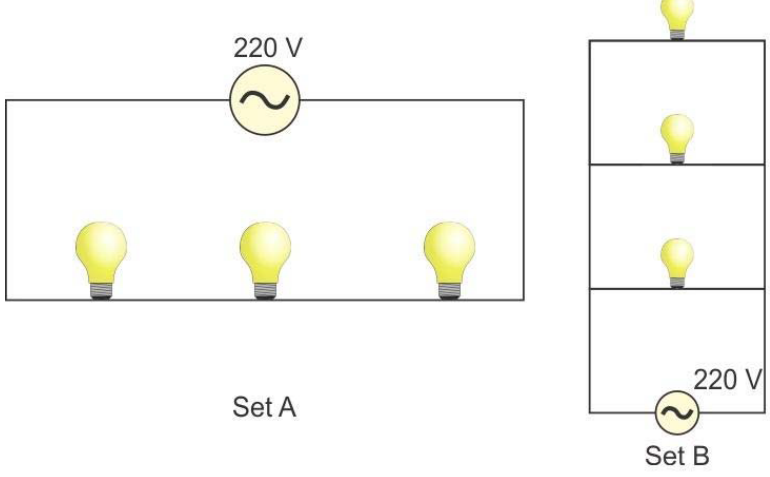
$R = \rho \frac{l}{\pi r^2}$

1. As resistance is inversely proportional to area of cross section, the wire with less thickness has more resistance.
2. Resistivity or specific resistance is $\rho = \frac{RA}{l}$

   So, the thicker wire will have more specific resistance as resistivity is directly proportional to area of cross-section.

(c)

i. In set A, all the three bulbs are connected in series. The voltage of source gets divided in all the three bulbs connected in series, and they operate simultaneously. None of the bulb can be operated independently, and hence when one bulb fuses the other two bulbs also cease to glow.
In set B, the three bulbs are connected in parallel. So, even when one of the bulbs ceases to glow, the others continue to glow. Each bulb operates independently.



ii. For house circuiting we use the set B arrangement i.e., all the appliances are connected in parallel. The advantage of connecting the appliances in parallel are:

1. Each appliance gets connected to 220 V supply for its normal working.
2. Each appliance works independently without being affected whether the other appliance is switched on or off.

Whereas when connected in series

1. All appliances that are connected operate simultaneously and none can be operated independently.
2. Voltage of the source gets divided and on connecting one more appliance in the same circuit, the resistance of the circuit will increase. Hence, it will reduce the current in the circuit, so each appliance will get less power.

Hence we prefer arrangements of set B for house circuiting.

9. (a)

Heat energy required to melt 100 g of ice at 0 °C is

$$Q = mL = 100 \times 336 = 33600 \text{ J}$$

Therefore, heat energy supplied per minute is

$$\frac{33600}{2} = 16800 \text{ J min}^{-1}$$

Now, heat energy required to raise the temperature of water from 0 °C to 20 °C is

$$Q' = mc \times \text{rise in temperature} = 100 \times 4.2 \times 20 = 8400 \text{ J}$$

If time required for this heat gain is t minutes, then

Heat energy supplied in t minutes is

$$16800 \times t = 8400$$

$$\therefore t = \frac{8400}{16800} = 0.5 \text{ min} = 30 \text{ s}$$

(b) (i) Substance B is a good conductor out of the two substances.
(ii) The specific heat capacity of B is lower than A. This means that less heat is required to raise the temperature of 1 g of B by 1 K than the heat required for A.
(iii) If both substances were liquids, then substance A will be more useful in radiators. This is because A will extract more heat without much change in its temperature as it has high specific heat capacity.

(c) (i) The two measures to minimize the effect of global warming are:
1) Use of renewable sources of energy in place of electricity from the power generating station.
2) Use of bio-char stoves for cooking.
3) Reforestation and sustainable use of land.
4) Controlling population through family planning, welfare reform and the empowerment of women. (ANY 2)

(ii) The green house effect is the phenomenon in which infrared radiations of long wavelength given out from the surface of a planet are absorbed by its atmospheric gases to keep the environment at the planet's surface and the lower atmosphere warm.
The green house gases present in the earth's atmosphere play a role similar to that of glass walls of a green house. Hence this phenomenon is called the green house effect.
The increase in the concentration of carbon dioxide due to above human activities is responsible for 60% increase in green house effect

10.
(a)
(i) The magnitude of e.m.f. induced in the secondary coil depends on the following two factors:

1) The ratio of the number of turns in the secondary coil to the number of turns in the primary coil (i.e., turns ratio), and
2) The magnitude of e.m.f applied in the primary coil.

(ii) (1) The direction of current in the coil is from B to A.
(2) The law used is the Lenz's law of electromagnetic induction.
The coil is moving towards the North Pole of the magnet. Due to this, there is a change in magnetic flux in the coil. Now, the direction of induced e.m.f. (induced current) is such that it opposes this change in flux. Hence, the right end of the coil should also behave as North Pole. Hence, the current will be in the anti-clockwise direction, i.e., from B to A.

(b) The ${}_{11}Na^{24}$ nucleus emits a beta particle and changes into Magnesium.
(i) The above process is represented by the equation

$$\underset{\text{Sodium}}{{}_{11}Na^{24}} \rightarrow \underset{\text{Magnesium}}{{}_{12}Mg^{24}} + \underset{\text{Beta particle}}{{}_{-1}e^{0}}$$

(ii) The number 24 is the mass number of the nucleus and 11 is the atomic number.

(iii) $_{11}Na^{24}$ and $_{12}Mg^{24}$ are isobars, i.e., $_{12}Mg^{24}$ is an isobar of $_{11}Na^{24}$ as they have same mass number (protons + neutrons) but different atomic number (protons).

(c) (i) The cathode is covered with thorium and carbon as it has low work function and it needs to be heated up to 2000 K to emit electrons. This serves it as a better electron emitter than tungsten.
(ii) The fluorescent screen helps in changing the electrical signal applied on the deflecting plates into the visual pattern on the screen.
(iii) The rate of emission of the electrons can be increased by
1) Using a metal with a lower work function,
2) Increasing the temperature of the surface of the metal, or
3) Increasing the surface area of the metal emitting the electrons.