Date: 04/03/2024

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005 | Ph.: 011-47623456

Time: 2 Hrs.

PHYSICS

Max. Marks: 80

(Science Paper 1)

ICSE Board Class X Exam (2024)

Answers & Solutions

GENERAL INSTRUCTIONS

Read the following instructions very carefully and follow them:

(i) Duration for the Test is 2 hours.

(ii) Maximum Marks for Section-**A** and **B** is 40 each.

(iii) The intended marks for questions or parts of questions are given in brackets [ ].

(iv) **Section A** is compulsory. Attempt all questions from this section.

(v) Attempt **any four** questions from **Section B**.

(vi) Use of calculator is not permitted.

(vii) It is mandatory to use Blue/Black ballpoint pen to write the answer.

SECTION-A (40 Marks)

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

Choose the correct answers to the questions from the given options. **[15×1=15]**

1. (i) When a bell fixed on a cycle rings, then the energy conversion that takes place is:

(a) gravitational potential energy to sound energy

(b) kinetic energy to sound energy

(c) sound energy to electrical energy

(d) sound energy to mechanical energy

Answer (b)

(ii) A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is:

(a) 5 N (b) 10 N

(c) 20 N (d) 0.2 N

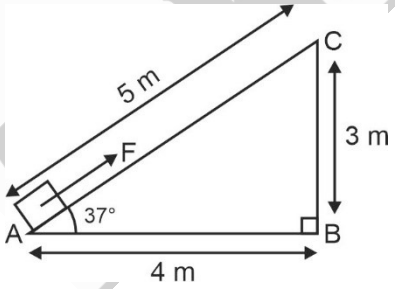
Answer (a)

Sol. Moment of force = Force × Moment arm

$$\Rightarrow \quad \text{Force} = \frac{\text{Moment of force}}{\text{Moment arm}}$$

$$= \frac{1}{0.2} = 5 \text{ N}$$

(iii) A force **'F'** moves a load from **A** to **C** as shown in the figure below. For the calculation of the work done, which of these lengths would you use as the displacement?



(a) 3 m (b) 4 m

(c) 5 m (d) 7 m

Answer (c)

Sol. For the calculation of work done, displacement is taken in the direction of force.

(iv) A radioactive nucleus containing 128 **nucleons** emits a β-particle. After β-emission, the number of **nucleons** present in the nucleus will be:

(a) 128 (b) 129

(c) 124 (d) 127

Answer (a)

Sol. After emission of β-particle, number of nucleons remain same.

(v) **Assertion (A) :** Ultraviolet radiations are scattered more as compared to the microwave radiations.

Reason (R) : Wavelength of ultraviolet radiation is more than the wavelength of microwave radiation.

(a) Both A and R are true
(b) A is true but R is false
(c) A is false but R is true
(d) Both A and R are false

Answer (b)

Sol. Wavelength of ultraviolet radiation is less than the wavelength of microwave radiation.

(vi) When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are **definitely** an example of:

(a) resonance
(b) natural vibrations
(c) forced vibrations
(d) damped vibrations

Answer (c)

(vii) Which of the following is a class III lever?

(a) Pair of scissors
(b) Wheelbarrow
(c) Crowbar
(d) Human forearm

Answer (d)

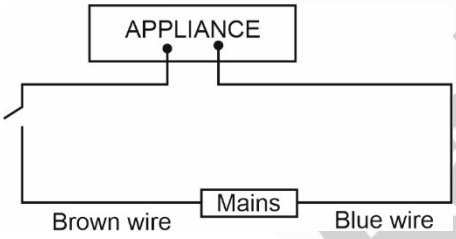
(viii) The specific resistance of a conductor depends on its:

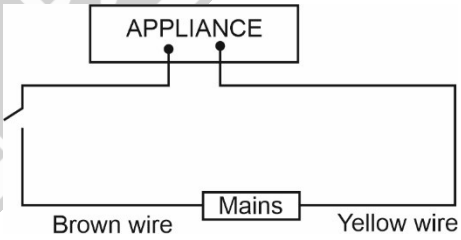
(a) length
(b) material
(c) area of cross section
(d) radius

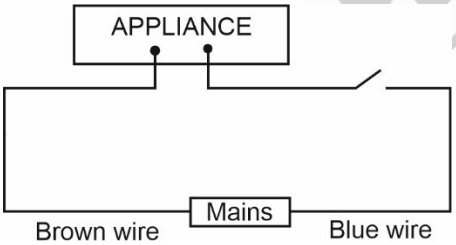
Answer (b)

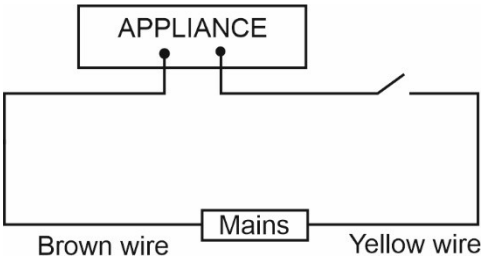
Sol. Specific resistance of conductor depends on its material and temperature.

(ix) Identify the option that displays the **correct wiring** with **correct colour code:**

(a)


(b)


(c)


(d)


Answer (a)

Sol. Key is connected with live wire in domestic wiring.

(x) The potential difference between terminals of a cell in a closed electric circuit is: **[1]**

(a) terminal voltage
(b) electro motive force
(c) voltage drop
(d) none of these

Answer (a)

Sol. The potential difference between terminals of a cell in a closed electric circuit is called terminal voltage.

(xi) During melting of ice at 0°C the: **[1]**

(a) energy is released and temperature remains constant.

(b) energy is absorbed and temperature remains constant.

(c) energy is released and temperature decreases.

(d) energy is absorbed and temperature increases.

Answer (b)

(xii) Linear magnification(m) produced by a concave lens is: **[1]**

(a) $m < 1$ (b) $m > 1$

(c) $m = 1$ (d) $m = 2$

Answer (a)

Sol. Concave lens produces virtual, erect and diminished image of a real object.

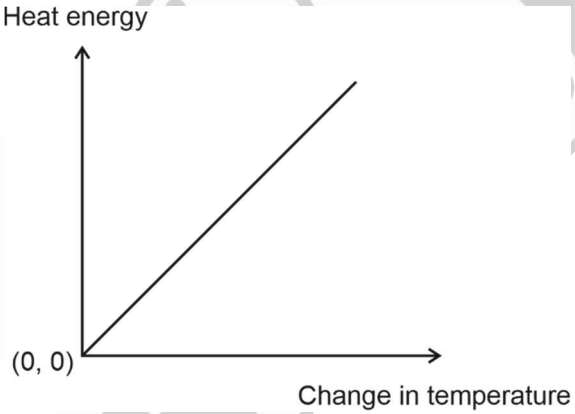
(xiii) A radioactive element is placed in an evacuated chamber. Then the rate of **radioactive decay** will: **[1]**

(a) Decrease (b) Increase

(c) Remain unchanged (d) Depend on the surrounding temperature

Answer (c)

(xiv) The graph given below shows heat energy supplied against change in temperature when no energy is lost to the surrounding. The slope of this graph will give:

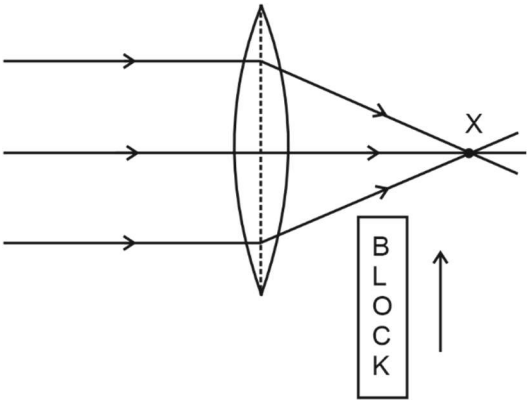


(a) Specific heat capacity (b) Latent heat of fusion

(c) Latent heat of vaporization (d) Heat capacity

Answer (d)

(xv) A block of glass is pushed into the path of the light as shown below. Then the converging point X will:



(a) Move away from the slab (b) Move towards the slab

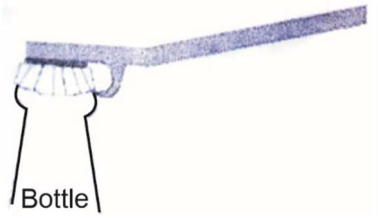
(c) Not shift (d) Move towards the left side of the lens

Answer (a)

2. (i) (a) In the following atoms, which one is a radioisotope? Give *one* use of this isotope. **[3]**

O^{16}, C^{14}, N^{14}, He^4

(b) Name the class of the lever shown in the picture below:



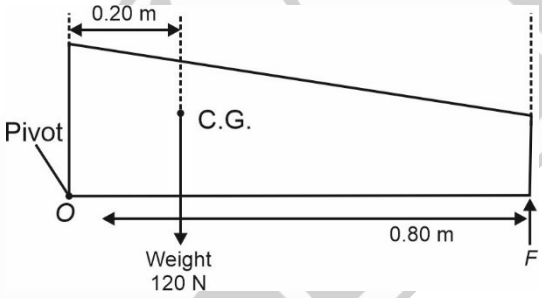
(ii) Fill in the blanks: **[2]**

(a) When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides _____ force necessary for circular motion.

(b) Work done by this force at any instant is _____.

(iii) A non uniform beam of weight 120 N pivoted at one end is shown in the diagram below.

Calculate the value of ***F*** to keep the beam in equilibrium. **[2]**



(iv) Meera choose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load. **[2]**

(a) What is the advantage of using a block and tackle system over a single movable pulley?

(b) Why should she connect more number of pulleys in the upper fixed block?

(v) Sumit does 600 J of work in 10 min and Amit does 300 J of work in 20 min. Calculate the ratio of the powers delivered by them. **[2]**

(vi) 5 bulbs are connected in **series** in a room. One bulb is fused. It is removed and remaining 4 bulbs are again connected in **series** to the same circuit. What will be the effect on the following physical quantities? (Increases, Decreases, Remain Same) **[2]**

(a) Resistance

(b) Intensity of light

(vii) Rohan conducted experiments on echo in different media. He observed that a minimum distance of '***x***' meters is required for the echo to be heard in oxygen and 'y' meters in benzene. Compare '***x***' and '***y***'. Justify your answer. **[2]**

Speed of sound in oxygen: 340 ms^{-1}

Speed of sound in benzene: 200 ms^{-1}

Sol. (i) (a) C^{14} **[1]**

It is used in carbon dating. **[1]**

(b) Class II levers **[1]**

(ii) (a) Centripetal **[1]**

(b) Zero **[1]**

(iii) Clockwise moment about the point O = Anticlockwise moment about the point O

$120 \times 0.2 = F \times 0.8$ **[1]**

$F = 30$ N **[1]**

(iv) (a) The advantage of using a block and tackle system over single movable pulley is that the effort gets multiplied n times, where n is the total number of pulleys in the system. Hence reduces the effort. **[1]**

(b) For greater efficiency, the pulleys in the lower block should be as light as possible, hence she should connect more number of pulleys in the upper fixed block. **[1]**

(v) Power = $\frac{\text{Work done}}{\text{Time taken}}$

$$\frac{P_1}{P_2} = \frac{w_1 \times t_2}{t_1 \times w_2}$$ **[1]**

$$\frac{P_1}{P_2} = \frac{600 \times 20}{10 \times 300}$$

$$\frac{P_1}{P_2} = \frac{4}{1}$$

$P_1 : P_2 = 4 : 1$ **[1]**

(vi) (a) Decreases,

Because effective resistance of the circuit decreases after removing a bulb in series. **[1]**

(b) Increases

Because effective resistance decreases and current flowing through the circuit increases. Hence, power consumption by the bulbs increases, so the intensity of light increases. **[1]**

(vii) To hear a distinct echo, minimum time taken by the sound to reach the obstacle and then come back to the observer should be 0.1 s. Take, speed of sound = v. **[1]**

Minimum distance = $\frac{vt}{2}$

$$x = \frac{340 \times 0.1}{2}$$

$= 17$ m

$$y = \frac{200 \times 0.1}{2}$$

$= 10$ m **[1]**

Thus, x is greater than y.

3. (i) (a) In a reading glass what is the position of the object with respect to the convex lens used? **[2]**

(b) Why can we **not** use concave lens for the same purpose?

(ii) A fuse is rated 5 A. Can it be used with a geyser rated 1540 W, 220 V. Write **Yes** or **No**. Give supporting calculations to justify your answer. **[2]**

(iii) State two factors affecting the speed of rotation of the coil in a D.C. motor. **[2]**

(iv) How much heat is required to convert 500 g of ice at 0°C to water at 0°C? The latent heat of fusion of ice is 330 Jg^{-1}. **[2]**

(v) Copy and complete the nuclear reaction by filling in the blanks. **[2]**

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{---} + \_\_\_Kr^{92} + 3\ {}_{0}n^{1}$$

Sol. (i) (a) In a reading glass, the object is placed between the first principal focus and the optical centre of the convex lens used. **[1]**

(b) Concave lens always forms virtual, upright and diminished image of the object. **[1]**

(ii) No

P = 1540 W

V = 220 V

$$I_g = \frac{P}{V}$$

$$= \frac{1540}{220}$$

= 7 A **[1]**

Since, I_g > 5 A, fuse rated 5 A can not be used with the geyser. **[1]**

(iii) (1) By increasing the strength of current in the coil the speed of rotation of the coil in a D.C. motor increases. **[1]**

(2) By increasing the number of turns in the coil the speed of rotation of the coil in a D.C. motor increases. **[1]**

(iv) Heat required to melt ice at 0°C

$Q = m_i L_i$

= 500 × 330 **[1]**

= 165000 J

Or $Q = 1.65 \times 10^5$ J **[1]**

(v) $_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3\ {}_{0}n^{1}$ **[2]**

SECTION-B (40 Marks)

*(Attempt **any four** questions from this **Section**.)*

4. (i) The image of a **candle flame** placed at a distance of 36 cm from a spherical lens, is formed on a screen placed at a distance of 72 cm from the lens. Calculate the focal length of the lens and its power. **[3]**

(ii) Below is an incomplete table showing the arrangement of **electromagnetic spectrum** in the increasing order of their wavelength. Complete the table. **[3]**

Gamma ray	X–ray	U V rays	Visible rays	Infrared	**A**	Radio waves

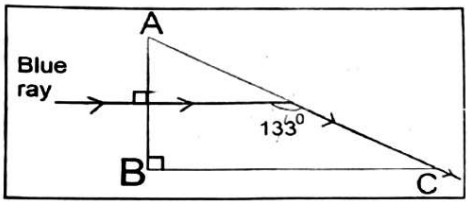
(a) Identify the radiation **A**.

(b) Name the radiation used to detect fracture in bones.

(c) Name *one* property common to both **A** and Radio waves.

(iii) (a) Why do we use red colour as a danger signal on the top of a skyscraper? **[4]**

(b) The diagram below shows the path of a blue ray through the prism:



1. Calculate the critical angle of the material of the prism for blue colour.
2. What is the measure of the angle of this prism (A)?
3. Which colour should replace the blue ray, for the ray to undergo Total Internal Reflection?

Sol. (i) Here, $u = -36$ cm

$v = +72$ cm

$f = ?$

$P = ?$

From lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{72} - \frac{1}{(-36)}$$

$$= \frac{1+2}{72}$$

$\Rightarrow$ $f = 24$ cm **[1.5]**

Thus, the focal length of the lens is 24 cm.

As $P = \frac{100}{f(\text{in cm})}$

$$P = \frac{100}{24} = 4.17 \text{ D}$$ **[1.5]**

Thus, the power of the lens is 4.17 D

(ii) (a) Microwaves **[1]**

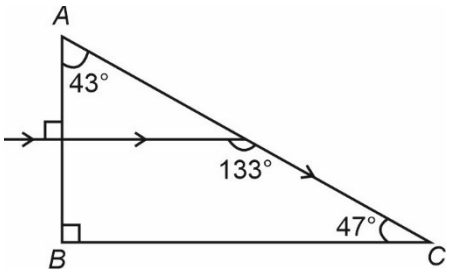
(b) X-rays **[1]**

(c) Microwaves and Radio waves both are used in radar communication. **[1]**

(iii) (a) We use red colour as a danger signal on top of a skyscraper because it has the highest wavelength, therefore, least scattered by the air molecules of the atmosphere. Thus, it can seen from far distances. **[1]**

(b) (1) Critical angle (C) = 133° – 90° = 43° **[1]**

(2) **[1]**



Here, angle of prism (A) = 43°

(3) Violet or Indigo colour should replace the blue ray, for the ray to undergo Total Internal Reflection. **[1]**

5. (i) (a) Refractive index of glass with respect to water is $\frac{9}{8}$. **[3]**

Find the refractive index of water with respect to glass.

(b) Name the principle used to find the value in part (a).

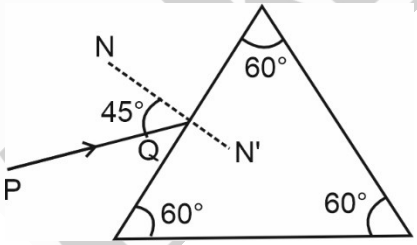
(c) If we change the temperature of water, then will the ratio $\frac{9}{8}$ remain the same? Write **Yes** or **No**.

(ii) Light travels a distance of ***'10x'*** units in time ***'t_1'*** in vacuum and it travels a distance of ***'x'*** units in time ***'t_2'*** in a denser medium. Using this information answer the question that follows :

(a) *'Light covers a distance of **'20x'** units in time **'t_1'** in diamond.'* State true or false. **[3]**

(b) Calculate the refractive index of the medium in terms of ***'t_1'*** and ***'t_2'***.

(iii) A monochromatic ray of light is incident on an equilateral prism placed at **minimum deviation position** with an angle of incidence 45° as shown in the diagram.



(a) Copy the diagram and complete the path of the ray PQ. **[4]**

(b) State *two* factors on which the angle of deviation depends.

Sol. (i) (a) Given

$$_{Water}\mu_{glass} = \frac{9}{8}$$

$$\therefore \quad _{Glass}\mu_{Water} = \frac{1}{_{Water}\mu_{glass}} = \frac{1}{\left(\frac{9}{8}\right)} = \frac{8}{9}$$ **[1]**

(b) Principle of reversibility **[1]**

(c) No **[1]**

(ii) (a) False **[1]**

Speed of light is maximum in vacuum.

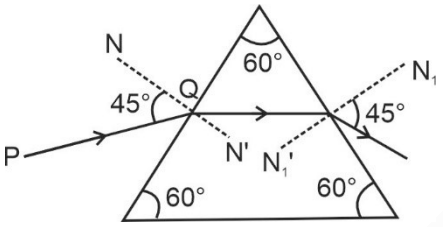
(b) Refractive index of medium = $\frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$

$$= \frac{\left(\frac{10x}{t_1}\right)}{\left(\frac{x}{t_2}\right)}$$ **[1]**

$$= \frac{10x}{t_1} \times \frac{t_2}{x}$$

$$= \frac{10t_2}{t_1}$$ **[1]**

(iii) (a)



[2]

(b) Angle of deviation depends upon :

(1) The angle of incidence

(2) Refractive index of the prism

(3) Wavelength of incident light

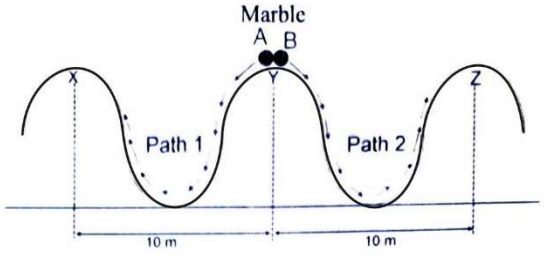
(4) Angle of prism (Any two) **[2]**

6. (i) (a) Define Centre of Gravity. **[3]**

(b) A hollow ice cream **cone** has height 6 cm.

1. Where is the position of its centre of gravity from the **broad base**?
2. Will its position change when it is filled completely with honey? Write **Yes** or **No**.

(ii)



[3]

Two identical marbles A and B are rolled down along Path 1 and Path 2 respectively.

Path 1 is **frictionless** and Path 2 is **rough**.

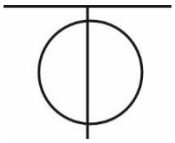
(a) Which marble will **surely** reach the next peak?

(b) Along which path/s the **mechanical energy** will be conserved?

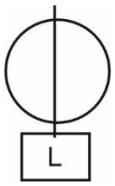
(c) Along which path/s is the law of **conservation of energy** obeyed?

(iii) Given are two pulleys. **[4]**

(a) Copy and complete the labelled diagram connecting the two pulleys with a tackle to obtain Velocity Ratio = 2.



(b) If Load = 48 kgf and efficiency is 80% then calculate:



1. Mechanical Advantage.
2. Effort needed to lift the load.

Sol. (i) (a) It is a point at which the whole weight of the particle acts. **[1]**

(b) 1. Centre of gravity of hollow cone = $\frac{1}{3}$rd of its height from its base

$= \frac{1}{3} \times 6 = 2$ cm **[1]**

2. Yes, because centre of gravity of a solid cone is at $\frac{1}{4}$th of its height from its base. **[1]**

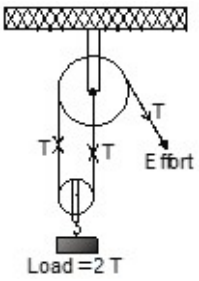
(ii) (a) Marble-A

Because, along path-1 no energy losses takes place. **[1]**

(b) Along path-1 no energy losses takes place, hence mechanical energy of the marble-A will be conserved. **[1]**

(c) Both paths obey the law of conservation of energy, because energy can neither be created nor be destroyed but can only be converted from one form to another. **[1]**

(iii) (a) **[2]**



(b) (1) *V.R.* = 2

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

$0.8 = \frac{M.A.}{2}$ **[½]**

M.A. = 1.6 **[½]**

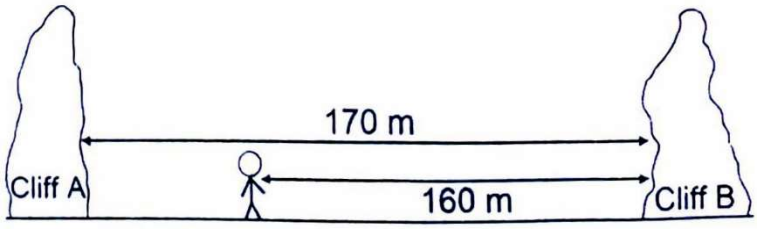
(2) $M.A. = \frac{L}{E}$

$$E = \frac{L}{M.A.} = \frac{48 \text{ kgf}}{1.6}$$ **[½]**

Effort = 30 kgf **[½]**

7. (i) (a) Name the waves used in SONAR. **[3]**

(b)



In the above diagram Lata stands between two cliffs and claps her hands.

Determine the time taken by her to hear the f**irst** echo.

Speed of sound in air 320 ms^{-1}.

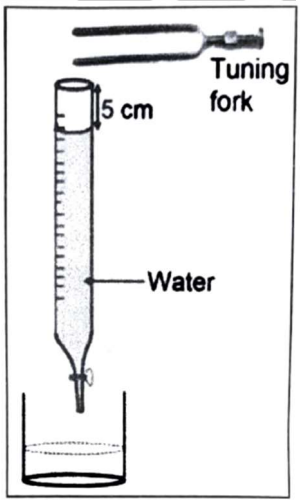
(ii) (a) Complete the following radioactive reaction: **[3]**

$$^{-}_{-}X \rightarrow Y + {}^{4}_{2}He \rightarrow {}^{234}_{91}Z + {}^{0}_{-1}e$$

(b) Uranium is available in two forms U-235 and U-238. Which of the two isotopes of Uranium is **more** fissionable?

(iii) In the given diagram, a vibrating tuning fork is kept near the mouth of a burette filled with water. The length of the air column is adjusted by opening the tap of the burette. **[4]**

At a length of 5 cm of the air column, a **loud sound** is heard.



(a) Name the phenomenon illustrated by the above experiment.

(b) Why is a loud sound heard at this particular length?

(c) If the present tuning fork is replaced with a tuning fork of higher frequency, should the length of the air column increase or decrease to produce a **loud sound**? Give a reason.

Sol. (i) (a) Ultrasound used in SONAR. **[1]**

(b) To hear a distinct echo, x should be greater than $\frac{320 \times 0.1}{2} = 16$ m **[1]**

So, first echo is heard from cliff B.

$$t = \frac{2d}{v} = \frac{2 \times 160}{320} = 1 \text{ s}$$ **[1]**

(ii) (a) $^{234}_{90}X \rightarrow {}^{230}_{88}Y + {}^{4}_{2}He \rightarrow {}^{234}_{91}Z + {}^{0}_{-1}e$ **[1]**

(b) U-235 is more easily fissionable than the isotope U-238. This is because the fission of U-238 nucleus is possible only by fast neutrons, while U-235 nucleus undergoes fission easily by the action of slow moving neutrons. **[2]**

(iii) (a) Resonance **[1]**

(b) It happens when the natural frequency of the air column becomes exactly equal to the frequency of the vibrating tuning fork. The air in the column now vibrates with a large amplitude and conveys more energy to the ears, so a loud sound is heard. **[2]**

(c) For an air column, $f \propto \frac{1}{l}$

So, if the present tuning fork is replaced with a tuning fork of higher frequency, the length of air column decreases to produce a loud sound. **[1]**

8. (i) The voltage - current readings of a certain material are shown in the table given below: **[3]**

Voltage (V)	10 V	20 V	30 V
Current (I)	2 A	3 A	4 A

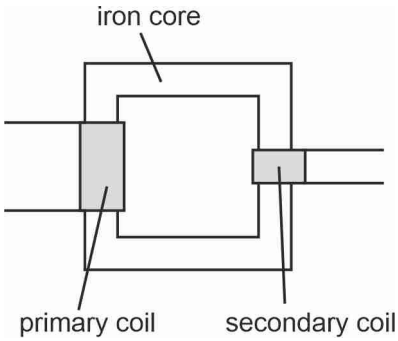
Study the table.

(a) State whether the conductor used is ohmic or non-ohmic.

(b) Justify your answer.

(c) State Ohm's law.

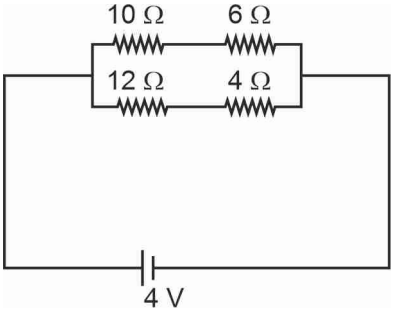
(ii) Below is the diagram of a transformer: **[3]**



(a) Identify the type of transformer.

(b) In this type of transformer which of the wire is **thicker**, the primary or the secondary? Give a reason.

(iii) Study the diagram: **[4]**



(a) Calculate the total resistance of the circuit.

(b) Calculate the current drawn from the cell.

(c) State whether the current through 10 Ω resistor is greater than, less than or equal to the current through the 12 Ω resistor.

Sol. (i) (a) $R = \frac{V}{I}$

For the given material the ratio of voltage and current is not constant.

Hence the conductor used is non-ohmic. **[1]**

(b) $R_1 = \frac{V_1}{I_1} = \frac{10}{2} = 5\ \Omega$

$R_2 = \frac{20}{3} = 6.7\ \Omega$

$R_3 = \frac{30}{4} = 7.5\ \Omega$ **[1]**

The given values of resistance justify that the conductor is non-ohmic.

(c) If the physical conditions remain unchanged (such as temperature), the potential difference across the two ends of a conductor is directly proportional to the electric current flowing through it.

$V \propto I$

$\boxed{V = RI}$

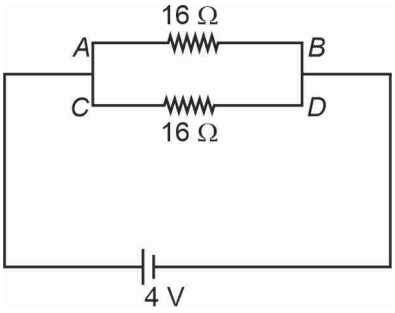
where, R is the constant of proportionality and is called the **resistance** of the conductor.

It is the property of a conductor to resist the flow of charges through it. **[1]**

(ii) (a) Step down transformer **[1]**

(b) In the step-down transformer, the wire in the secondary coil is thicker than that in the primary coil because the current in secondary coil is more than that in the primary coil and the use of thicker wire in a coil reduces its resistance and therefore reduces the loss of energy as heat in that coil. **[2]**

(iii) (a) The given network can be simplified as



$R_{AB} = 10 + 6 = 16\ \Omega$

$R_{CD} = 12 + 4 = 16\ \Omega$

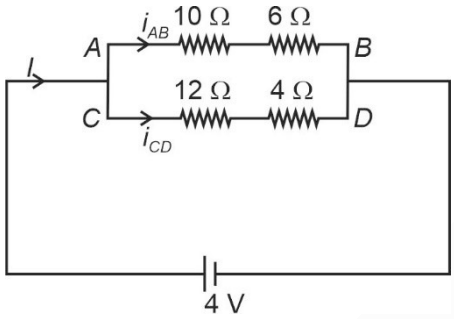
$$\frac{1}{R_{eq}} = \frac{1}{R_{AB}} + \frac{1}{R_{CD}} = \frac{1}{16} + \frac{1}{16}$$

$\Rightarrow \quad R_{eq} = 8\ \Omega$ **[1]**

(b) $I = \dfrac{V}{R_{eq}}$

$= \dfrac{4}{8} = 0.5\ \text{A}$ **[1]**

(c)



Here,

$R_{AB} = R_{CD} = 16\ \Omega$

$\Rightarrow \quad i_{AB} = \dfrac{4}{16}\ \text{A}$, and $i_{CD} = \dfrac{4}{16}\ \text{A}$ **[1]**

$\therefore \quad i_{AB} = i_{CD}$

Hence, the current through 10 Ω resistor is equal to the current through the 12 Ω resistor. **[1]**

9. (i) 85 g of water at 30°C is cooled to 5°C by adding certain mass of ice. Find the mass of ice required.
[Specific heat capacity of water = 4.2 $Jg^{-1}°C^{-1}$, Specific latent heat of fusion = 336 Jg^{-1}] **[3]**

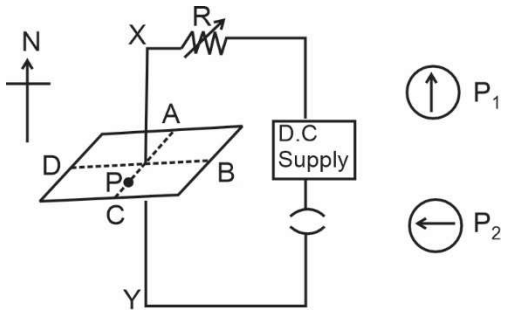
(ii) (a) Why does it become pleasantly warm when the lakes start freezing? **[3]**

(b) Water freezes to form ice. What change would you expect in the average kinetic energy of the molecules?

(c) Which will contain more heat energy 1 g of ice at 0°C or 1 g water at 0°C?

(iii) (a) State one factor that affects the magnitude of induced current in an AC generator. **[4]**

(b) Given below is a circuit to study the magnetic effect of electric current. ABCD is a cardboard kept perpendicular to the conductor XY. A magnetic compass is placed at the point P of the cardboard. P_1 and P_2 are the positions of the magnetic compass, before and after passing a current through XY respectively.



1. Name the **rule** that is used to predict the direction of deflection of the magnetic compass.
2. State the direction of current in the conductor (X to Y or Y to X) when the circuit is complete.
3. If resistance R is increased, then what will be the effect on the magnetic lines of force around the conductor?

Sol. (i) Heat energy given by water = Heat energy taken by ice to melt and raise its temperature

$m_w c_w \Delta T = m_{ice} L_{ice} + m_{ice} \times c_w \Delta T'$ **[1]**

$85 \times 4.2 \times [30 - 5] = m_{ice}[336 + 4.2 \times (5 - 0)]$ **[1]**

$m_{ice} = 25$ g **[1]**

(ii) (a) Large amount of heat is released by the freezing water of lakes which keeps the temperature near about 0°C. **[1]**

(b) When water freezes, the temperature of the water molecules reduce and hence the average kinetic energy of water molecules also reduces. **[1]**

(c) 1 g of water at 0°C contains more heat energy than 1 g of ice at 0°C because 1 g of water at 0°C liberates 80 cal heat to form 1 g of ice at 0°C. **[1]**

(iii) (a) The number of turns in coil, the area of cross section of coil and the speed of rotation of coil. (Any one) **[1]**

(b) 1. Right hand thumb rule is used to predict the direction of deflection of the magnetic compass **[1]**

2. The direction of current in the conductor is from X to Y when the circuit is complete. **[1]**

3. If the resistance R is increased, then the current through the wire will decrease which will further decrease the strength of the magnetic field. So, the magnetic field lines are comparatively farther in region of weaker field. **[1]**

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