ICSE 2024 EXAMINATION

PHYSICS

SAMPLE PAPER - 2

Time Allowed : 2 hours ***Max. Marks : 80***

Answers to this Paper must be written on the paper provided separately.
You will not be allowed to write during 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 A** is compulsory. Attempt **any four** questions from **Section B**.*
The intended marks for questions or parts of questions are given in brackets [ ].

SECTION - A (40 Marks)

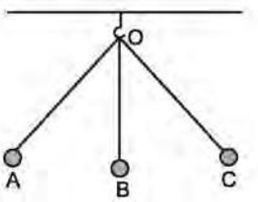
(Attempt *all* questions from this Section)

Question 1 : Choose the correct answers to the questions from the given options: [15]

(i) During uniform circular motion:
(a) Speed of a body continuously changes, because the direction of motion continuously changes
(b) Velocity of a body continuously changes, because the direction of motion continuously changes.
(c) the motion of body is accelerated (d) both (b) and (c)

(ii) One electron-volt is equal to:
(a) 1.6×10^{-17}J (b) 6.1×10^{-19}J (c) 1.6×10^{-19}J (d) 1.6×10^{-10}J

(iii) A simple pendulum is swinging freely about 'O'. It has:
(a) Maximum kinetic energy at points A and C.
(b) Minimum potential energy at points A and C.
(c) Maximum kinetic energy at point B.
(d) Maximum potential energy at point B.

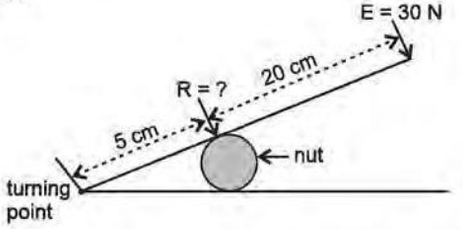


(iv) Physical quantity 'power', mathematically is the product of:
(a) Force and uniform velocity (b) Force and displacement
(c) Force and time (d) Force and acceleration

(v) A displacement of 64 m is caused by an energy of 4kJ. The force acting on the body is:
(a) 26.5 N (b) 52.6 N (c) 25.6 N (d) 62.5 N

(vi) Correct relationship between velocity ratio (V.R.), Mechanical advantage (MA) and the efficiency (η) of a machine is:
(a) η = M.A. × V.R. (b) η = M.A. ÷ V.R.
(c) η × V.R. = M.A. (d) both (b) and (c)

(vii) In diagram shown alongside the resistance(R) offered by a nut is:
(a) 120N
(b) 150N
(c) 180N
(d) 90N



(viii) A set of three pulleys is used to lift a load by applying effort upward on the free end of string. The velocity ratio of this setup is:
(a) 3 (b) 4 (c) 2 (d) none of these

(ix) Specific heat capacity of copper in S.I. system is:
(a) 0.4 $Jg^{-1}{}^{o}C^{-1}$ (b) 0.4$Jg^{-1}K$ (c) 400 $Jkg^{-1}{}^{o}C^{-1}$ (d) 400$Jkg^{-1}K^{-1}$

(x) The sea breeze blows during:

(a) daytime (b) during night time (c) depends upon weather (d) none of these

(xi) The heat capacity of a substance is 5000 $\frac{J}{K}$. If the sp. heat capacity of the substance is $\frac{2J}{gK}$, the mass of substance is:

(a) 2000 g (b) 2500 g (c) 2250 g (d) 2150 g

(xii) The phenomenon due to which a ray of light while travelling from denser to rarer medium is reflected back in denser medium at the interface of two media is called:

(a) Reflection (b) Refraction (c) Dispersion (d) Total internal reflection

(xiii) A lens which can form a virtual, erect and enlarged image is:

(a) double convex lens (b) plano-convex lens (c) concavo-convex lens (d) any of the (a), (b) or (c)

(xiv) A postage stamp placed under a glass slab appears raised due to the phenomenon of:

(a) reflection (b) Refraction (c) Total internal reflection (d) Dispersion

(xv) Sodium $_{11}Na^{24}$ decays into $_{12}Mg^{24}$. The reaction responsible for this is:

(a) Chemical reaction (b) biochemical reaction (c) nuclear reaction (d) any of these

ANSWERS

(i) (d) **(ii)** (c) **(iii)** (c) **(iv)** (a) **(v)** (d) **(vi)** (d) **(vii)** (b) **(viii)** (b) **(ix)** (c) **(x)** (a)
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Question 2

(i) Complete the statements given below: [3]

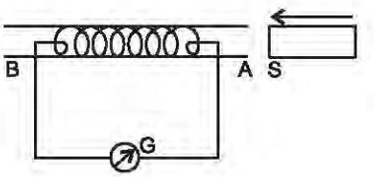
(a) Splitting of nucleus into two nearly light nuclei is called _____.

(b) Union of two lighter nuclei into a bigger nuclei is called _____.

(c) The spontaneous splitting of large number of radioactive nuclei with the release of enormous energy is called _____.

(ii) A satellite revolves around a planet in a circular orbit. What is the work done by the satellite **at any instant**? Give a reason. [2]

(iii) The diagram alongside shows a coil AB connected to the very sensitive galvanometer. A magnet is moved in and out in the coil such that induced current is generated. State the two conditions which will produce maximum e.mf in the coil AB. [2]

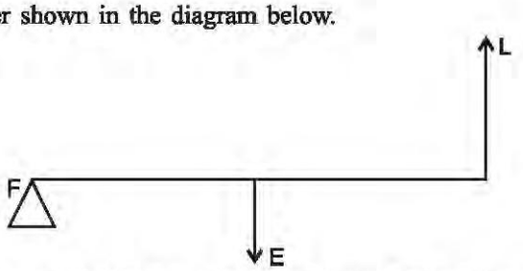


(iv) State the law which determines the direction of induced current in: [2]

(a) a straight conductor

(b) a closed coil

(v) (a) Identify the class of the lever shown in the diagram below. [2]



(b) How is it possible to increase the M.A. of the above lever without increasing its length?

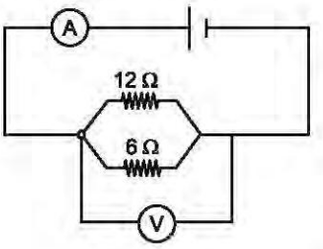
(vi) Draw a diagram connecting a switch, an electric lamp and fuse in the household circuit showing clearly the electric phase in wires. [2]

(vii) State Ohm's law. Explain why it is necessary to verify it at a low current value. [2]

Question 3

(i) 4 tubelights of 40 W each are connected to 200 V mains and operate 16h a day. Calculate (a) current drawn by tube lights and (b) (electric) energy consumed by the tube lights in kWh. [2]

(ii) The circuit diagram alongside, shows a battery of e.m.f. 24 V and internal resistance of 2 Ω. Calculate (a) reading of ammeter (b) reading of voltmeter. [2]



(iii) State any two characteristics of a series circuit. [2]

(iv) (a) What do you understand by the term pitch of sound? [2]

(b) How is the loudness of sound related to the frequency of sound?

(v) Why does sky appear blue on the Earth, but black on the moon? [2]

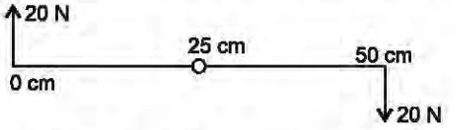
SECTION - B (40 Marks)

(Attempt *any four* questions from this Section)

Question 4

(i) (a) Is it possible to have accelerated motion at a constant speed? Explain. [4]

(b) Two forces each of 20 N act vertically upward and downward respectively on two ends of a half metre scale which placed on a wedge at its mid point as shown in diagram. What is the resultant moment of force about mid point in SI system and state its direction?



(ii) (a) With reference to the direction of action how does a centripetal force differ from a centrifugal force during uniform circular motion? [3]

(b) Is centrifugal force the force of reaction of centripetal force?

(c) Compare the magnitudes of centripetal and centrifugal force.

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

Question 5

(i) (a) It is observed that temperature of surroundings generally rise when it starts snowing. Give a reason for this observation. [3]

(b) How is heat capacity of a body is related to its sp. heat capacity?

(ii) (a) A certain amount of heat H will warm 1 g of a material X by 3°C and 1 g of material Y by 4°C. What material has a higher sp. heat capacity. [3]

(b) Why does a bottle of soft drink cools faster when surrounded by ice cubes than ice cold water, both at 0°C?

(iii) A calorimeter of mass 40 g and specific heat capacity of 0.40 $Jg^{-1}°C^{-1}$, contains some mass of water at 30°C. A metal piece of mass 25 g at 100°C is dropped in calorimeter. After stirring final temperature of mixture is found to be 35°C. Find the mass of water in calorimeter. [Take S.H.C of water 4.2 $Jg^{-1}°C^{-1}$ and S.H.C of metal piece 0.5 $Jg^{-1}°C^{-1}$.] [4]

Question 6

(i) (a) Light passes through a triangular glass prism and rectangular glass slab. In what way the direction of emergent ray differ. [4]

(b) Reeta claims to have obtained an image 3 times the size of object with a concave lens. Is she correct? Give a reason for your answer.

(ii) A lens forms a virtual, erect and magnified image of an object. [3]

(a) Name the lens.

(b) Draw a labelled diagram to show the formation of image.

(iii) (a) Define power of lens. [3]

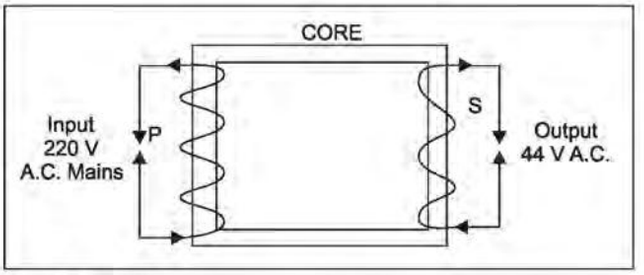
(b) A lens mentioned in (ii) above has a focal length of 20 cm. Calculate its power.

Question 7

(i) (a) Name a prism required for obtaining spectrum of ultraviolet light. [2]

(b) Name a radiation which can be detected by a thermopile.

(ii) The diagram below shows the core of a transformer and its input and output connections. [3]



(a) State the material used for the core.
(b) Copy and complete the diagram of the transformer by drawing input and output coils.

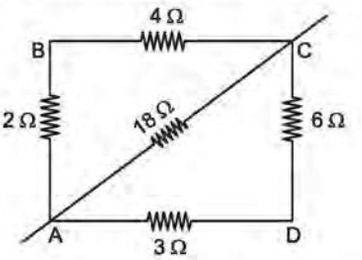
(iii) (a) Why is red colour used as a sign of danger? [2]
(b) Name the type of an electromagnetic wave having wavelength 10,000 Å.

(iv) (a) Draw a graph between displacement and time for a body executing free vibrations. [3]
(b) Where can a body execute free vibrations in true sense?
(c) State the safe limit of sound level in terms of decibel for human hearing.

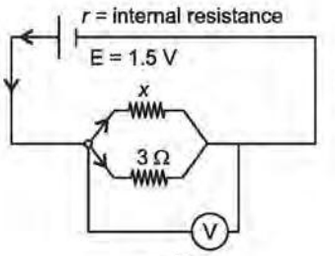
Question 8

(i) You have three resistors of 2 Ω, 3 Ω, and 5 Ω. How will you join them that total resistance is between 2 Ω and 3 Ω? [3]
(a) Draw a diagram of arrangement.
(b) Calculate the equivalent resistance.

(ii) Study the diagram alongside carefully and calculate the equivalent resistance between A and C. [3]

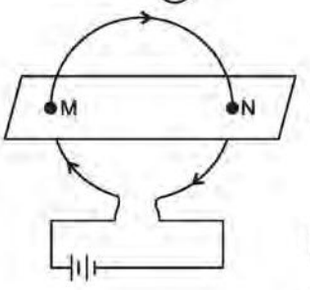


(iii) A current of 1A flows through the main circuit when p.d. recorded at the ends of parallel circuit is 1 volt in the diagram alongside. Calculate the (a) value of X (b) value of *r*. [4]



Question 9

(i) The diagram alongside shows a current carrying loop or a circular coil passing through a sheet of cardboard at points M and N. The sheet of cardboard is sprinkled uniformly with fine iron fillings. [3]
(a) Copy the diagram and draw an arrow on the circular coil to show the direction of current flowing through it.
(b) Draw the pattern of arrangement of iron filings when current passed through coil.



(ii) (a) Draw a neat labelled diagram of a d.c. motor. [3]
(b) Write any one use of a d.c. motor.

(iii) (a) Differentiate between nuclear fusion and nuclear fission. [4]
(b) State one safety precaution in the disposal of nuclear waste.
(c) Why there is no change in the rate of radioactivity when radioactive element undergoes a chemical change?

❖ ❖ ❖

SOLUTION

Time Allowed : 2 hours *Max. Marks* : **80**

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SECTION - A (40 Marks)

(Attempt *all* questions from this Section)

Question 1 : Choose the correct answers to the questions from the given options: [15]

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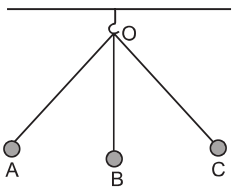

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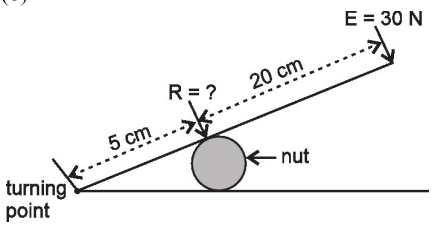

(viii) A set of three pulleys is used to lift a load by applying effort upward on the free end of string. The velocity ratio of this setup is:
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(ix) Specific heat capacity of copper in S.I. system is:
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(x) The sea breeze blows during:

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(xv) Sodium $_{11}Na^{24}$ decays into $_{12}Mg^{24}$. The reaction responsible for this is:

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ANSWERS

(i) (d) **(ii)** (c) **(iii)** (c) **(iv)** (a) **(v)** (d) **(vi)** (d) **(vii)** (b) **(viii)** (b) **(ix)** (c) **(x)** (a)
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Question 2

(i) Complete the statements given below: [3]

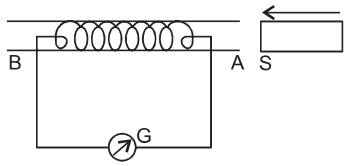
(a) Splitting of nucleus into two nearly light nuclei is called _____.

(b) Union of two lighter nuclei into a bigger nuclei is called _____.

(c) The spontaneous splitting of large number of radioactive nuclei with the release of enormous energy is called _____.

(ii) A satellite revolves around a planet in a circular orbit. What is the work done by the satellite **at any instant**? Give a reason. [2]

(iii) The diagram alongside shows a coil AB connected to the very sensitive galvanometer. A magnet is moved in and out in the coil such that induced current is generated. State the two conditions which will produce maximum e.mf in the coil AB. [2]

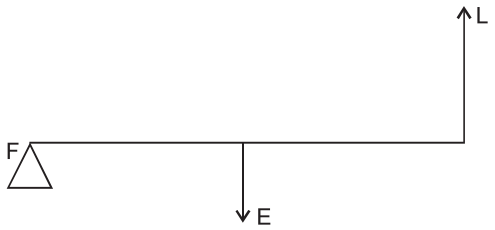


(iv) State the law which determines the direction of induced current in: [2]

(a) a straight conductor

(b) a closed coil

(v) (a) Identify the class of the lever shown in the diagram below. [2]



(b) How is it possible to increase the M.A. of the above lever without increasing its length?

(vi) Draw a diagram connecting a switch, an electric lamp and fuse in the household circuit showing clearly the electric phase in wires. [2]

(vii) State Ohm's law. Explain why it is necessary to verify it at a low current value. [2]

Solution :

(i) (a) nuclear fission, (b) nuclear fusion, (c) nuclear chain reaction.

(ii) No work is done by the satellite. It is because the gravitational force of the planet acting on the satellite is always at right angles to the direction of motion. Furthermore, on one complete revolution of the satellite its displacement is zero.

(iii) (a) The permanent magnet should be moved in and out as rapidly as possible.

(b) The permanent magnet should have as strong magnetic field as possible.

(iv) (a) For straight conductor the direction of current is found by Fleming's right hand rule :

Definition : Stretch the thumb, the fore-finger and middle finger of our right hand mutually at right angles to each other, such that fore-finger points in the direction of magnetic field, and thumb in the direction of motion of a conductor. Then the direction in which middle finger points gives the direction of the flow of induced current.

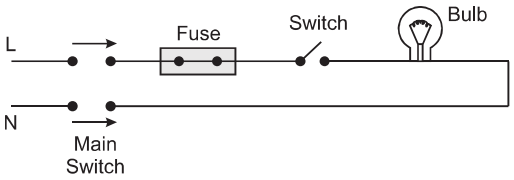
(b) For closed coil the direction of current is found by Lenz's Law.

Definition : It states in all cases of electromagnetic induction the direction of induced current is such that it always opposes the cause (the motion of conductor) which produces it.

(v) (a) Lever of third class.

(b) By moving point of effort towards the load such that length of effort arm is increased.

(vi) Diagram shown alongside :



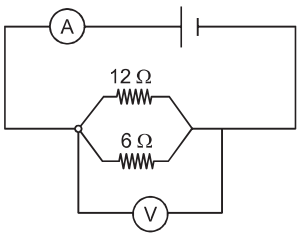
(vii) (a) **Ohm's law :** It states that temperature of a conductor remaining constant the potential difference at the ends of conductor is directly proportional to the current flowing through it.

(b) If Ohm's law is varified at high value of current, the conductor gets heated up. This in turn changes the resistance of conductor and hence Ohm's law cannot be verified.

Question 3

(i) 4 tubelights of 40 W each are connected to 200 V mains and operate 16 h a day. Calculate (a) current drawn by tube lights and (b) (electric) energy consumed by the tube lights in kWh. [2]

(ii) The circuit diagram alongside, shows a battery of e.m.f. 24 V and internal resistance of 2 Ω. Calculate (a) reading of ammeter (b) reading of voltmeter. [2]



(iii) State any two characteristics of a series circuit. [2]

(iv) (a) What do you understand by the term pitch of sound? [2]

(b) How is the loudness of sound related to the frequency of sound?

(v) Why does sky appear blue on the Earth, but black on the moon? [2]

Solution :

(i) Total power of 4 tube lights (P) = 4 × 40 W = 160 W

Time of operation per day = 16 *h*

Potential difference (V) = 200 V

(a) Current drawn (I) = $\frac{P}{V} = \frac{160\ W}{200\ V} = \frac{4}{5} A$ = **0.8 A**

(b) Energy consumed by tube lights = P × *t*

= 160 W × 16 *h* = 2560 W*h* = **2·560 kWh**.

(ii) Resistance of 12 Ω and 6 Ω in parallel

$$\frac{1}{R_p} = \frac{1}{12} + \frac{1}{6} = \frac{1+2}{12} = \frac{3}{12} = \frac{1}{4}$$

$\therefore R_p = 4\ \Omega$

(a) Reading of ammeter, $I = \frac{E}{R+r} = \frac{24}{4+2} = \frac{24}{6}$ = **4 A**.

(b) Reading of voltmeter, V = I.R = 4 A × 4 Ω = **16 V**

(iii) Characteristics of series circuit.

1. Magnitude of current in all resistors in a series circuit is a constant quantity.
2. There is a continuous drop in potential all along in series circuit. If V_1, V_2, V_3 are potential difference across resistors R_1, R_2 and R_3, such that 'V' is the total drop in potential then, $V = V_1 + V_2 + V_3$.

(iv) (a) The characteristic which enables us to differentiate two sounds of equal loudness, coming from different sources having different frequencies is called pitch of sound.

(b) Loudness does not depend upon the frequency, but depends on the response of ear.

(v) On the earth, atmosphere contains very fine particles which scatter white light. As blue colour gets scattered most nearest to the eye, therefore, the scattered blue light on entering eye gives us the sensation that sky is blue.

However, on the surface of moon there is no atmosphere and no suspended particles. Thus, white light reaches straight to moon without getting scattered. Now as no scattered light reaches the moon therefore sky appears black.

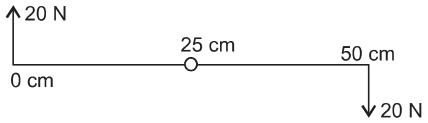
SECTION - B (40 Marks)

(Attempt *any four* questions from this Section)

Question 4

(i) (a) Is it possible to have accelerated motion at a constant speed? Explain. [4]

(b) Two forces each of 20 N act vertically upward and downward respectively on two ends of a half metre scale which placed on a wedge at its mid point as shown in diagram. What is the resultant moment of force about mid point in SI system and state its direction?



(ii) (a) With reference to the direction of action how does a centripetal force differ from a centrifugal force during uniform circular motion? [3]

(b) Is centrifugal force the force of reaction of centripetal force?

(c) Compare the magnitudes of centripetal and centrifugal force.

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

Solution :

(i) (a) Yes, it is possible. It is because when a body moves with a uniform speed, its velocity is variable because of the continuous change in direction. Due to this variable velocity the body has an accelerated motion.

(b) As two equal and unlike parallel forces act on the half metre scale, they constitute couple.

$\therefore$ Moment of couple = Force × perpendicular distance

$$= 20\text{ N} \times \frac{50}{100}\text{ m} = \mathbf{10\ Nm}$$

Direction of moment of couple is **clockwise**.

(ii) (a) Centripetal force is directed towards the centre of rotating body along the radius, whereas centrifugal force is directed away from the centre of rotating body along the radius.

(b) Yes, centrifugal force is the force of reaction of centripetal force.

(c) The magnitudes of centripetal force and centrifugal force are equal.

(iii) Consider a practical machine which overcomes a load 'l' through a distance 'd' when an effort 'E', acts through a distance D.

$\therefore$ Mechanical advantage of machine = $\frac{l}{\text{E}}$

Velocity ratio of machine = $\frac{\text{D}}{d}$

Also, work done on the machine (input) = E × D

Work done by the machine (output) = $l \times d$

Now, Efficiency of machine (η) = $\frac{\text{Output}}{\text{Input}} = \frac{l \times d}{\text{E} \times \text{D}} = \frac{l}{\text{E}} \div \frac{\text{D}}{d}$

$$\eta = \text{M. A.} \div \text{V. R.} \quad \text{or } \eta = \frac{\text{MA}}{\text{V.R}}.$$

Question 5

(i) (a) It is observed that temperature of surroundings generally rise when it starts snowing. Give a reason for this observation. [3]

(b) How is heat capacity of a body is related to its sp. heat capacity?

(ii) (a) A certain amount of heat H will warm 1 g of a material X by 3ºC and 1 g of material Y by 4ºC. What material has a higher sp. heat capacity. [3]

(b) Why does a bottle of soft drink cools faster when surrounded by ice cubes than ice cold water, both at 0ºC?

(iii) A calorimeter of mass 40 g and specific heat capacity of 0.40 $Jg^{-1}{}^{o}C^{-1}$, contains some mass of water at 30ºC. A metal piece of mass 25 g at 100ºC is dropped in calorimeter. After stirring final temperature of mixture is found to be 35ºC. Find the mass of water in calorimeter. [Take S.H.C of water 4.2 $Jg^{-1}{}^{o}C^{-1}$ and S.H.C of metal piece 0.5 $Jg^{-1}{}^{o}C^{-1}$.] [4]

Solution :

(i) (a) Ice has the highest specific latent heat, i.e. 336 Jg^{-1}. Thus, every one gram of water of 0°C on freezing will liberate 336 J of heat energy which will be dissipated in atmosphere. As millions of tons of snow falls, huge amount of heat is dissipated in air, which results in the rise in temperature.

(b) Specific heat capacity = $\dfrac{\text{Heat capacity}}{\text{Mass of body}}$.

(ii) (a) Material X has higher specific heat capacity as its temperature rises less as compared to material Y.

(b) Every gram of ice at 0°C will take 336 J of heat energy more than water at 0°C with the result ice is better coolant than water at 0°C.

(iii)

Substance	Mass	SHC	Initial temp.	Final temp. = 35°
Calorimeter	40 g	0·40 $Jg^{-1}\,°C^{-1}$	30 °C	$\theta_R = (35 - 30) = 5$ °C
Water	? (x)	4·2 $Jg^{-1}\,°C^{-1}$	30 °C	
Metal Piece	25 g	0·5 $Jg^{-1}\,°C^{-1}$	100 °C	$\theta_R = (100 - 35) = 65$ °C

Heat gained by calorimeter = $mc\theta_R$ = 40 g × 0·4 $Jg^{-1}\,°C^{-1}$ × 5°C = 80 J

Heat gained by water = $mc\theta_R$ = x × 4·2 $Jg^{-1}\,°C^{-1}$ × 5°C = 21x Jg^{-1}

Heat lost by metal piece = $mc\theta_f$ = 25 g × 0·5 $Jg^{-1}\,°C^{-1}$ × 65°C = 812·5 J

By the principle of calorimetry

Heat gained = Heat lost

$\Rightarrow 21x\ Jg^{-1} + 80J = 812.5$ J

$\Rightarrow 21x\ Jg^{-1} = (812{\cdot}5 - 80)$ J = 732·5 J

$\therefore x = \dfrac{732{\cdot}5}{21} g = 34.9$

Mass of water calorimeter (x) = **34·9 g**

Question 6

(i) (a) Light passes through a triangular glass prism and rectangular glass slab. In what way the direction of emergent ray differ. [4]

(b) Reeta claims to have obtained an image 3 times the size of object with a concave lens. Is she correct? Give a reason for your answer.

(ii) A lens forms a virtual, erect and magnified image of an object. [3]

(a) Name the lens.

(b) Draw a labelled diagram to show the formation of image.

(iii) (a) Define power of lens. [3]

(b) A lens mentioned in (ii) above has a focal length of 20 cm. Calculate its power.

Solution :

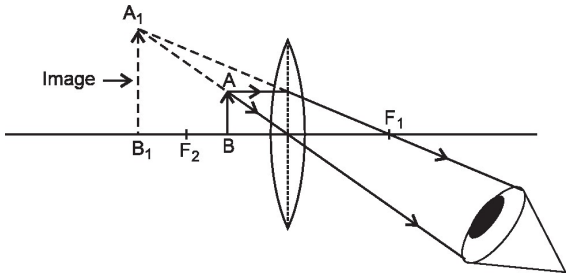
(i) (a) In case of prism the refracted ray and emergent ray bend towards the base of prism, such the angle of incidence is not equal to angle of emergence except when prism is in minimum deviation position.

In case of glass slab incident ray is parallel to the emergent ray and the angle incidence is equal to angle of emergence.

(b) No, she is wrong. It is because a concave lens always forms a virtual, erect and diminished image.

(ii) (a) Lens is a convex lens.

(b)



(iii) (a) Reciprocal of focal length in metres is called power of lens.

(b) $P = \frac{1}{f} = \frac{1}{\frac{20}{100}\text{m}} = \frac{100}{20\text{m}} = \frac{5}{\text{m}} =$ **+5 dioptre**

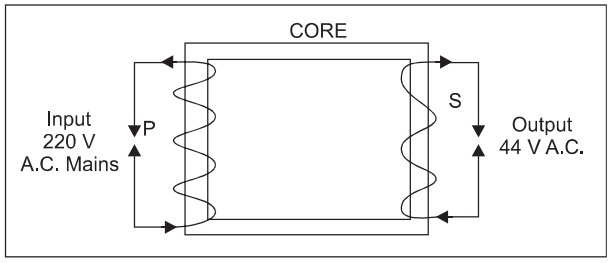
+ive sign means that lens is convex.

Question 7

(i) (a) Name a prism required for obtaining spectrum of ultraviolet light. [2]

(b) Name a radiation which can be detected by a thermopile.

(ii) The diagram below shows the core of a transformer and its input and output connections. [3]



(a) State the material used for the core.

(b) Copy and complete the diagram of the transformer by drawing input and output coils.

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

(b) Name the type of an electromagnetic wave having wavelength 10,000 Å.

(iv) (a) Draw a graph between displacement and time for a body executing free vibrations. [3]

(b) Where can a body execute free vibrations in true sense?

(c) State the safe limit of sound level in terms of decibel for human hearing.

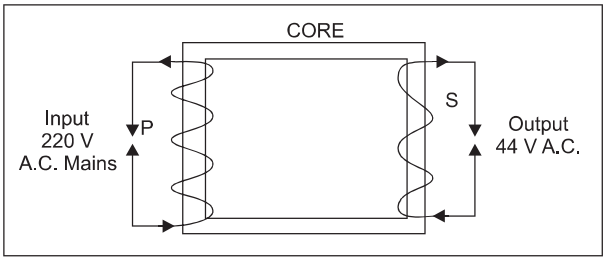
Solution :

(i) (a) A quartz prism (equilateral) is best as it does not absorb ultraviolet rays.

(b) Infrared radiation can be detected by thermopile.

(ii) (a) Soft ion

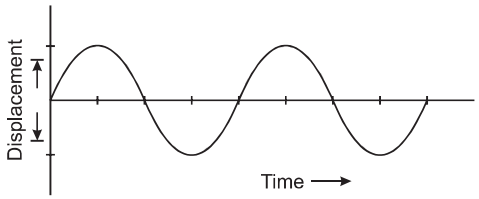
(b)



(iii) (a) Red colour has wavelength between 8000 Å and 6200 Å and gets least scattered in fog. Thus, it is visible even in foggy weather and hence is used as a signal for danger to prevent untoward incidents.

(b) Infrared radiation has wavelength of 10,000 Å.

(iv) (a)



(b) Ideally free vibrations are possible in vacuum only.

(c) Safe limit of sound for human ears is 50 dB–60 dB.

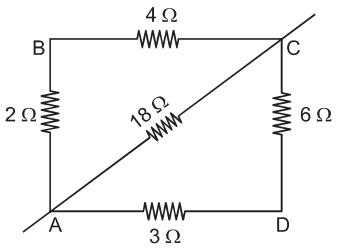
Question 8

(i) You have three resistors of 2 Ω, 3 Ω, and 5 Ω. How will you join them that total resistance is between 2 Ω and 3 Ω? [3]

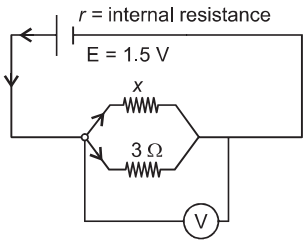
(a) Draw a diagram of arrangement.

(b) Calculate the equivalent resistance.

(ii) Study the diagram alongside carefully and calculate the equivalent resistance between A and C. [3]

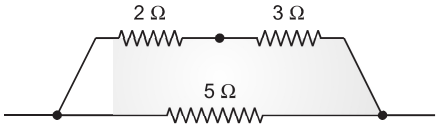


(iii) A current of 1A flows through the main circuit when p.d. recorded at the ends of parallel circuit is 1 volt in the diagram alongside. Calculate the (a) value of X (b) value of *r*. [4]



Solution :

(i) (a) Diagram shown alongside.



(b) Equivalent resistance of the circuit in parallel, $\frac{1}{R} = \frac{1}{5} + \frac{1}{5} = \frac{2}{5}$

$\therefore R = \frac{5}{2} = \mathbf{2.5}\ \Omega$

(ii) Resistance of AB and BC in series $(R_1) = (2 + 4)\Omega = 6\Omega$

Resistance of AD and DC in series $(R_2) = (3 + 6)\Omega = 9\Omega$

$\therefore$ Resistance of R_1, R_2 and 18Ω resistance are parallel.

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{18} = \frac{1}{6} + \frac{1}{9} + \frac{1}{18} = \frac{3+2+1}{18} = \frac{6}{18} = \frac{1}{3}$$

$\Rightarrow \quad \frac{1}{R} = \frac{1}{3} \qquad \therefore R = 3\Omega.$

$\therefore$ Equivalent resistance of circuit is 3Ω.

(iii) (a) Let resistance of parallel circuit = R_1

As current in main circuit is 1A and p.d. is 1V

$$\therefore R_1 = \frac{V}{I} = \frac{1V}{1A} = 1\Omega$$

Now, $\frac{1}{R_1} = \frac{1}{X} + \frac{1}{3}$, in parallel circuit

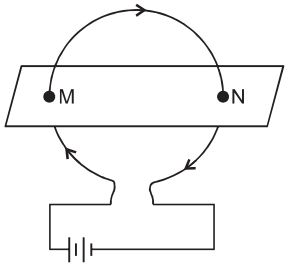
$$\Rightarrow \frac{1}{1} = \frac{1}{X} + \frac{1}{3} \qquad \Rightarrow \frac{1}{X} = 1 - \frac{1}{3} = \frac{2}{3}$$

$$\therefore X = \frac{3}{2} = \mathbf{1{\cdot}5\ \Omega}$$

(b) $I = \frac{E}{1+r} \Rightarrow 1 = \frac{1.5}{1+r}$ or $1 + r = 1.5$ or $r = 1.5 - 1 = \mathbf{0.5\ \Omega}$.

Question 9

(i) The diagram alongside shows a current carrying loop or a circular coil passing through a sheet of cardboard at points M and N. The sheet of cardboard is sprinkled uniformly with fine iron fillings.



[3]

(a) Copy the diagram and draw an arrow on the circular coil to show the direction of current flowing through it.

(b) Draw the pattern of arrangement of iron filings when current passed through coil.

(ii) (a) Draw a neat labelled diagram of a d.c. motor. [3]

(b) Write any one use of a d.c. motor.

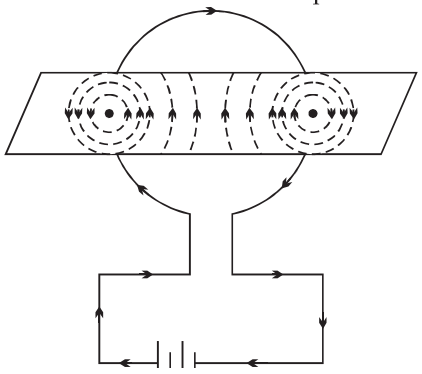
(iii) (a) Differentiate between nuclear fusion and nuclear fission. [4]

(b) State one safety precaution in the disposal of nuclear waste.

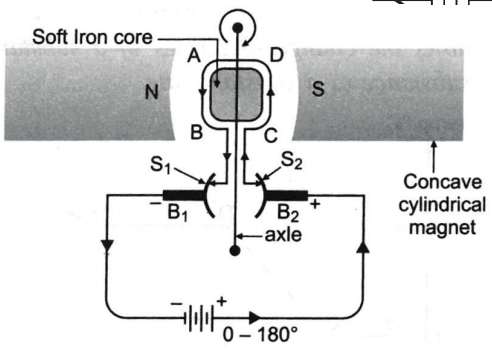
(c) Why there is no change in the rate of radioactivity when radioactive element undergoes a chemical change?

Solution :

(i) (a) and (b) Diagram showing the direction of current in coil and pattern of iron filings is shown.



(ii) (a)



(b) In electric appliances, like fan, juicer, mixer, grinder, washing machine, etc., an electric motor is used to produce rotational motion by the use of electricity.

(iii) (a) The process of combining lighter nuclei (atomic weight less than 20) into heavier nuclei with the release of energy is called nuclear fusion. It cannot be controlled so as to generate electricity. While the process by which a heavy radioactive nucleus is broken into light nuclei by the bombardment of slow neutron, so as to liberate energy and more neutrons than used for bombardment is called nuclear fission. It can be controlled so as to generate electricity.

(b) The nuclear waste must be first kept in thick casks and then buried in the specially constructed deep underground stores. These stores should be made quite far from the populated areas.

(c) During chemical change only electrons in the valance shell of elements take part, but the nucleus remains undisturbed. As there is no change in the composition of nucleus, therefore, there is no change in the rate of radioactivity.

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