ICSE 2024 EXAMINATION

PHYSICS

SAMPLE PAPER - 4

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) A body is acted upon by two UNEQUAL and opposite forces along different lines of action of force. The body will have
   (a) only rotatory motion   (b) only translatory motion (c) both (a) and (b)   (d) neither (a) and (b)

(II) A heavy duty wrench or a spanner has:
   (a) short handle   (b) long handle
   (c) length of handle does not matter   (d) none of these

(III) One horse power is equal to:
   (a) 764 Js^{-1} (b) 746 Js^{-1} (c) 700 Js^{-1} (d) 674 Js^{-1}

(iv) An energy 5kJ causes a displacement of 75 m in a body. The magnitude of force acting on the body is
   (a) 66.66 N   (b) 60.66 N   (c) 64.66 N   (d) 68.66 N

(v) A uniform plank 8 m long is balanced on a pivot at its centre. A boy weighing 60 kgf sits at distance of 2.5 m from the pivot. The distance from pivot where another boy of mass 55 kgf sits in order to balance the plank is:
   (a) 2.63 m   (b) 2.83 m   (c) 2.73 m   (d) 2.93 m

(vi) A single movable pulley has:
   (a) Velocity ratio 2 and actual mechanical advantage 2
   (b) Velocity ratio 2 and actual mechanical advantage less than 2
   (c) Velocity ratio 2 and actual mechanical advantage more than 2
   (d) None of these

(vii) The S.I unit of thermal capacity is:
   (a) J kg^{-1} (b) kJ kg^{-1} (c) JK^{-1} (d) Cal °C^{-1}

(viii) The snow does not melt rapidly on mountains in summer because:
   (a) It is fairly cool on mountains   (b) Specific heat capacity of ice is very high
   (c) Specific latent heat of ice is highest for any substance (d) None of these

(ix) The ratio of speed of light in vacuum to the speed of light in a given medium is 15 : 7. The refractive index of medium is:
   (a) 2.18   (b) 2.14   (c) 2.11   (d) 2.17

(x) A thick glass slab with silvered side forms multiple images on account of:
   (a) only reflection of light   (b) only dispersion of light (c) refraction of light only   (d) both (a) and (c)

(xi) A crack in window pane appears silvery when viewed from some particular angle. The phenomenon is due to:
   (a) reflection of light   (b) refraction of light
   (c) total internal reflection of light   (d) dispersion of light

(xii) A concave lens always forms:
   (a) real, inverted and enlarged image
   (b) virtual, inverted and enlarged image
   (c) virtual, erect and diminished image
   (d) virtual, erect and enlarged image

(xiii) Infrared rays with very large wavelength are easily reflected by:
   (a) air
   (b) glass
   (c) carbon dioxide molecules
   (d) both (b) and (c)

(xiv) Which is not condition for the formation of an echo?
   (a) Minimum distance between source of sound and reflecting body be 17 m
   (b) Temperature of air should be above 20°C
   (c) The wavelength of sound should be less than the height of reflecting body.
   (d) The intensity of sound should be sufficient, so that it could be heard reflection.

(xv) The sound is produced by two tuning forks A and B have same amplitude and same waveform, but frequency of A is three times more than B. In such case:
   (a) Quality of sound A differs from B.
   (b) Note produced by A is shiller than B.
   (c) Note produced by B is shiller than A
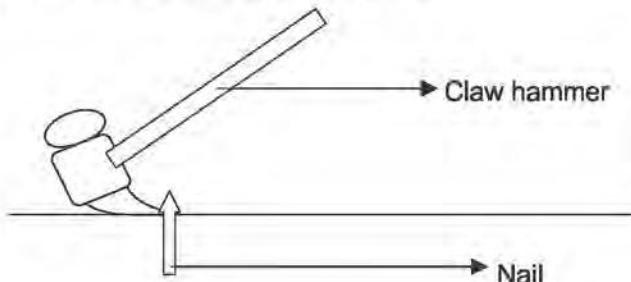   (d) Note produced by A has more speed than B.

ANSWERS

(i) (a)   **(ii)** (b)   **(iii)** (b)   **(iv)** (a)   **(v)** (c)   **(vi)** (b)   **(vii)** (c)   **(viii)** (c)   **(ix)** (b)   **(x)** (d)
(xi) (c)   **(xii)** (c)   **(xiii)** (d)   **(xiv)** (b)   **(xv)** (b)

Question 2

(i) (a) What do you understand by the term loudness of sound? [3]
   (b) How is the loudness of sound related to:
      1. Amplitude of vibrating body
      2. Density of medium in which sound originates?

(ii) State two ways to increase the speed of rotation of a D.C. motor. [2]

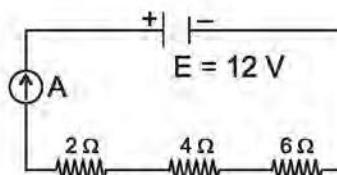**(iii)** The diagram below shows a claw hammer used to remove a nail: [2]

   (a) To which class of lever does it belong?
   (b) Give one more example of the **same class** of lever mentioned by you in (i) for which the **mechanical advantage is greater than one;**

(iv) Study the circuit diagram alongside carefully and calculate: [2]
   (a) Current registered by ammeter A.
   (b) P.D across 4 Ω resistor

(v) (a) What does watt-hour represent in current electricity? [2]
   (b) What is its value in S.I units?

(vi) An electirc kettle draws an electric current of 4 A for 10 minutes. If the resistance of its element is 40 Ω, calculate the energy drawn by kettle in kilo-joules. [2]
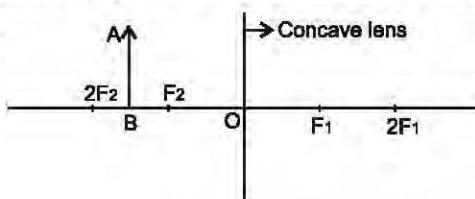
(vii) How does the magnetic field set up by a solenoid change when: [2]
   (a) Strength of current in it is increased?
   (b) Soft iron core is placed within it?

Question 3

(i) Thorium isotopes $_{90}\text{Th}^{223}$ undergoes two successive decays by emitting 2 beta particles. Represents the change by writing nuclear equation and state the mass number and atomic number of residual daughter nuclei. [2]

(ii)

The diagram above shows a concave lens and an object AB placed between $2F_2$ and F_2. Copy the diagram and complete it to show the formation of image. [2]

(iii) Draw a neat diagram to show how an isosceles right-angled glass prism can deflect a ray of light through 180°. [2]

(iv) Why more than one image is formed in a thick glass mirror? Show by drawing a neat diagram. [No explanation is required] [2]

(v) A glass slab 4.0 cm thick is placed over a postal stamp. Calculate the height through which image of postal stamp appears raised. The refractive index of glass 1.48. [2]

SECTION - B (40 Marks)

(Attempt *any four* questions from this Section)

Question 4

(i) A stone of mass 'm' is rotated in a circular path with a uniform speed by tying it to a strong string with the help of hand. Answer the following questions. [5]

   (a) Is the stone moving with a uniform or variable speed? Give a reason.

   (b) Is the stone moving with a uniform or variable velocity? Give a reason.

   (c) Is the stone moving with a uniform acceleration? If so, in which direction the acceleration acts?

   (d) What kind of force acts on the hand and state its direction?

(ii) (a) A brass ball is hanging from a stiff nylon thread. Draw a neat labelled diagram showing the forces acting on brass ball and the nylon thread. [5]

   (b) The distance between two freely suspended brass spheres is tripled. How does the magnitude of gravitational forces between them is affected?

   (c) Why is a jack screw provided with long handle?

Question 5

(i) A force 'F' is applied on a body of mass 10 kg moving with a velocity of 15 ms^{-1}. If the body attains a velocity of 30 ms^{-1} in 10 seconds, calculate: [5]

   (a) Acceleration acting on body.

   (b) Distance covered by body while accelerating

   (c) Force 'F' acting on body.

   (d) Work done on the body.

   (e) Power acting on the body.

(ii) A block and tackle system of pulleys has velocity ratio 5. [5]

   (a) How many pulleys are in its movable block?

   (b) What is the ideal mechanical advantage of this pulley system?

   (c) If the movable block is connected to a weight of 20 kgf and the efficiency of pulley system is 80%, calculate the mechanical advantage of pulley system.

   (d) What is the effort required to lift the weight of 20 kgf?

   (e) What is weight of movable block?

Question 6

(i) (a) Write mathematical expression for the heat energy absorbed by a cold body. [3]

   (b) Some heat energy is given out by a body, such that its temperature drops by 30°C. What is the corresponding drop in temperature on kelvin scale.

   (c) What happens to the average kinetic energy to the molecules as ice melts to form water at 0°C?

(ii) A piece of ice at 0°C is heated at a constant rate and its temperature is recorded at regular intervals of time, till steam is formed at 100°C. Draw a temperature-time graph to represent change in phase. Label different parts of graph. [3]

(iii) 50 g of ice at 0°C is used to bring down the temperature of a certain mass of water of 70°C to 20°C. What is the mass of water required? [Specific heat capacity of water is 4200 $Jkg^{-1}°C^{-1}$ and specific latent heat of fusion of ice is $336 \times 10^3 Jkg^{-1}$]. [4]

Question 7

(i) Copy the diagram alongside and clearly show the path taken by emergent ray. [2]

(ii) (a) A ray of light passes from alcohol to air. How does the speed of light change in air? [4]

    (b) Which colour of visible light travels slowest in any medium except air?

    (c) Name the factors affecting critical angle for the pair of media.

(iii) A convex lens produces a real and inverted image 4 times magnified at a distance of 20 cm from the lens. Calculate

    (a) distance of the object from lens and   (b) focal length of lens. [4]

Question 8

(i) A bucket kept under running tap is getting filled with water. A person sitting at distance is able to get the idea, when the bucket is about to filled. [2]

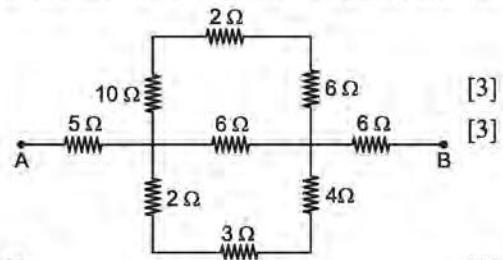   (a) What changes take place in the sound to give him this idea?

    (b) What causes the changes in sound?

(ii) A sound made on the surface of lake takes 2 seconds to reach a boatman. How long it will take to reach diver inside lake water at the same distance as boatman. [Velocity of sound in air and water is 330 ms^{-1} and 1450 ms^{-1} respectively] [2]

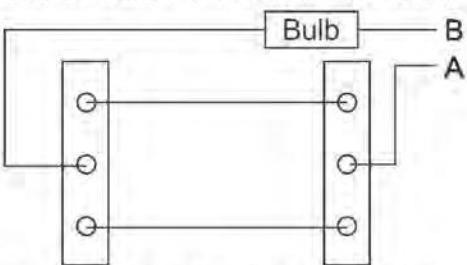**(iii)** (a) State one important property of waves used for echo depth sounding.

    (b) A radar sends a signal to an aircraft at a distance of 300 km and receives it back in 2×10^{-3}s. What is the speed of radar signal? [3]

(iv) Calculate the equivalent resistance between points A and B. [3]

Question 9

(i) (a) The diagram below shows a dual control switch circuit connected to a bulb. [5]

    1. Copy the diagram and complete it so that the bulb is switched ON.

    2. Out of A & B which one is the live wire and which one is the neutral wire?

    (b) An electric gadget can give electric shock to its user under certain circumstances. Mention any of the two circumstances.

    (c) What preventive measure provided in gadget can protect a person from electric shock?

(ii) An atomic nucleus A is composed of 86 protons 136 neutrons. [5]

    (a) The nucleus of A emits an alpha particle and is transformed into nucleus B. What is the composition of nucleus B?

    (b) The nucleus B emits a beta particle and is transformed into nucleus C. What is the composition of nucleus C.

    (c) Does the composition of nucleus C change, if it emits gamma radiation?

❖ ❖ ❖

SOLUTION

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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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(xiv) Which is not condition for the formation of an echo?
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ANSWERS

(i) (a)   **(ii)** (b)   **(iii)** (b)   **(iv)** (a)   **(v)** (c)   **(vi)** (b)   **(vii)** (c)   **(viii)** (c)   **(ix)** (b)   **(x)** (d)
(xi) (c)   **(xii)** (c)   **(xiii)** (d)   **(xiv)** (b)   **(xv)** (b)

Question 2

(i) (a) What do you understand by the term loudness of sound? [3]
  (b) How is the loudness of sound related to:
    1. Amplitude of vibrating body
    2. Density of medium in which sound originates?

(ii) State two ways to increase the speed of rotation of a D.C. motor. [2]

(iii) The diagram below shows a claw hammer used to remove a nail: [2]
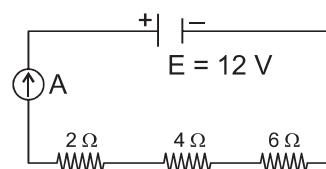

  (a) To which class of lever does it belong?

  (b) Give one more example of the **same class** of lever mentioned by you in (i) for which the **mechanical advantage is greater than one**;

(iv) Study the circuit diagram alongside carefully and calculate: [2]
  (a) Current registered by ammeter A.
  (b) P.D across 4 Ω resistor

(v) (a) What does watt-hour represent in current electricity? [2]
  (b) What is its value in S.I units?

(vi) An electirc kettle draws an electric current of 4 A for 10 minutes. If the resistance of its element is 40 Ω, calculate the energy drawn by kettle in kilo-joules. [2]

(vii) How does the magnetic field set up by a solenoid change when: [2]
  (a) Strength of current in it is increased?
  (b) Soft iron core is placed within it?

Solution :

(i) (a) Loudness of sound is the magnitude of sensation of auditory and may differ from person to person for the same level of intensity of sound.

    (b) 1. Loudness is directly proportional to square of amplitude of vibrating body.

       2. Loudness increases with density of vibrating medium.

(ii) The speed of rotation of a D.C. motor can be increased by

    1. Increasing the strength of current.

    2. Increasing the number of turns in the coil.

(iii) (a) Lever of first order.

     (b) Handle of a common water pump.

(iv) (a) Current registered by ammeter (I) = $\dfrac{\text{Total } e.m.f}{\text{Total resistance}}$ = $\dfrac{12V}{(2 + 4 + 6)\Omega}$

$$= \dfrac{12\text{ V}}{12\ \Omega} = \textbf{1A.}$$

     (b) P.D across 4 Ω resistor (V) = I.R = 1A × 4Ω = **4V**.

(v) (a) Wall-hour represents commercial unit of electric energy.

    (b) 1 watt hour = 1W × 1 h = 1Js^{-1} × 3600 s = **3600J.**

(vi) Energy drown by kettle = Power × time

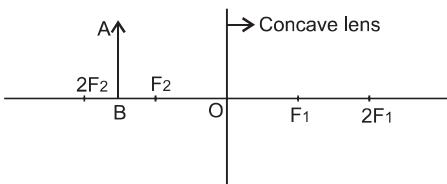$$= (I^2.R) \times \text{time} \Rightarrow (4 \times 4 \times 40)\ \frac{J}{s} \times 600\text{ s}$$

$$\Rightarrow 384000J = \textbf{384 kJ.}$$

(vii) (a) Strength of magnetic field setup by solenoid increases with the increase in strength of current.

      (b) Soft iron core increases the strength of magnetic field of solenoid.

Question 3

(i) Thorium isotopes $_{90}\text{Th}^{223}$ undergoes two successive decays by emitting 2 beta particles. Represents the change by writing nuclear equation and state the mass number and atomic number of residual daughter nuclei. [2]
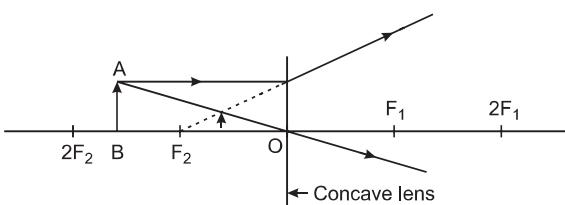
(ii)

The diagram above shows a concave lens and an object AB placed between 2F$_2$ and F$_2$. Copy the diagram and complete it to show the formation of image. [2]

(iii) Draw a neat diagram to show how an isosceles right-angled glass prism can deflect a ray of light through 180º. [2]

(iv) Why more than one image is formed in a thick glass mirror? Show by drawing a neat diagram. [No explanation is required] [2]

(v) A glass slab 4.0 cm thick is placed over a postal stamp. Calculate the height through which image of postal stamp appears raised. The refractive index of glass 1.48. [2]
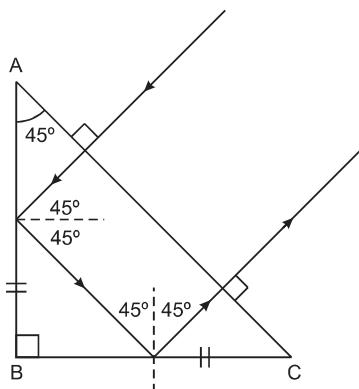
Solution :

(i) $_{90}\text{Th}^{223} \xrightarrow{\ -\beta\ } {}_{91}X^{223} \xrightarrow{\ -\beta\ } {}_{92}X_1{}^{223}$

∴ Mass number of daughter nuclei is 223 amu and atomic number 92 amu.
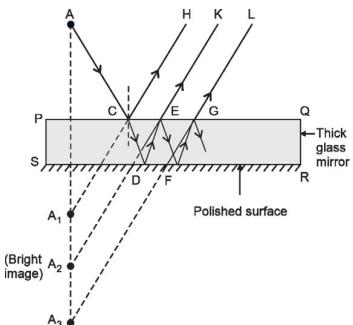
(ii)

(iii)

Path of rays through isosceles right-angled prism such that they deflect through an angle of 180°.

(iv)

Images formed in thick glass mirror

(v) Real thickness of glass slab = 4.0 cm

Let the stamp appears to the raised by length x cm.

∴ Apparent thickness where stamp appears = $(4.0 - x)$

Now, refractive index $= \dfrac{\text{Real depth}}{\text{Apparent depth}}$

$$1.48 = \dfrac{4.0}{4.0 - x}$$

⇒

⇒ $4 \times 1.48 - 1.48x = 4.0$ ⇒ $(4 \times 1.48 - 4) = 1.48x$

⇒ $1.92 = 1.48x$ ⇒ $x = 1.3$

∴ Stamp appears raised by **1.3 cm.**

SECTION - B (40 Marks)
(Attempt *any four* questions from this Section)

Question 4

(i) A stone of mass 'm' is rotated in a circular path with a uniform speed by tying it to a strong string with the help of hand. Answer the following questions. [5]

(a) Is the stone moving with a uniform or variable speed? Give a reason.

(b) Is the stone moving with a uniform or variable velocity? Give a reason.

(c) Is the stone moving with a uniform acceleration? If so, in which direction the acceleration acts?

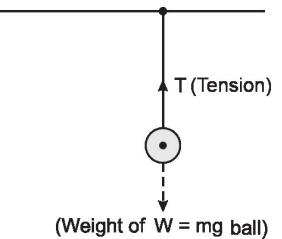(d) What kind of force acts on the hand and state its direction?

(ii) (a) A brass ball is hanging from a stiff nylon thread. Draw a neat labelled diagram showing the forces acting on brass ball and the nylon thread. [5]

(b) The distance between two freely suspended brass spheres is tripled. How does the magnitude of gravitational forces between them is affected?

(c) Why is a jack screw provided with long handle?

Solution :

(i) (a) Stone is moving with a uniform speed, because it covers equal distances in equal intervals of time.

(b) Stone is moving with a variable velocity as its direction changes from point to point all along the circular path.

(c) Yes, stone is moving with a uniform acceleration, which acts at right angles to the direction of motion of the stone, i.e. directed towards the centre along the thread.

(d) The force acting on the hand is centrifugal force. The direction of this force is away from the centre of circle.

(ii) (a) Forces acting on the brass ball and the nylon thread shown in diagram.

T (Tension)

(Weight of W = mg ball)

(b) The magnitude of gravitational force decreases by the factor **9**.

(c) The torque is the product of force and the perpendicular distance between the point of application of force and turning point. Now as the long handle is provided to a jack-screw, the perpendicular distance increases. Thus, for the required torque the applied force decreases and hence, it becomes easier to turn the handle of the jack-screw.

Question 5

(i) A force 'F' is applied on a body of mass 10 kg moving with a velocity of 15 ms^{-1}. If the body attains a velocity of 30 ms^{-1} in 10 seconds, calculate: [5]

(a) Acceleration acting on body.

(b) Distance covered by body while accelerating

(c) Force 'F' acting on body.

(d) Work done on the body.

(e) Power acting on the body.

(ii) A block and tackle system of pulleys has velocity ratio 5. [5]

(a) How many pulleys are in its movable block?

(b) What is the ideal mechanical advantage of this pulley system?

(c) If the movable block is connected to a weight of 20 kgf and the efficiency of pulley system is 80%, calculate the mechanical advantage of pulley system.

(d) What is the effort required to lift the weight of 20 kgf?

(e) What is weight of movable block?

Solution :

(i) (a) $u = 15\,\text{ms}^{-1}$; $v = 30\,\text{ms}^{-1}$; $t = 10$ s; $a = ?$

Now, $a = \dfrac{v-u}{t} = \dfrac{(30-15)\text{ms}^{-1}}{10\text{s}} = \mathbf{1.5\ ms^{-2}}$

(b) Distance covered, $s = ut + \dfrac{1}{2}\,at^2$

$= 15\ \text{ms}^{-1} \times 10\text{s} + \dfrac{1}{2} \times 1.5\ \text{ms}^{-2} \times 10\text{s} \times 10\text{s}$

$= 150\ \text{m} + 75\ \text{m} = \mathbf{225\,m}$

(c) Force acting on body, $F = m.a = 10\ \text{kg} \times 1.5\ \text{ms}^{-2}$

$= 15\ \text{kg ms}^{-2} = \mathbf{15\,N}$

(d) Work done on body, $W = F \times S \Rightarrow 15\ \text{N} \times 225\ \text{m} = \mathbf{3375J}$.

(e) Power acting on the body, $P = \dfrac{W}{t} \Rightarrow \dfrac{3375J}{10s} = 337.5\,\text{Js}^{-1} = \mathbf{337.5W}$.

(ii) (a) Movable block has **2** pulleys.

(b) Ideal mechanical advantage = Velocity ratio = **5**

(c) $\eta = \dfrac{\text{M.A}}{\text{V.R}}$ or M.A $= \eta.\text{V.R} = \dfrac{80}{100} \times 5 = \mathbf{4}$

(d) M.A $= \dfrac{l}{E}$ ∴ $4 = \dfrac{20\ \text{kgf}}{E}$

∴ Effort required $= \dfrac{20\ \text{kgf}}{4} = \mathbf{5\ kgf}$

(e) Weight of movable block 'x' = E (I.MA – A.M.A)

= 5kgf (5 – 4) = **5 kgf.**

Question 6

(i) (a) Write mathematical expression for the heat energy absorbed by a cold body. [3]

(b) Some heat energy is given out by a body, such that its temperature drops by 30ºC. What is the corresponding drop in temperature on kelvin scale.

(c) What happens to the average kinetic energy to the molecules as ice melts to form water at 0ºC?

(ii) A piece of ice at 0ºC is heated at a constant rate and its temperature is recorded at regular intervals of time, till steam is formed at 100ºC. Draw a temperature-time graph to represent change in phase. Label different parts of graph. [3]

(iii) 50 g of ice at 0ºC is used to bring down the temperature of a certain mass of water of 70ºC to 20ºC. What is the mass of water required? [Specific heat capacity of water is 4200 $Jkg^{-1}{}^{\circ}C^{-1}$ and specific latent heat of fusion of ice is 336×10³Jkg^{-1}]. [4]

Solution :

(i) (a) Heat energy absorbed by cold body = mass × specific heat capacity × rise in temperature = $mc\theta_R$

(b) Drop in temperature in kelvin scale = Drop in temp. in °C = **30K.**

(c) The average kinetic energy of the molecules of water is the same as that of ice molecules, because no change in temperature takes place.

(ii) **AB is solid phase**.

In this phase ice melts but temperature stays at 0°C, till all ice melts.

BC is liquid phase.

In this phase water at 0°C gradually rises in temperature, till it attains a **temperature of 100°C**.

CD is a gaseous phase.

In this phase temperature stays at 100°C, water at 100°C gradually changes to steam.

(iii) Let the mass of water required = x.

∴ Heat energy given out by water in cooling from 70°C to 20°C = $mc\theta_F$

$$= x \times \frac{4.2J}{g°C} \times 50°C = 210\ x\ \frac{J}{g}.$$

Heat absorbed 50g of ice to form water at 0°C = mL_{ice} = 50 g × 336 $\frac{J}{g}$ = 16800J

Heat absorbed by 50 g of water at 0°C to attain temperature of 20°C = $mc\theta_R$

$$= 50\ g \times 4.2\frac{J}{g°C} \times 20°C = 4200J$$
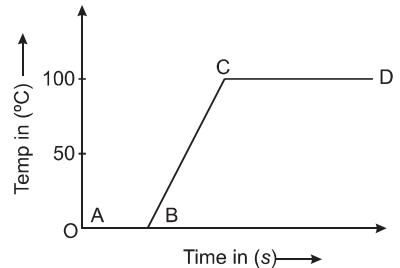
∴ Total heat absorbed = (16800 + 4200)J = 21000 J

By the law of conservation of energy,

Heat energy given out = Heat energy absorbed

$$210x\frac{J}{g} = 21000J$$

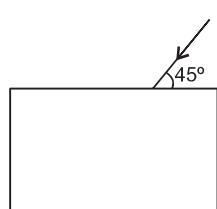∴ x (Amount of water required) = **100 g**.

Question 7

(i) Copy the diagram alongside and clearly show the path taken by emergent ray. [2]

(ii) (a) A ray of light passes from alcohol to air. How does the speed of light change in air? [4]

(b) Which colour of visible light travels slowest in any medium except air?

(c) Name the factors affecting critical angle for the pair of media.

(iii) A convex lens produces a real and inverted image 4 times magnified at a distance of 20 cm from the lens. Calculate (a) distance of the object from lens and (b) focal length of lens. [4]

Solution :

(i) Path of ray shown in diagram alongside

(ii) (a) The speed light increases in air.

(b) Violet colour travels slowest in any medium except air.

(c) (i) Critical angle depends upon the refractive index of the medium in which ray of light travels.

(ii) Critical angle depends upon the wavelength of light travelling in a medium.

(iii) (a) Magnification = 4; Distance of image from lens (v) = 20 cm.

Distance of image from lens (u) = ?

Applying $m = \dfrac{v}{u}$ $\Rightarrow 4 = \dfrac{20}{u}$
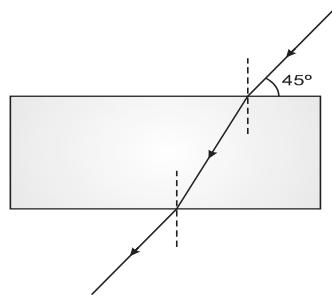
$\therefore$ Distance of object from lens = **5 cm**

(b) As u is always negative for any lens, therefore $u = -5$ cm

Applying $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

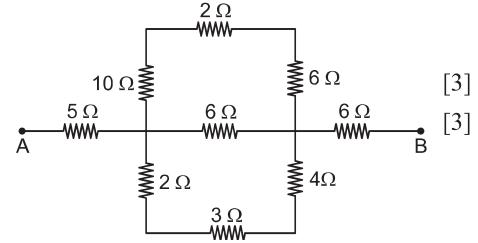$\Rightarrow \dfrac{1}{20} - \dfrac{1}{-5} = \dfrac{1}{f}$

$\Rightarrow \dfrac{1}{f} = \dfrac{1}{20} + \dfrac{1}{5} = \dfrac{1+4}{20} = \dfrac{5}{20} = \dfrac{1}{4}.$

$\therefore$ Focal length of lens (f) = **4 cm.**

Question 8

(i) A bucket kept under running tap is getting filled with water. A person sitting at distance is able to get the idea, when the bucket is about to filled. [2]

(a) What changes take place in the sound to give him this idea?

(b) What causes the changes in sound?

(ii) A sound made on the surface of lake takes 2 seconds to reach a boatman. How long it will take to reach diver inside lake water at the same distance as boatman. [Velocity of sound in air and water is 330 ms⁻¹ and 1450 ms⁻¹ respectively] [2]

(iii) (a) State one important property of waves used for echo depth sounding.

(b) A radar sends a signal to an aircraft at a distance of 300 km and receives it back in 2×10^{-3}s. What is the speed of radar signal? [3]

(iv) Calculate the equivalent resistance between points A and B. [3]

Solution :

(i) (a) The sound coming from the bucket gradually changes to shrill as the bucket gets filled. When the bucket is about to be filled the intensity of shrillness is maximum and then dies out. Thus, noting the shrillness of sound, the man has a fair idea as the bucket gets filled or not.

(b) It is the length (or volume) above the surface of water which controls the frequency of sound or its shrillness, i.e., less the length more is the frequency.

(ii) Distance of sound from boatman = speed × time = 330 ms⁻¹ × 2s = **660m**

$\therefore$ Time taken by sound to reach diver = $\dfrac{\text{distance}}{\text{speed}} = \dfrac{660\text{m}}{1450\text{ms}^{-1}}$ = **0.455s**

(iii) (a) The sound waves should be of high frequency and low wavelength, such as ultrasonic waves are ideal for echo depth sounding.

(b) Speed of radar signal = $\dfrac{2d}{t} = \dfrac{2 \times 300 \text{ km}}{2 \times 10^{-3}s}$ = **3 × 10⁵ kms⁻¹**

(iv) Resistance of 10Ω, 2Ω and 6Ω in series (R₁) = (10 + 2 + 6)Ω = 18 Ω

Resistance of 2Ω, 3Ω and 4Ω in series (R₂) = (2 + 3 + 4)Ω = 9 Ω

$\therefore$ Resistance of R_1, R_2 and 6Ω resistance is parallel thus, $\dfrac{1}{R_3} = \dfrac{1}{18} + \dfrac{1}{9} + \dfrac{1}{6}$

$$\Rightarrow \dfrac{1}{R_3} = \dfrac{1+2+3}{18} = \dfrac{6}{18} = \dfrac{1}{3}$$
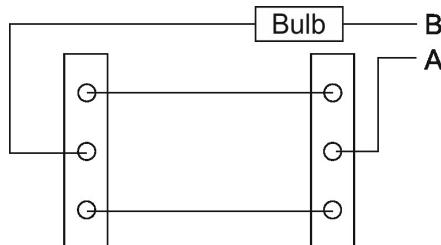
$\therefore R_3 = 3\,\Omega$

Thus, total equivalent resistance of 5Ω, R_3, and 6Ω in series.

$$R = (5 + 3 + 6) = 14\,\Omega$$

Thus, equivalent resistance between points A and B = **14Ω**.

Question 9

(i) (a) The diagram below shows a dual control switch circuit connected to a bulb. [5]

    1. Copy the diagram and complete it so that the bulb is switched ON.

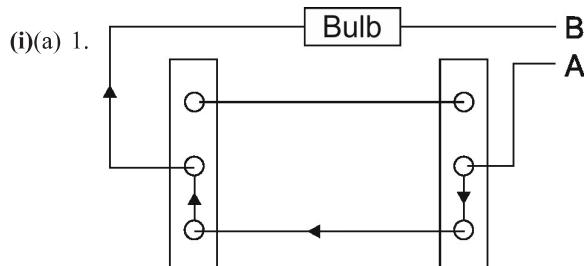   2. Out of A & B which one is the live wire and which one is the neutral wire?

(b) An electric gadget can give electric shock to its user under certain circumstances. Mention any of the two circumstances.

(c) What preventive measure provided in gadget can protect a person from electric shock?

(ii) An atomic nucleus A is composed of 86 protons 136 neutrons. [5]

(a) The nucleus of A emits an alpha particle and is transformed into nucleus B. What is the composition of nucleus B?

(b) The nucleus B emits a beta particle and is transformed into nucleus C. What is the composition of nucleus C.

(c) Does the composition of nucleus C change, if it emits gamma radiation?

Solution :

(i)(a) 1.

    2. A – Live wire;   B – Neutral wire

(b) 1. The electric circuit may get short circuited i.e., live or neutral wire is touching the metallic body of a given appliance.

2. The hands of user may be wet, such that water dripping from his hands makes a contact with live wire.

(c) The body of the electric gadget is connected to earth terminal by means of earth wire. In case of short circuit a huge surge of current flows through the earth terminal. This, in turn melts the fuse in the live wire and hence, flow of current stops in the gadget.

(ii) (a) When nucleus A emits an alpha particle it changes to nucleus B, it ejects 2 neutrons and 2 protons.

Thus composition of B is : protons **84** and neutrons **134**.

(b) When nucleus B emits a beta particle, a neutron in it decays to from a proton and an electron. The proton is retained by nucleus of C but electron is ejected.

Thus, composition of C is : protons **85** and neutrons **133**.

(c) The composition of nucleus of C does not change with the emission of gamma radiations.

∨   ∨   ∨