

Answer 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)

Q1. Choose the correct answers to the questions from the given options:

[15M]

i) A sheaf pulley has:

- (a) efficiency more than 100% (b) it multiplies speed
(c) it multiplies effort (d) both (a) and (b)

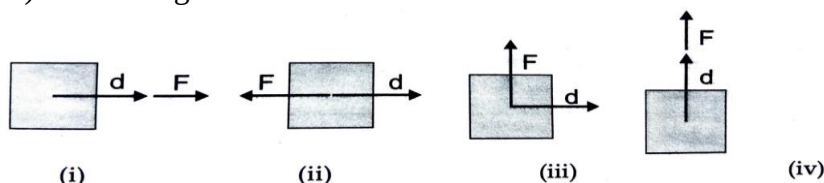
ii) Which of the statement is not true for an actual machine?

- (a) its mechanical advantage is always less than velocity ratio
(b) its efficiency is always less than 100%
(c) its mechanical advantage is greater than velocity ratio
(d) its output is always less than input.

iii) A stone resting on a roof of a building has:

- (a) kinetic energy (b) gravitational energy
(c) potential energy (d) both (b) & (c)

iv) Refer to figure below



The work done is maximum in case of

- (a) Figure (ii) (b) figure (iii) (c) figure (i) (d) figure (iv)

v) A body is describing a uniform circular motion. Which of the following quantities is/are constant?

- (a) Speed (b) Velocity (c) acceleration (d) both (a) and (c)

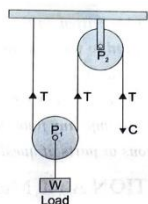
vi) Which cools soft drink bottles best?

- (a) A liquid of sp. Heat capacity $0.70 \text{ Jg}^{-1}\text{°C}^{-1}$ and at -10°C
(b) Water at 0°C
(c) Crushed ice at 0°C
(d) An organic solid of sp. Heat capacity $0.38 \text{ Jg}^{-1}\text{°C}^{-1}$ and at -40°C

(vii) A solid of mass 0.150 kg and of specific heat capacity $390 \text{ J kg}^{-1} \text{ }^{\circ}\text{C}^{-1}$ is cooled from 90°C to 10°C . The heat given out of solid is

- (a) 4680 J (b) 4650 J (c) 4860 J (d) 6480 J

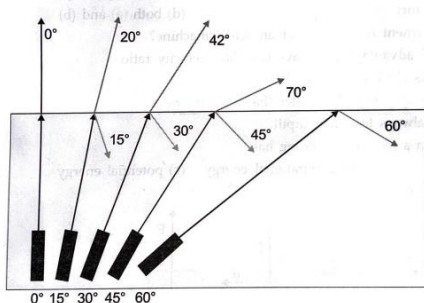
(vii) The figure shown alongside represent a fixed pulley and a movable pulley. What is its velocity ratio?



- (a) Two (b) one (c) four (d) none of these

(ix) In the following diagram, the total reflection is taking place, when the angle of incidence is

- (a) 15° (b) 30° (c) 45° (d) 60°



(x) The most visible colour of visible spectrum is :

- (a) red (b) violet (c) orange (d) green

(xi) To locate its prey in darkness the owl or bat emits:

- (a) sonic-waves (b) infrared waves (c) ultrasonic waves (d) infrasonic waves

(xii) The amplitude of forced vibrations is generally –

- (a) more (b) less (c) equal to (d) none of these

(xiii) When the amplitude of a pure note is reduced its:

- (a) speed decreases (b) wavelength decreases

- (c) frequency decreases (d) loudness decreases

(xiv) A charge of 5000 C flows through a conductor for 8 min and 20 sec . The current flowing through conductor is:

- (a) 8 A (b) 10 A (c) 9.5 A (d) 10.4 A

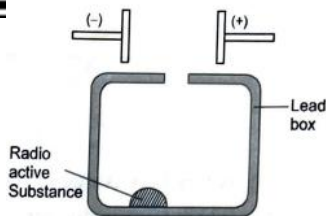
(xv) Which of the following is non-ohmic resistance?

- (a) Element of room heater (b) electronic valves
(b) Connecting wire of copper (d) A thin strip of manganin alloy

Q2. Answer the following questions.

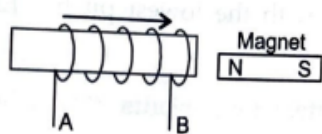
(i) (a) Copy and complete diagram shown alongside by drawing deflection of radioactive radiation in the electric field. Label the radiations. [3M]

(b) State one precaution in handling radioactive substances.



(ii) This diagram shows the direction of motion of coil towards magnet.

[2M]



(a) State the direction in which current flows, i.e.; A to B or B to A.

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

(iii) Complete the following sentences:

[2M]

(a) When a force acts on a stationary rigid body which is free to move, moves in a straight line is called -----

(b) No work is said to have been done when an object moves at an angle of ----- with the direction of the force.

(iv) An electric bulb of resistance 500 S2, draws a current of 0.4A.

[2M]

Calculate : (a) power of bulb (b) p.d at its ends.

v) (a) At what voltage alternating current is supplied to homes?

[2M]

(b) How should electric appliances be connected in household circuit?

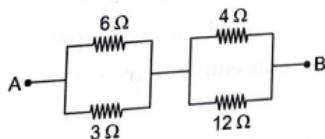
(vi) How does increase in temperature affect the specific resistance of

(a) Metal (b) Semiconductor?

[2M]

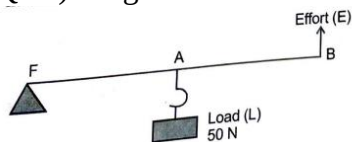
(vii) Find the equivalent resistance between points A and B.

[2M]



Q3. i) Diagram shows a lever in use

[2M]



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

(b) If $FA = 40 \text{ cm}$, $AB = 60 \text{ cm}$, then find the mechanical advantage of the lever.

(ii) (a) What is a super conductor?

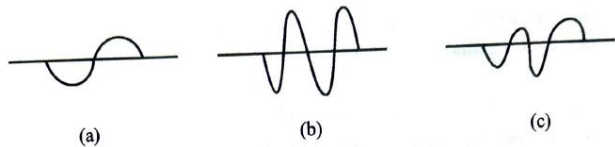
[2M]

(c) Name a material and the temperature at which it becomes super conductor.

(iii) A microphone is connected to the Y-input of a C.R.O. Three different sounds are made in turn in front of the microphone.

[2M]

Their traces (a), (b) and (c) produced on the screen are as shown in Fig given below.



- (i) Which trace is due to the loudest sound? Give reason for your answer.
 (ii) Which trace is due for the sound with the lowest pitch ? Explain your answer.

(iv) (a) Define scattering. [2M]

(b) The smoke from a fire looks white.

Which of the following statements is true?

1. Molecules of the smoke are bigger than the wavelength of light.
2. Molecules of the smoke are smaller than the wavelength of light.

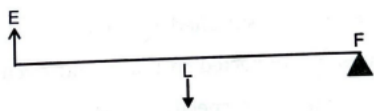
v) On what factors does the force experienced by a straight conductor placed in a magnetic field depends? [2M]

SECTION B

(Attempt any four questions from this Section)

Q4. Answer the following questions.

(i) (a) The diagram below shows a lever in use: [4M]



1. To which class of levers does it belong?
2. Without changing the dimension of the lever, if the load is shifted toward the fulcrum what happens to the mechanical advantage of the lever?

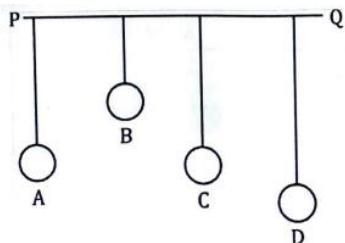
(b) 1. Define power 2. State a mathematical expression for power.

(ii) (a) What do you understand by the term equilibrium of a body? [3M]

(b) State a condition when a body is in dynamic equilibrium

(c) Give an example of a body which is in dynamic equilibrium.

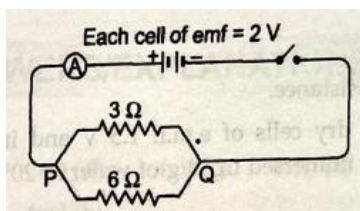
iii) In the diagram below, A, B, C, D are four pendulums suspended from the same elastic string PQ. The length of A and C are equal to each other while the length of pendulum B is smaller than that of D. Pendulum A is set in to a mode of vibrations. [3M]



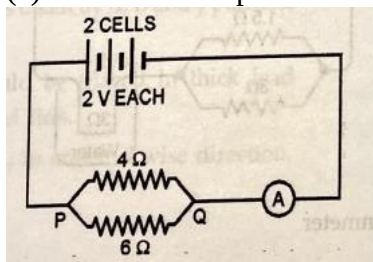
- (a) Name the type of vibrations taking place in pendulum B and D?
- (b) What is the state of pendulum C?
- (c) State the reason for the type of vibrations in pendulums B and C.

Q5. Answer the following questions.

- i) (a) How can a single pulley be used as single movable pulley? Show by drawing a diagram.
 (b) What is the velocity ratio of above pulley? Is its mechanical advantage is less or more than velocity ratio? [3M]
- ii) A pulley system has five pulleys in all, two in a movable block and three in a fixed block, such that effort applied in the UPWARD direction and a load of 120 kgf is attached to movable block. Answer the following questions :
 (a) What is the velocity ratio of system?
 (b) Assuming pulley system an ideal one, what is its mechanical advantage?
 (c) What is the magnitude of effort applied?
 (d) If pulley system is not ideal and is 60% efficient, what is the effort required? [4M]
- iii) Study the diagram carefully and calculate : [3M]
 (a) The equivalent resistance between P and Q.



- (b) the reading of the ammeter.
 (c) The electrical power between P and Q.

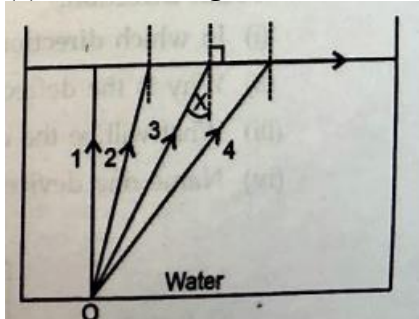


Q6. Answer the following questions.

- (i) Diagram alongside shows a source of light 'O' placed in water tank and rays 1, 2, 3 and 4 Originating from point. [4M]

The path of ray 3 is shown in diagram

- (a) Copy the diagram and trace the course of rays 1, 2 and 4.
 (b) Which ray does not suffer refraction and why?
 (c) Which ray suffers refraction and why?
 (d) Which ray suffers total internal reflection and why?
 (e) If critical angle for water is 48° which is the value of angle X?

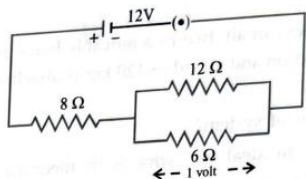


(d) An object 1.5 cm high is placed at a distance of 16 cm from a convex lens of focal length 20 cm. Calculate

- (a) Position of image; (b) size of image. State the characteristics of image formed.

Q7. Answer the following questions.

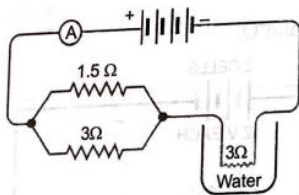
- (i) (a) Is the spectrum obtained by an equilateral prism pure or impure? Explain your answer. [4M]
 (b) What is ultraviolet spectrum? State its range in Å.
 (ii) How do the following make use of echoes? [2M]
 (a) Army (b) fisherman.
 (iii) Three resistors $8\ \Omega$, $12\ \Omega$ and $6\ \Omega$ are connected to a 12 volt battery as shown. Find [4M]



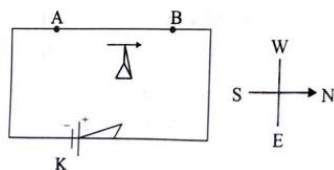
- (a) The current through $8\ \Omega$ resistance.
 (b) P.d across the parallel combination of $6\ \Omega$ and $12\ \Omega$
 (c) The current through the $6\ \Omega$ resistor.

Q8. Answer the following questions.

- (i) (a) Define electrical resistance. [1M]
 (b) State two laws of electric resistance. [2M]
 (c) Circuit diagram shows four dry cells of e.m.f 1.5 V and internal $0.25\ \Omega$ connected to an external circuit. A $3\ \Omega$ wire is immersed in 20g of water 20°C . The current switched on for 6 minutes and 36 seconds. Calculate:



- (i) Reading shown by the ammeter
 (ii) Current in $1.5\ \Omega$ wire
 (iii) Final temperature of water [3M]
 (d) The diagram below shows a magnetic needle kept just below the conductor AB which is kept in North South Direction.
 (i) In which direction will the needle deflect when the key is closed?
 (ii) Why is the deflection produced?
 (iii) What will be the change in the deflection if the magnetic needle is taken just above the conductor AB.
 (iv) Name one device which works on the principle. [4M]



Q9. Answer the following questions.

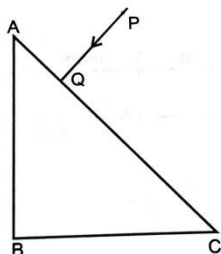
(i) State three characteristics of a parallel electrical circuit.

[3M]

(ii) A ray of light PQ is incident normally on the hypotenuse of a right angled prism ABC as shown in

The diagram given alongside:

[3M]



(a) Copy the diagram and complete the path of the ray PQ till it emerges from the prism.

(b) What is the value of the angle of deviation of the ray?

(c) Name an instrument where the action of the prism is used.

(iii) A radioactive nucleus ${}_{84}\text{X}^{202}$ of an element emits a beta particle followed by 2 alpha particles such that final nucleus is ${}_a\text{Y}^b$. Find the value of 'a' and b

[4M]

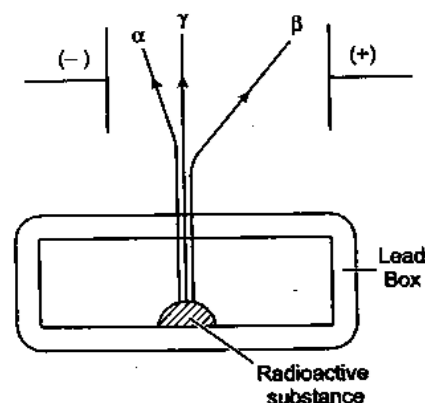
-----All the Best-----

ANSWER 1

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

ANSWER 2

- (i) (a) Diagram alongside shows paths taken by α , β and γ particles radiations.
(b) The radioactive material should be placed in thick lead containers with leak proof lead lids.
(ii) (a) Current flows from B to A, i.e.; in anticlockwise direction.
(b) Lenz's Law.
(iii) (a) Linear motion (b) 90°
(iv) (a) Power of bulb : $I^2 \times R = (0.4)^2 \times 500 = 80 \text{ W}$
(b) P.D at the ends of bulb, $V = I.R = 0.4 \times 500 = 200 \text{ V}$.
(v) (a) Power to household consumer is supplied at 220 V.
(b) Electric appliances in household circuit should be connected in parallel.
(vi) (a) Specific resistance of metal increases with the rise in temperature.
(b) Specific resistance of semi-conductors decreases with the rise in temperature.



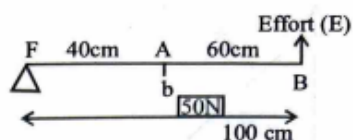
(vii) Resistance of 6Ω and 3Ω in parallel $(R_1) = \frac{1}{R_1} = \frac{1}{3} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

$\therefore R_1 = 2 \Omega$

Resistance of 4Ω and 12Ω in parallel $(R_2) = \frac{1}{R_2} = \frac{1}{4} + \frac{1}{12} = \frac{4}{12} = \frac{1}{3}$

$\therefore R_2 = 3 \Omega$

- (i) (a) Class II lever.



$$(b) \text{ M.A.} = \frac{BF}{AF} = \frac{FA + AB}{FA} = \frac{40 + 60}{40} = \frac{100}{40} = 2.5$$

- (ii) (a) A material which does not offer resistance to the flowing of electric current is called super conductor.
 (b) Mercury is a super conductor at 4.2 K.

- (iii) (i) (b) trace is due to the loudest sound because its amplitude is largest.

- (ii) (a) trace is due to the sound with the lowest pitch because its frequency is lowest.

- (iv) (a) The phenomenon in which an incident light strikes a particle which has a diameter greater than the wavelength of incident light, then the incident light is absorbed by the particle and transmitted in all possible directions, is called scattering.

- (b) Molecules of the smoke are bigger than the wavelength of light.

- (v) (i) Force experienced by conductor is directly proportional to length of conductor in magnetic field.

- (ii) Force experienced by conductor is directly proportional to the magnitude of current in it.

ANSWER 4

- (i) (a) 1. Lever of second class.

2. If the load is shifted towards the fulcrum, then load arm will decrease, consequently, mechanical advantage of the lever will increase.

- (b) 1. Rate of doing work is called power.

$$2. \text{ Power} = \frac{\text{work}}{\text{times (in s)}} = \frac{W}{t}$$

- (ii) (a) When number of forces (two or more) act on a rigid body, such that they do not change the state of rest or uniform motion of a body in a straight line then the rigid body is in the state of equilibrium.

- (b) The body should not change its state of motion in any way when two or more external forces are applied.

- (c) A train running at constant speed (say 72 km h^{-1}) in a particular direction is in dynamic equilibrium.

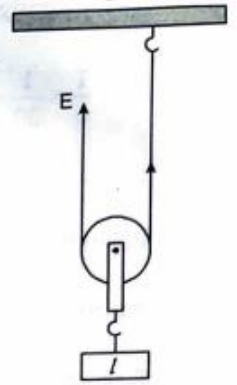
- (iii) (a) The vibrations which occur in pendulums B and D are called forced vibrations.

- (b) Pendulum C is in the state of resonance with pendulum A as it is of the same length.

- (c) The pendulums vibrate because the forced vibration from A is transferred due to string PQ.

Pendulum B is of a different length as compared to pendulum A. Hence, it will continuously vibrate with a frequency which is different from that of pendulum A. Its amplitude will also be very small.

Pendulum C is of the same length as compared to pendulum A. Hence, it will vibrate in phase with pendulum A. Its amplitude will be equal to that of pendulum A as it will attain resonance.



ANSWER 5

- (i) (a) A single fixed pulley can be converted with a single movable system by making the single pulley movable and applying effort in the upward direction as shown in diagram alongside.
- (b) Velocity ratio of pulley system = No of supporting segment of rope = 2
The mechanical advantage of this pulley is less than velocity ratio, because a part of effort is wasted in friction and overcoming the weight of movable block.
- (ii) (a) Velocity ratio = No of supporting segments of rope = 6
(b) For ideal machine, $MA = VR = 6$

$$(c) \quad M.A = \frac{l}{E} \quad \therefore \quad E = \frac{l}{M.A} = \frac{120 \text{ kgf}}{6} = 20 \text{ kgf}$$

$$(d) \quad \eta = \frac{M.A}{V.R} \quad \therefore \quad M.A = \eta V.R \Rightarrow \frac{l}{E} = \frac{60}{100} \times 6$$

$$\therefore \quad E = \frac{100}{60 \times 6} \times l = \frac{100}{60 \times 6} \times 120 \text{ kgf} = 33.33 \text{ kgf}$$

$$(iii) (a) \text{ Equivalent resistance between P and Q} = \frac{1}{R} = \frac{1}{3} + \frac{1}{6} = \frac{2+1}{6} = \frac{3}{6} = \frac{1}{2}$$

$$\therefore \quad \frac{1}{R} = \frac{1}{2}$$

$$\therefore \quad R = 2 \text{ W}$$

Equivalent resistance between P and Q = 2 W Ans.

(b) Ammeter reading

$$V \text{ of two cells in series} = 2 + 2 = 4 \text{ V}$$

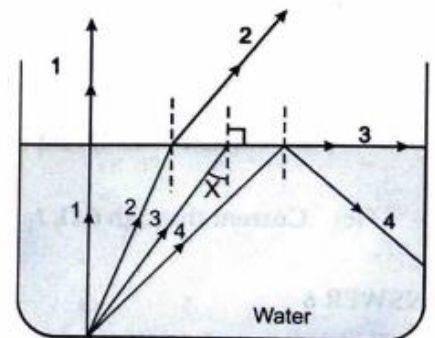
$$I = \frac{V}{R} = \frac{4}{2} = 2 \text{ A}$$

(c) Electric power = $VI = P$

$$P = 4 \times 2 = 8 \text{ W}$$

ANSWER 6

- (i) (a) Course of rays 1, 2 and 4 is shown in diagram alongside.
- (b) Ray 1 does not suffer refraction because angle of incidence at interface of water and air is zero. So angle of refraction is zero.
- (c) Ray 2 suffers refraction because the angle of incidence in rare medium is less than critical angle.
- (d) Ray 4 suffers total internal reflection because angle of incidence is greater than critical angle.
- (e) The value of angle X = critical angle of water = 48° .
- (ii) Height of object (h_0) = 1.5 cm
Distance object from lens (u) = -16 cm
Focal length of lens (f) = +20 cm
Distance of image from lens (v) to be calculated



$$\begin{aligned} \text{(a) Applying, } \frac{1}{v} - \frac{1}{u} &= \frac{1}{f} \Rightarrow \frac{1}{v} - \frac{1}{-16} = \frac{1}{20} \\ \Rightarrow \frac{1}{v} &= \frac{1}{20} - \frac{1}{16} \Rightarrow \frac{1}{v} = \frac{4-5}{80} \\ \Rightarrow \frac{1}{v} &= \frac{-1}{80} \Rightarrow v = -80 \text{ cm} \end{aligned}$$

∴ Position of image at distance of **80 cm** from optical centre on the same side of object.

$$\text{(b) Applying, } \frac{h_i}{h_o} = \frac{v}{u} \Rightarrow \frac{h_i}{1.5 \text{ cm}} = \frac{80}{16} \Rightarrow h_i = 5 \times 1.5 \text{ cm} = 7.5 \text{ cm}$$

∴ Size of image = **7.5 cm**.

Characteristics of image :

Image is (1) virtual (2) erect (3) magnified and (4) formed on the same side of object.

ANSWER 7

(i) (a) An equilateral prism always forms impure spectrum.

Reason : The ray striking on the dispersing face of the prism are not striking at the same angle of incidence. Thus, the dispersed colours mix to form impure spectrum.

(b) Invisible spectrum below the violet end of visible spectrum is called ultraviolet spectrum.

The range of ultraviolet spectrum is between 4000 Å to 100 Å.

(ii) (a) Army uses the echoes to locate enemy gun positions very accurately that time echoes produced by enemy gun fire and then applying trigonometric calculations can locate position of gun.

(b) Fishing boats are fitted with sonar which operates in the horizontal plane, rather than vertical plane. The fisherman send ultrasonic signals in the forward direction. If these signals strike fish shoals they are reflected back to the fishing boat. On the fishing boat they calculate the distance and direction of fish shoal. They move their boat in the calculated direction to net the fish.

(iii) We are given $V = 12$ volt

$$\text{Total resistance } R = 8 + (R_p) = 8 + \left(\frac{6 \times 12}{6 + 12} \right) = 8 + 4 = 12 \Omega$$

$$\text{(a) } I \text{ through } 8 \Omega = \frac{V}{R} = \frac{12}{12} = \boxed{1 \text{ A}}$$

$$\text{(b) P.d across } R_p = \frac{R}{I} = \frac{4}{1} = \boxed{4 \text{ volt}}$$

i.e. P.d across 12 Ω and 6 Ω each is 4 volt.

$$\text{(c) Current through } 6 \Omega, I_1 = \frac{V}{6} = \frac{4}{6} = \boxed{0.67 \text{ A}}$$

ANSWER 8

(i) (a) Friction or obstruction encountered by an electric current while passing through a conductor is called electrical resistance.

(b) 1. Temperature remaining constant the resistance of a conductor is directly proportional to the length of conductor.

2. Temperature remaining constant the resistance of a conductor is inversely proportional to the area of cross-section of conductor.

(c) Potential difference of 4 cells $E = 4 \times 1.5 = 6 \text{ v}$

$$R_p = \frac{1}{1.5} + \frac{1}{3} = 1\Omega$$

$$\text{External resistance } R = R_p + 3\Omega$$

$$1 + 3 = 4\Omega$$

$$(i) \text{ Reading in ammeter } = I = \frac{E}{R}$$

$$I = \frac{6}{4} = 1.5 \text{ A}$$

$$(ii) \text{ } v \text{ across parallel resistances } v = IR_p$$

$$V = 1.5 \times 1 = 1.5 \text{ V}$$

$$\therefore \text{ Current through } 1.5\Omega \text{ wire } I_1 = \frac{v}{1.5} = \frac{1.5}{1.5} = 1 \text{ A}$$

(iii) Final temperature of water.

$$Q = I^2 R t = mc_w (T - 20)$$

{ $\because$ By the principle of calorimetry}

$$\Rightarrow 1.5 \times 1.5 \times 3 \times (6 \times 60 + 36) = 20 \times 4.2 (T - 20)$$

$$\Rightarrow \frac{27}{4} \times 396 = 84 (T - 20^\circ\text{C}) \Rightarrow \frac{27 \times 99}{84} = T - 20^\circ\text{C} \Rightarrow T = 31.8 + 20^\circ\text{C} = 51.8^\circ\text{C}$$

(d) (i) East direction

(ii) The needle align itself with the direction of magnetic field lines. Since the lines are perpendicular to the direction of current, the needle will try to align that way also.

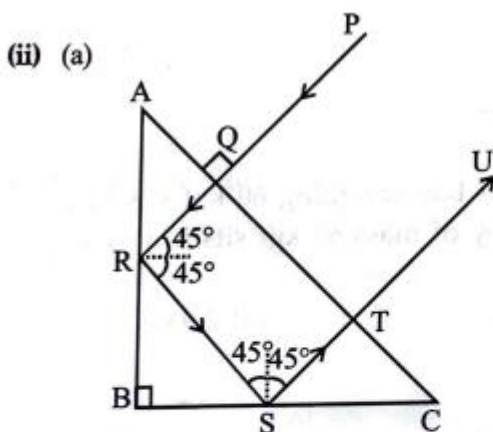
(iii) The North pole of the compass needle deflects towards West.

(iv) Electric motor.

ANSWER 9

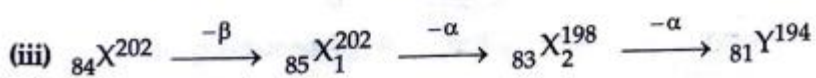
(i) Characteristic of parallel circuit.

1. Potential difference across resistors in parallel is a constant quantity.
2. The current divides in parallel circuit in the inverse ratio of the resistance of the resistor.
3. The total current entering or leaving parallel circuit is equal to the sum total of individual current flowing in the resistors in parallel circuit : i.e., $I = I_1 + I_2 + I_3 + \dots$



(b) The ray deviates through 180° .

(c) This action of prism is used in camera to invert the image.



$\therefore$ In ${}_a\text{Y}^b$, $a = 81$ and $b = 194$