ICSE Board 2009
CLASS X
PHYSICS

Maximum Marks: 80   **Time: One hour and a half**

1**.** Answer to this Paper must be written on the paper provided separately.
2. You will **not** be allowed to write during the first **15** minutes. This time is to be spent in reading the Question Paper.
3. The time given at the head of this Paper is the time allowed for writing the answers.
4. **Section I** is compulsory. Attempt **any four** questions from **Section II**.
5. The intended marks for questions or parts of questions are given in brackets [ ].

SECTION-I (40 MARKS)

(Attempt all question from this section)

Question 1.

(a)   If 'm' is the mass of the body. 'v' its velocity and 'p' the momentum then write a relationship between change in momentum , mass and velocity of the body when **

     (i)   v is almost equal to c, the velocity of light.
     (ii)   v is very, very less as compared to c, the velocity of light.   [2]

(b)   (i)   With reference to the terms mechanical advantage, velocity ratio and efficiency of a machine, name the term that will not change for a machine of a given design.

     (ii)   Define the term stated by you in part (i).   [2]

(c)   What is the SI unit of energy? How is the electron volt (eV) related to it?   [2]

(d)   State the energy changes that take place in the following when they are in use :

(i)   a photovoltaic cell.
(ii)   an electromagnet.   [2]

(e)   A body of mass 5 kg is moving with a velocity of 10 ms^{-1}. What will be the ratio of its initial kinetic energy and final kinetic energy. if the mass of the body is doubled and its velocity is halved? (2 marks)

Question 2.

(a)   A ray of light strikes the surface of a rectangular glass block such that the angle of incidence is (i) 0° (ii) 42°. Sketch a diagram to show the approximate path taken by the ray in each case as it passes through the glass block and emerges from it. [2]

(b)   State the conditions required for total internal reflection of light to take place.   [2]

(c)   Copy and complete the following table: [2]

Types of Lens	Position of Object	Nature of Image	Size of Image
Convex	At F		
Concave	At infinity		

(d)   (i)   Why is white light considered to be polychromatic in nature?
(ii)   Give the range of the wavelength of those electromagnetic waves which are visible to us.   [2]

(e)   An ultrasonic wave is sent from a ship towards the bottom of the sea. It is found that the time interval between the sending and the receiving of the wave is 1.5 seconds. Calculate the depth of the sea if the the velocity of sound in sea water is 1400 ms^{-1}.   [2]

Question 3.

(a)   A stringed musical instrument, such as the Sitar, is provided with a number of wires of different thicknesses. Explain the reason for this.   [2]

(b)   What is meant by noise pollution? Write the name of one source of sound that causes noise pollution.   [2]

(c)   The equivalent resistance of the following circuit diagram is 4Ω .
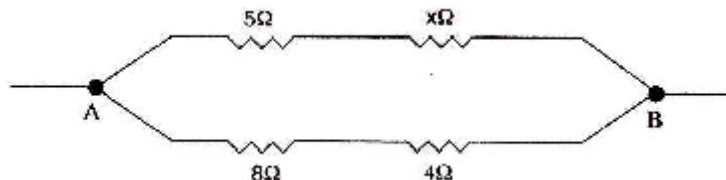
(d) An electric heater is rated 1000W–200V. Calculate:
(i) the resistance of the heating element.
(ii) the current flowing through it.   [2]

(e) (i) Give two characteristic properties of copper wire which make it unsuitable for use as fuse wire.
(ii) Name the material which is used as a fuse wire?   [2]

Question 4.

(a) The figure below shows an electromagnet.
(i) What will be the polarity at the end X?

(ii) Suggest a way by which the strength of the electromagnet referred to in the question, may be increased.   [2]
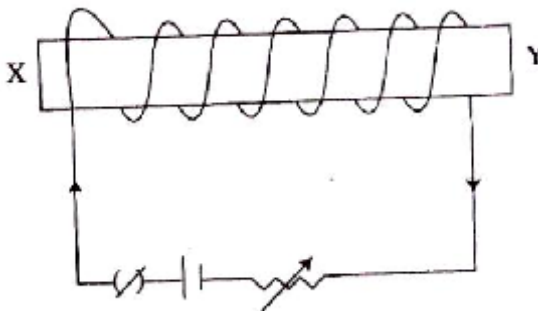

(b) Why do pieces of ice added to a drink cool it much faster than ice cold water added to it ?   [2]

(c) 40 g of water at 60°C is poured into a vessel containing 50 g of water at 20°C. The final temperature recorded is 30°C. Calculate the thermal capacity of the vessel. (Take specific heat capacity of water as 4.2 J $g^{-10}C^{-1}$).   [2]

(d) Give two important precautions that should be taken while handling radioactive materials.   [2]

(e) (i) What is the name given to atoms of a substance which have the same atomic number but different mass numbers?

(ii) What is the difference in the atomic structure of such

Question 5.

(a)   6.4 kJ of energy causes a displacement of 64 m in a body in the direction of force in 2.5 seconds. Calculate (i) the force applied (ii) power in horse power (hp). (Take 1 hp= 746 W).   [3]

(b)   A pulley system comprises two pulleys, one fixed and the other movable.
(i) Draw a labelled diagram of the arrangement and show clearly the directions of all the forces acting on it.

(ii) What change can be made in the movable pulley of this system to increase the mechanical advantage of the system? [3]

(c)   An object of mass 'm' is allowed to fall freely from point A as shown in the figure. Calculate the total mechanical energy of the object at:

(i) Point A   (ii) Point B   (iii) Point C

(iv) State the law which is verified by your calculations in parts (i). (ii) and (iii).   [4]
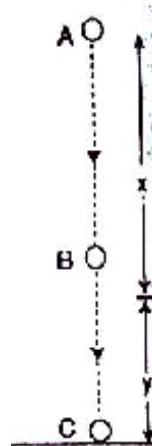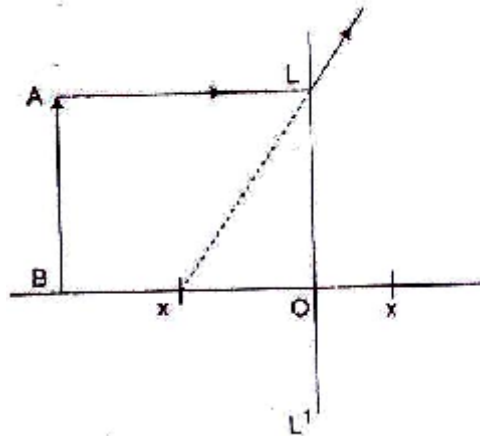

Question 6.

(a)   How does the value of angle of deviation produced by a prism change with an increase in the :

(i)   value of angle of incidence

(ii)   wave-length of incident of light ?   [3]

(b)   (i)   Copy and complete the diagram to show the formation of the image of the object AB.

        (ii)   What is the name given to x ?   [3]

(c)   (i)   The diagram below shows a ray of white light PQ coming from an object P and incident on the surface of a thick glass plane mirror. Copy the diagram and complete it to show the formation of three images of the object P as formed by the mirror.
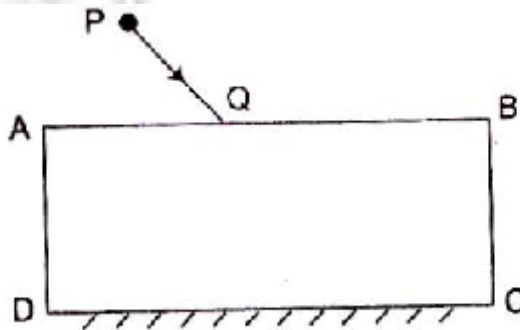
   (ii)   Which image will be the brightest image ?   [4]

Question 7.

(a)   (i)   What is the principle on which sonar is based ?

(ii)   Calculate the minimum distance at which a person should stand in front of a reflecting surface so that he can hear a distance echo. (Take speed of sound in air = 350 ms⁻¹.)   [3]

(b)   (i)   Name the characteristic of sound which enables a person to differentiate between two sounds with equal loudness but having different frequencies.
        (ii)   Define the characteristic named by you in (i).
        (iii)   Name the characteristic of sound which enables a person to differentiate between two sounds of the same loudness and frequency but produced by different instruments.   [3]

(c)   (i)   A person is tuning his radio set to particular station. What is the person trying to do to tune it ?
        (ii)   Name the phenomenon involved in tuning the radio set.
        (iii)   Define the phenomenon named by you in part (ii).   [4]

Question 8.

(a)   (i)   State ohm's Law.
        (ii)   Diagrammatically illustrate how you would connect a key, a battery, a voltmeter, an ammeter, an unknown resistance R and a rheostat so that it can be used to verify the above law.   [3]

(b)   (i)   Draw a neat and labeled diagram to show the structure of an a.c. generator.
        (ii)   State the energy conversion taking place in the generator when it is working.   [3]

(c)   (i)   The diagrams (a) and (b) given below are of a plug and a socket with arrows marked as 1, 2, 3 and 4, 5, 6 respectively on them. Identify and write Live (L), Neutral (N) and Earth (E) against the correct number.

(a) Plug   (b) Socket
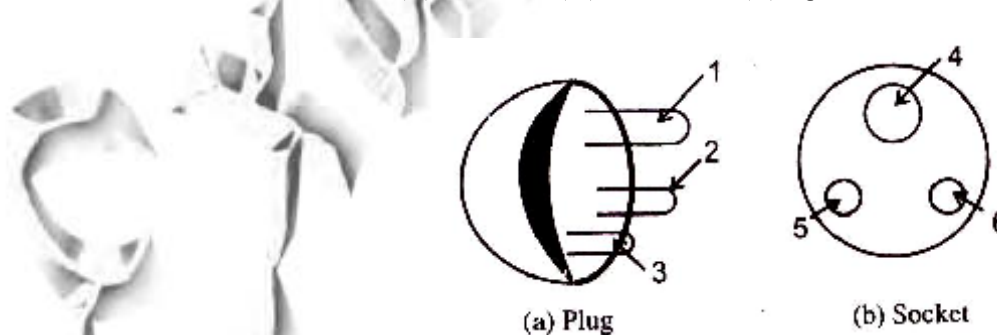
        (ii)   Calculate the electrical energy consumed when a bulb of 40 W is used for 12.5 hours everyday for 30 days.   [4]

Question 9.

(a)   State in brief, the meaning of each of the following :

(i)   The heat capacity of a body is 50 J °C.
(ii)   The specific latent heat of fusion of ice is 336000 J kg^{-1}.
(iii)   The specific heat capacity of copper is 0.4 J g^{-1} °C^{-1}.   [3]

(b)   (i)   What is the principle of method of mixtures?
        (ii)   Name the law on which this principle is based?   [3]

(c)   (i)   Calculate the amount of ice which is required to cool 150 g of
                water contained in a vessel of mass 100 g at 30°C, such that
                the final temperature of the mixture is 5 °C. (Take specific heat
                capacity of material of vessel as 0.4 J g^{-1} °C^{-1}, specific latent
                heat of fusion of ice = 336 J g^{-1}, specific heat capacity of water
                = 4.2 J g^{-1} °C^{-1})   [4]

Question 10.

(a)   (i)   What is meant by free electrons?
        (ii)   Why are they generally not able to leave the metallic surface?
        (iii)   Suggest one way by which these electrons could be made to leave the
                metal surface.   [3]

(b)   In a cathode ray tube why is the :
        (i)   Filament made of tungsten
        (ii)   Cathode plate coated with oxide of barium or strontium?
        (iii)   Thick glass screen coated with barium platinocyanide?   [3]

(c)   A nucleus $^{A}_{Z}X$ emits an alpha particle followed by γ emission, thereafter it
        emits two β particles to form X$_3$.

        (i)   Copy and complete the values of A and Z for X$_3$:

                $$^{A}_{Z}X \xrightarrow{-a} X_2 \xrightarrow{-2\beta} ....._{.....}X_3$$

        (ii)   Out of alpha (α) beta (β) and gamma (γ) radiations :
                (i)   Which radiation is the most penetrating ?
                (ii)   Which radiations are negatively charged?   [4]

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SECTION-I (40 MARKS)

(Attempt all question from this section)

Answer 1.

(a)   (i) $\Delta p = \Delta(mv)$ (ii) $\Delta p = m \Delta v$

(b)   (i)   Velocity ratio.

               (ii)   Velocity ratio is the ratio of velocity of effort to the velocity of load.

(c)   SI unit of energy – Joule

                            $1 \text{ eV} = 1.6 \times 10^{-19}$ Joule

(d)   (i)   Light energy to electrical energy.
               (ii)   Electrical energy to magnetic energy.

(e)   m= 5 kg,   v=10m/sec.

$$\frac{kE_1}{kE_2} = \frac{\frac{1}{2}m_1v_1^2}{\frac{1}{2}m_2v_2^2} = \frac{5 \times 10^2}{10 \times 5^2} = \frac{2}{1}$$

$$= 2:1$$
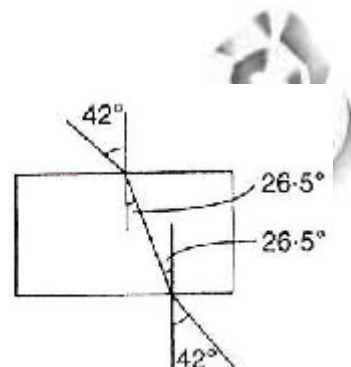
Answer 2.

(a)

(i)
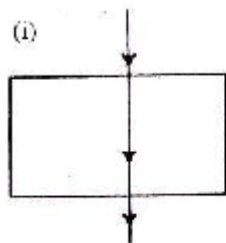
(ii) $n = \dfrac{\sin i}{\sin r}$

$1 \cdot 5 = \dfrac{\sin 42}{\sin r}$

$r = 26 \cdot 5°$

(b)   Conditions necessary for total internal reflection to take place are:
(i) Angle of incidence must be greater than critical angle for the pair of media.
(ii) Ray should move from denser medium to rarer medium.

(c)

Lens	Position	Nature	Size
Convex	At F	Real, Inverted	Highly magnified
Concave	AT infinity	Virtual, Erect	Diminished to a point

(d)   (i) It is because white light is made up of seven colours or wavelengths. On passing white light through a prism, a spectrum of seven colours is seen i.e. VIBGYOR. Hence,it is considered to be polychromatic.

(ii) Range of wavelength which is visible to us is $4000 \overset{0}{A}$ to $8000 \overset{0}{A}$.

(e)   t = 1.5 sec
$v = 1400 \text{ ms}^{-1}$
If d is the depth of the sea, then

$v = \dfrac{2d}{t}$

$\Rightarrow d = \dfrac{vt}{2} = \dfrac{1400 \times 1.5}{2} = 1050 \text{ m}$

Answer 3.

(a) String instruments such as sitar is provided with no. of wires of different thickness so that frequency of vibration could be altered.

(b) **Noise Pollution:** Sound which is produced by irregular succession of disturbances is called noise pollution , e.g grinding machine.

(c)
$$\frac{1}{4} = \frac{1}{12} + \frac{1}{5+x}$$

$$\frac{1}{5+x} = \frac{1}{4} - \frac{1}{12}$$

$$\frac{1}{5+x} = \frac{1}{6}$$

$$5 + x = 6$$

$$x = 1\Omega \qquad \text{Ans.}$$

(d) 1000 w – 200 V

(i)
$$p = \frac{v^2}{R}$$

$$1000 = \frac{200^2}{R}$$

$$R = 40\Omega \qquad \text{Ans.}$$

(ii) V= IR
200 = I x 40
I = 5 amp.   Ans.

(e)   (i) Two characteristics which make Cu wire unsuitable for using as a fuse wire are (a) low resistivity and (b) high melting point.

(ii) Material used for fuse wire → alloy of lead and tin.

Answer 4.

(a)   (i) Polarity at the end X → North pole.
(ii) By reducing the resistance or increasing the current in circuit by means of rheostat.

(b)   Because ice has latent heat of fusion of 336 J and thus it takes an additional heat of 336 J from the drink than an equal mass

(c)   Heat given by hot water = $40 \times 4.2 \times (60-30)$ = 5040 J
Heat taken by cold water = $50 \times 4.2 \times (30-20)$ = 2100 J
Heat taken by vessel = $C' \times (30-20)$ = 10C' where C' is the
thermal capacity of vessel.
If there is no loss of energy, heat given by hot water = heat taken by cold
water and vessel
5040 = 2100 + 10C'
10C' = 2940
C' = 294 J $^{\circ}C^{-1}$

(d)   Two important precautions while handling radioactive materials
are:
(i) Should wear lead aprons and lead gloves.
(ii) Should place radioactive material in thick lead containers.

(e)   (i) Substances which have the same atomic no. but different
mass numbers are isotopes.
(ii) Such atoms have same number of protons but different
numbers of neutrons in their nuclei.

SECTION-II (40 Marks)
(Attempt any four questions from this section)

Answer 5.

(a)   (i) We know
$W = F \times d$

$6.4 \times 10^3 = F \times 64$
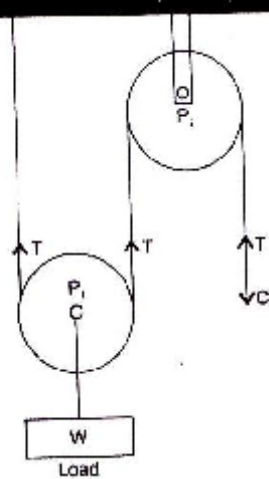
$F = 100 \, N$

(ii) $P = \dfrac{W}{t}$

$= \dfrac{6.4 \times 10^3}{2.5}$

$= 2560 \, watt.$

$746 \, watt = 1 hp$

$2560 \, watt = \dfrac{1 \times 2560}{746} = 3.43 \, hp$

(b)   (i)

65°
(4e)

(ii) M.A. of the system can be increased by reducing the friction in the pulley bearings and reducing the weight of the movable pulley.

(d) (i) **At point A**

Velocity = 0

Potential energy = mg(x+y)

Knetic energy = 0

Total mechanical energy = PE +KE = mg(x+y)

(ii) **At point B**

Velocity acquired ,$v = \sqrt{0+2gx}$

PE = mgy

$KE = \dfrac{1}{2}m \times 2gx = mgx$

Total mechanical energy = PE +KE = mgy + mgx = mg(x+y)

(iii) **At point C**

Velocity acquired ,$v = \sqrt{0+2g(x+y)}$

PE = mg×0 = 0

$KE = \dfrac{1}{2}m \times 2g(x+y) = mg(x+y)$

Total mechanical energy = PE +KE = 0 + mg(x+y) = mg(x+y)

(iv) Calculations in part (i), (ii), (iii) verified the law of conservation of mechanical energy.
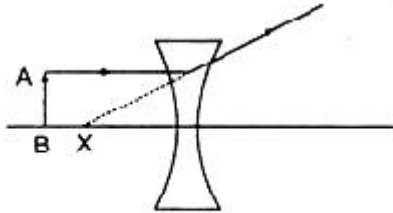
Answer 6.

(a) (i)
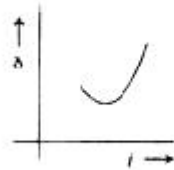
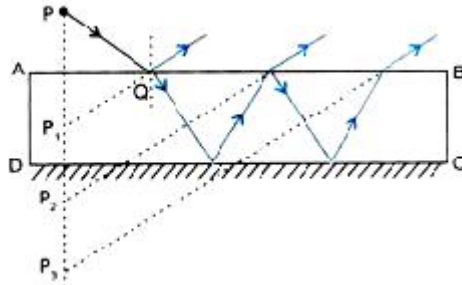(ii) As wavelength increases angle of deviation decreases.

(b) (i)

(ii) Name of X is focus.

(c) (i)

(ii) Second image will be the brightest.

Answer 7.

(a) (i) Sonar is based on the principle of echo.

(ii) To hear echo distinctly, the minimum time travel between the wave sent and wave received after reflection must be t= 0.1 s.

$$\text{Speed of sound } V = \frac{2d}{t}$$

$$350 = \frac{2d}{0.1}$$

$$\therefore \text{Minimum distance, } d = \frac{350 \times 0.1}{2} = 17.5\,m$$

(b) (i) Pitch enables a person to differentiate b/w two sounds with equal loudness but having different frequencies.

(ii) Pitch : It is that characteristic of sound which depends on its frequency and by which a grave sound can be distinguished from a shrill sound.

(iii) Quality of the sound enables a person to differentiate between two sounds of same loudness and frequency but produced by different instruments.

(c) (i) To tune a particular radio station in a radio set, the person produces vibrations in the electrical circuit of his set (containing an

waves transmitted from that particular radio station (by changing the capacity of condenser).

(ii) Phenomenon involved in tuning the radio set is electrical resonance.

(iii) **Resonance :** If external applied frequencies matches up with the natural frequency of the body then the amplitude of vibration increases tremendously. This is known as resonance.

Answer 8.

(a)   (i)   Ohm's Law : If physical conditions of the conductor remains the same and temperature is constant then potential difference across the conductor is directly proportional to the current flowing in it. This is known as Ohm's law.

(ii)
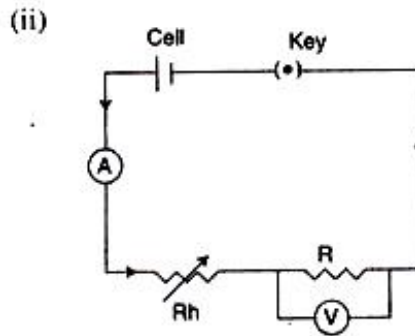
(b) (i) Diagram of a.c. generator is shown below :
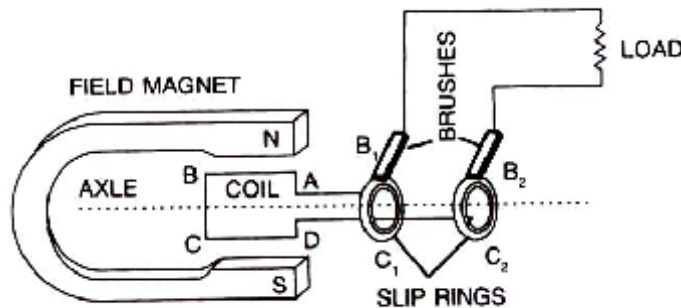
(ii)   Energy conversion is mechanical energy to electrical energy.

(c)   (i)   Plug   1 → Earth   Socket   4 → Earth
                        2 → Neutral   6 → Live
                        3 → Live   5 → Neutral   www.examrace.com

Answer 9.

(a) (i) Heat capacity of a body is 50 J/^{o}C → It means 50 joule of heat energy is required to raise the temperature by 1°C.

(ii) Amount of heat required to melt 1kg of ice at 0°C without change in its temperature is 336000 J.

(iii) 0.4 J of heat is required to raise the temperature of 1g of copper by 1°C.

(b) (i) Principle of method of mixtures
→ Heat given by hot body = Heat taken by cold body

(ii) Law of conservation of energy.

(c) Given : 150 g cold water at 30°C
100 g of vessel at 30°C

Heat given = Heat taken
150 x 4.2 x (30-5) + 100 x 0.4 x (30-5) = m x 336 + m x 4.2 x (5-0)
15750 + 1000 = 357 m
m = 46.91 g

Answer 10.

(a) (i) Free electron : Electron in the outer most shell leave their individual atom and are thus free to move inside the solid such that they remain within the boundary of the solid and remain a part of the solid as a whole. They are called free electrons.

(ii) They are not able to leave the metallic surface because they do not have sufficient kinetic energy to overcome the force of attraction of positive ions and leave the metal surface.

(iii) If we provide the energy from outside by heating the metal surface then free electrons acquire sufficient kinetic energy and leave the surface.

(b) (i) because it has very high melting point.
(ii) to reduce its work function.
(iii) because it is a fluorescent material and the electron beam on striking the screen gives a bright spot due to fluorescence on screen.

(c) (i) $_Z^A X \xrightarrow{\ -\alpha\ } _{Z-2}X_1^{A-4} \xrightarrow{\ -\gamma\ } _{Z-2}X_2^{A-4} \xrightarrow{\ -2\beta\ } _ZX_3^{A-4}$

(ii) γ is most penetrating.

(iii) Beta particles are negatively charged.