ICSE Class 10 Physics Question Paper Solution 2020

SECTION I (40 Marks)

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

Question 1

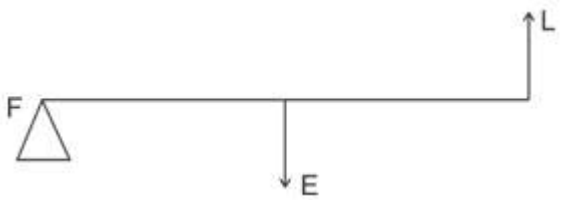
(a) (i) Define moment of force. **[2]**

(ii) Write the relationship between the SI and CGS unit of moment of force.

(b) Define a kilowatt hour. How is it related to joule? **[2]**

(c) 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]**

(d) (i) Identify the class of the lever shown in the diagram below: **[2]**



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

(e) Give one example of each when: **[2]**

(i) Chemical energy changes into electrical energy.

(ii) Electrical energy changes into sound energy.

Comments of Examiners	Suggestions for Teachers
(a) (i) Majority of the candidates were able to answer this question correctly. Some errors which were observed are as follows: - Instead of writing 'line' of action, they wrote 'point' of application. In many cases, candidates did not mention *perpendicular distance*. Some even mentioned *displacement*. - Some merely wrote *turning effect* and did not mention the axis of rotation or fulcrum. Instead of turning effect of	▪ *Explain the difference between distance and perpendicular distance. Also, the difference between the point of application of force and line of application of force should be explained.* ▪ *Draw diagrams corresponding to the two different situations and probe till the concept is clear.* ▪ *Train students to write definition in a statement form instead of a formula.*

force, many wrote turning effect of a *body*.

(ii) Most of the candidates answered it correctly. But some made following errors:
A few candidates wrote 1 N m= 10^7 erg instead of dyn-cm.
Some wrote 1 J=10^7 dyn.
Some related the SI and CGS unit of *force*, instead of relating the SI and CGS unit of *moment of force*.

(b) Most candidates could establish the relation between kW h and J. Some errors were as follows:

- Several candidates did not mention that it is the energy consumed / required; in some cases, they mentioned *power*.
- Some comprehended 1kW h as 1watt energy consumed in 1 hour.
- Some candidates used the *concept of kilo* and multiplied by 10^3 for writing the relation between *kilowatt hour* and *joule*.
- A few candidates committed errors in converting 1kW h to J, or while converting into MJ.

(c) Most candidates answered correctly. However, some candidates could not give a satisfactory reason for their answer. The mistake which they made was common i.e., they wrote displacement as zero. Candidates overlooked the words *work at any instant*.

(d) (i) Some candidates did not identify the class of lever correctly.

(ii) This part of the question was not answered by most candidates. Many candidates expressed the answer learnt by rote, i.e., "By increasing effort arm". They did not pay attention to the statement *without increasing the length of the lever*. The following errors were also observed.
- Some candidates wrote by *increasing load* or *by decreasing effort* without

- *Clearly illustrate the difference between a vector and a scalar quantity unit.*
- *Explain the derivation between the kW h and joule. Also administer a few sums on conversions in class to verify the students understanding.*
- *Advise students to comprehend a physical quantity before defining its unit.*
- *Give adequate practice in multiples and sub multiples of units along with conversion in the standard form.*
- *Discuss the uniform circular motion in detail. Clarify to students that the displacement is not zero at all places, but it is perpendicular to the centripetal force all the time during uniform circular motion. i.e. W=0 as angle between force and displacement is 90.*
- *Help students to develop the idea of correct identification of different classes of levers through diagrams.*
- *Clarify different ways of increasing and decreasing the effort arm. When the length of the lever is not the same, mechanical advantage (M.A.) can be increased by increasing the length of effort arm or decreasing the load arm. When the length of the lever is the same then the lengths can be changed only shifting positions of load and effort within the length of the lever to increase M.A.*
- *Teach students the difference between a microphone and a speaker and then relate them with respect to the energy conversions.*
- *Discuss maximum possible types of energy conversion in class.*

realising that as load changes, effort also changes proportionately.

- A few candidates wrote - *change the position of load and effort* without realising that the class of lever would change.

(e) (i) Most of the candidates answered it correctly. Many candidates were confused between 'cell in use' and 'charging of a cell'. A few candidates wrote vague answers.

(ii) A number of candidates answered this part correctly but following errors were also observed:

- Many of them wrote *microphone* instead of *loudspeaker*.
- Some gave technically incorrect answers such as, *bell* instead of an *electric bell*.

MARKING SCHEME

Question 1

(a)	(i)	The turning effect of force (on a body pivoted) about an axis/fixed point/ a point or the product of magnitude of force and the perpendicular distance of line of action of force from the axis of rotation/fulcrum or moment = $F \times d$ where d = perpendicular distance between the point of application of force and axis of rotation / fulcrum.
	(ii)	1 N m = 10^7 dyn cm or 1 dyn cm = 10^{-7}N m
(b)		One kilowatt hour is the energy spent/ or work done by a source of power 1kW in one hour (1000 W in 3600 s) Or it is the work done when 1 kW power is consumed for one hour or any statement to this effect. 1kW h = 3.6 x 10^6 J or 1 kW h = 3.6 M J
(c)		Zero Force/centripetal force (of gravity) is always perpendicular to the displacement. OR $W = Fs\ cos90$ W = 0
(d)	(i)	Class III

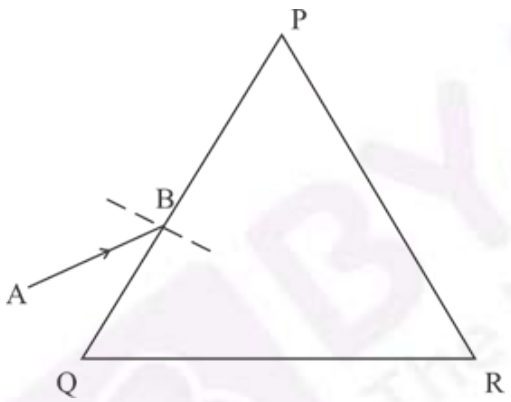
	(ii)	By shifting effort away from the fulcrum/ towards the load Or Shifting load towards effort/decreasing the load arm.
(e)	(i)	Dry cell
	(ii)	Loudspeaker / Electric bell

Question 2

(a) A crane **'A'** lifts a heavy load in 5 seconds, whereas another crane **'B'** does the same work in 2 seconds. Compare the power of crane **'A'** to that of crane **'B'**. **[2]**

(b) A ray of light falls normally on a rectangular glass slab. **[2]**
Draw a ray diagram showing the path of the ray till it emerges out of the slab.

(c) Complete the path of the monochromatic light ray AB incident on the surface PQ of the equilateral glass prism PQR till it emerges out of the prism due to refraction. **[2]**



(d) Where should an object be placed in front of a convex lens in order to get: **[2]**

(i) an enlarged real image

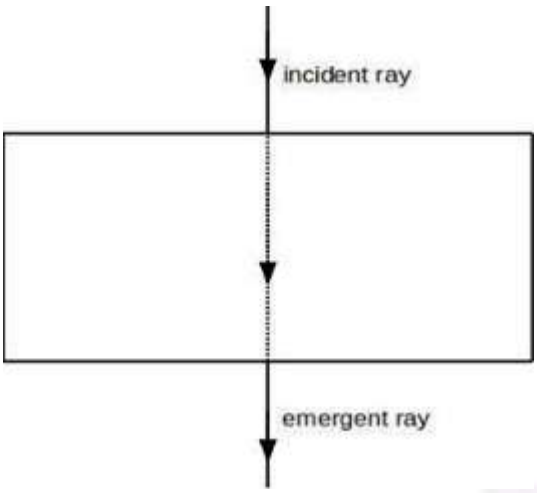
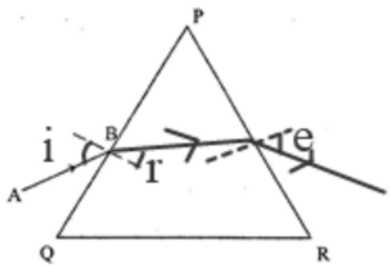
(ii) enlarged virtual image?

(e) A pond appears to be 2.7 m deep. If the refractive index of water is 4/3, find the actual depth of the pond. **[2]**

Comments of Examiners	Suggestions for Teachers
(a) This part was well attempted by a number of candidates. Some did not express their answers in ratio form and left it in fractional form. A few did not get the inverse proportion between power and time for same work. Some candidates wrote their answer in the form of > and < and not in ratio form. (b) Some candidates took the ray normal at one surface but after refraction, the ray shown was bent at the other surface. The angle with the second surface was marked as 90^0 by them. Several candidates did not mark arrows on the rays. (c) Majority of the candidates answered correctly barring some who showed dispersion or some who missed marking arrows on the rays. (d) Many candidates wrote the positions of the objects correctly in subparts (i) and (ii) corresponding to the asked nature of the images. However, some candidates were confused in F_1 and $2F_1$, F_2 and $2F_2$, between virtual and real image, etc. A few candidates answered by drawing ray diagram, which was not asked. (e) Most candidates answered this part correctly. However, some made the following errors: - Wrote incorrect formula. - Took shift as apparent depth. - Made calculation errors. - Did not write the unit in the final answer.	▪ *Instruct students that whenever comparison is asked, answer in ratio form if the data is available to calculate the ratio. If data is not available, it can be accepted in > or < form.* ▪ *Train students to write calculated ratio, with the left-hand side of the expression to clarify which quantity is compared with which i.e., whether the first quantity is compared with the second one or vice versa.* ▪ *Give adequate practice of drawing ray diagrams on a rectangular glass slab, taking the incident ray obliquely / normally.* ▪ *Explain the difference between monochromatic and poly chromatic light clearly.* ▪ *Teach students how to draw normal to an inclined surface.* ▪ *Instruct students to mark arrows on the rays before and after refraction.* ▪ *Familiarise students with related terminology. e.g. centre of curvature or 2F with respect to second focal length.* ▪ *Tell students that if a descriptive question is asked, the answer cannot be in the form of a diagram.* ▪ *Point out the difference between real depth and apparent depth and shift clearly to students. More practice of these type of numerical problems should be given.* ▪ *Advise students to write the data before substituting the values in the formula.* ▪ *Lay stress on writing the final answer with the unit.*

MARKING SCHEME

Question 2

(a)	$P_A / P_B = W_A / t_A \div W_B / t_B$ $\therefore P_A / P_B = W_A / t_A \times t_B / W_B$ but $W_A = W_B \therefore P_A / P_B = t_B / t_A$ $\therefore P_A : P_B = 2 : 5$ *(Or any other correct method)*	
(b)	Ray with correct name and arrow marks carries  	
(c)	 	
(d)	(i)	Object is placed between F and 2F Or at F
	(ii)	Object is placed between F and O / within the focal length/between lens and F
(e)	Apparent depth = 2.7 m μ = actual depth [Real depth]/Apparent depth. 4/3 = X/2.7 X = 4/3 x2.7 = 3.6 m. *(Any other correct method)*	

Question 3

(a) The wave lengths for the light of red and blue colours are nearly 7.8 x 10^{-7} m and 4.8 x 10^{-7} m respectively. **[2]**

(i) Which colour has the greater speed in a vacuum?

(ii) Which colour has a greater speed in glass?

(b) Draw a graph between displacement from mean position and time for a body executing free vibration in a vacuum. **[2]**

(c) A sound wave travelling in water has wavelength 0.4 m. **[2]**
Is this wave audible in air? (The speed of sound in water = 1400 ms^{-1})

(d) Why does stone lying in the sun get heated up much more than water lying for the same duration of time? **[2]**

(e) Why is it not advisable to use a piece of copper wire as fuse wire in an electric circuit? **[2]**

Comments of Examiners

(a) (i) Most candidates answered this part correctly but a few who did not know the concept wrote *blue* or *red* randomly. Some candidates treated wavelengths as speed.

(ii) Some candidates did not establish a relation between speed and wavelength in a medium and thus wrote incorrect answers. Several candidates just wrote *blue* randomly.

(b) Many candidates drew the free vibrations in vacuum graphically in a correct manner, but axes were not labelled. A few candidates did not take X-axis as the mean position. Some candidates drew a single curve while several drew a graph of minimum deviation and angle of incidence but labelled the axes as *displacement* and *time*. A few candidates drew the graph only in the positive quadrant of the graph. It did not have any negative amplitude. Many candidates drew the graph for damped vibrations.

(c) Many candidates committed the mistake of simply writing "audible in air" or "not audible" without calculating frequency. Some wrote an incorrect unit of frequency. A few used the velocity formula of echo. Several candidates

Suggestions for Teachers

- *Tell students that the velocity of light of all colors in vacuum or air remains the same and it changes only when the medium changes.*
- *Give sufficient practice of graph-based questions. Also, clarify that in free vibrations, the amplitude remains the same, above and below the X-axis, that is, the wave is equally spaced about the mean position.*
- *Explain to students the difference in the graph of free and damped vibrations.*
- *Acquaint students with the relation velocity=frequency × wavelength, the unit of frequency and the audible range of frequency.*
- *Point out the difference between specific heat capacity and heat capacity.*
- *Train students to answer reasoning-based questions to the point.*
- *Clarify the difference between resistivity and resistance.*

were not aware of the audible range. Other candidates calculated 'time', treated it as time period to calculate frequency and finally wrote that the wave is not audible in air. A number of candidates used speed of sound in water as 336 m s^{-1} for calculation.

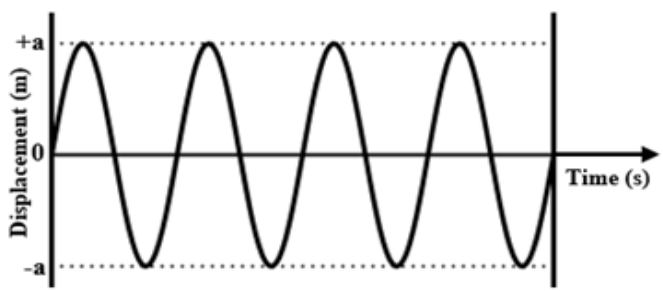
(d) Almost all the candidates gave partially correct answers. They related it to the difference in the absorption of heat or to heat capacity instead of specific heat capacity of the stone and water. Some candidates wrote that the stone takes less time since it is a good conductor instead of writing about the specific heat capacity.

(e) Majority of the candidates wrote about *resistance* instead of *resistivity*. Some candidates wrote the reason for not using a copper wire as a fuse wire was the low melting point of copper/copper melts quickly/low specific heat capacity of copper. Some wrote the characteristics of a fuse only without comparing it with copper.

- *Discuss fuse, its characteristics and uses in detail. Also, explain how a fuse wire can be compared with copper wire.*

MARKING SCHEME

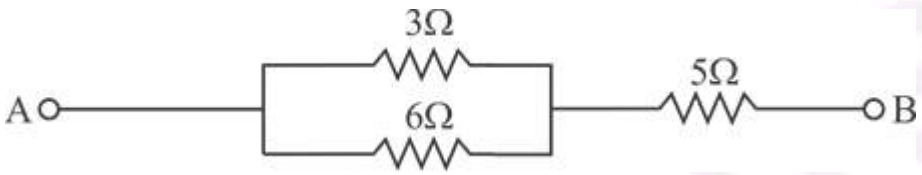
Question 3

(a)	(i)	In vacuum, both have the same speed.	
	(ii)	In glass, red light has greater speed.	*(Or any correct statement)*
(b)			
(c)	V = $f\lambda$ 1400 = $f \times 0.4$ f = 3500 Hz		

	Yes, it is audible.
(d)	The specific heat capacity of water is very much higher than that of stone. So, temperature of stone increases quickly by absorbing comparatively less heat than water.
(e)	Copper has low resistivity and high melting point whereas fuse wire should have low melting point and high resistivity.

Question 4

(a) Calculate the total resistance across AB: **[2]**



(b) Two metallic blocks P and Q having masses in ratio 2:1 are supplied with the same amount of heat. If their temperatures rise by same degree, compare their specific heat capacities. **[2]**

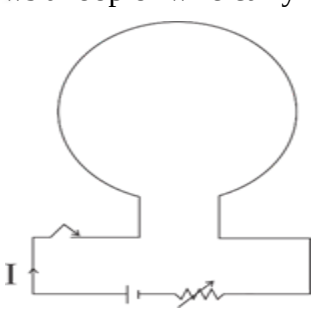
(c) When a current carrying conductor is placed in a magnetic field, it experiences a mechanical force. What should be the angle between the magnetic field and the length of the conductor so that the force experienced is: **[2]**

(i) Zero

(ii) Maximum?

(d) A nucleus ${}_{84}X^{202}$ of an element emits an alpha particle followed by a beta particle. The final nucleus is ${}_{a}Y^{b}$. Find a and b. **[2]**

(e) The diagram below shows a loop of wire carrying current I: **[2]**



(i) What is the magnetic polarity of the loop that faces us?

(ii) With respect to the diagram how can we increase the strength of the magnetic field produced by this loop?

Comments of Examiners

(a) Most of the candidates answered this part correctly. However, the following errors were also observed:

- In the parallel combination formula, substitution was incorrect.
- Calculation errors were common.
- Units were not written in the final answer.

(b) Following errors were observed:

- Substitution for masses was incorrect.
- Some candidates compared heat capacities.
- Several candidates substituted for masses correctly but could not express the specific heat capacities in the ratio form.

(c) This was answered correctly by most candidates. However, a few candidates answered this part of the question by keeping a coil in mind instead of a straight conductor. Some candidates were not able to write the angles between the magnetic field and the length of the conductor for the asked forces.

(d) Most of the candidates answered this part correctly. However, a few candidates did not answer *what is 'a' and 'b'* in the final nucleus and left the answer as $^{83}Y^{198}$, leaving it for the examiner to identify which is 'a' and which is 'b'. Some interchanged atomic and mass numbers.

(e) (i) Most of the candidates answered this part correctly, but some candidates wrote *north* instead of *south*. A few candidates wrote that the magnetic polarity of the loop that faces us as *south to north* or *north to south*, which was incorrect.

(ii) Some candidates did not pay attention to the loop shown in the diagram (the number of turns remains the same) and wrote that the strength of the magnetic field produced by this loop could be increased by increasing the number of turns of the coil. A few candidates wrote that the

Suggestions for Teachers

- *Give adequate practice of numerical problems / conceptual problems based on combination of resistors and specific heat capacity.*
- *Lay emphasis on correct mathematical operations.*
- *Revise conceptual questions in the class frequently.*
- *Train students to draw conclusion about the proportion of remaining quantities if some quantities are kept constant. Also, instruct them that comparison has to be expressed in ratio form only.*
- *Demonstrate the force experienced by a current carrying straight conductor and by a current carrying coil to the students for better understanding.*
- *Train students to find the atomic number and mass number of the products giving the reactants on emission of an α / β particle and vice-versa.*
- *Lay Stress on practicing balanced nuclear equations. Help students understand the correct position of mass number and atomic number of an element.*

strength of the magnetic field can be increased by increasing the magnetic strength.

MARKING SCHEME

Question 4

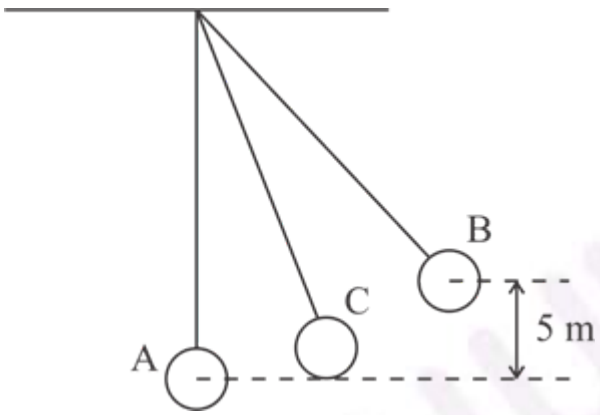
(a)	Parallel combination $R_1 = \frac{6 \times 3}{6+3}$ $\therefore R_1 = 2\Omega$ $R = 2 + 5 = 7\ \Omega$	
(b)	$m_p = 2$ m(say) $m_q = m$ $\Delta t_{p} = \Delta t_{q} = \Delta t$ (say) Heat given to the block P = Heat given to block Q $m_p \times c_p \times \Delta t = m \times c_q \times \Delta t$ $2\ m \times c_p \times \Delta t = m \times c_q \times \Delta t$ (correct formula with substitution) $C_p / C_q = 1/2$ $C_p : C_q = 1:2$	
(c)	(i)	0^o / zero or parallel (180,360…...)
	(ii)	90^o or Perpendicular (270….)
(d)	$_{84}X^{202} \rightarrow {}_{82}Z^{198} + {}_{2}He^{4}$ $_{82}Z^{198} \rightarrow {}_{83}Y^{198} + {}^{-1}\beta^{0}$ a = 83 and b = 198	
(e)	(i)	South
	(ii)	By increasing the strength of the current.

SECTION II (40 Marks)

Attempt any four questions from this Section

Question 5

(a) The figure below shows a simple pendulum of mass 200 g. It is displaced from the mean position A to the extreme position B. The potential energy at the position A is zero. At the position B the pendulum bob is raised by 5 m. **[3]**



(i) What is the potential energy of the pendulum at the position B?

(ii) What is the total mechanical energy at point C?

(iii) What is the speed of the bob at the position A when released from B? (Take g = 10 ms^{-2} and there is no loss of energy.)

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

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

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

(c) A block and tackle system of pulleys has velocity ratio 4. **[4]**

(i) Draw a neat, labelled diagram of the system indicating clearly the points of application and direction of load and effort.

(ii) What will be its V.R. if the weight of the movable block is doubled?

Comments of Examiners	Suggestions for Teachers
(a) (i) Several candidates did not convert mass from g to kg, hence the answer was incorrect. (ii) Many candidates did not realize the principle of conservation of energy involved in the	▪ *Lay stress on conversion of units.* ▪ *Train students to mention the principle involved while solving*

process. Some got this incorrect because of errors made in the first part. Many candidates simply wrote total mechanical energy =P.E. + K.E. but did not write the exact value.

(iii) Many candidates wrote the unit of *acceleration* instead of writing the unit of *velocity*. A large number of candidates could not apply the principle of conservation of mechanical energy and thus, could not arrive at the correct answer. Some wrote v^2 = 10 m/s. In this subpart, some candidates did not convert mass into the SI unit 'kg', however in the comparison of kinetic energy and potential energy, that is ½ m v^2 = m g h, as m was cancelled, they got the correct velocity, as the error got nullified.

(b) (i) Almost all candidates answered correctly. However, some only wrote *inside* or *outside* instead of writing *radially inside* or *radially outside the circular path*.

(ii) Barring a few, most candidates answered this part correctly.

(iii) Most candidates answered this part correctly. However, a few candidates wrote vague answers. They explained centrifugal and centripetal forces but did not compare their magnitudes. Some wrote that centripetal force is greater /more than centrifugal force.

(c) (i) Following errors were observed:
- No fixed support was shown.
- Strands drawn were loose.
- Connections shown were incorrect.
- Directions of either/both load and effort were not marked.
- Rough sketches of pulleys were drawn.

(ii) Most candidates wrote that V.R. becomes half/double.

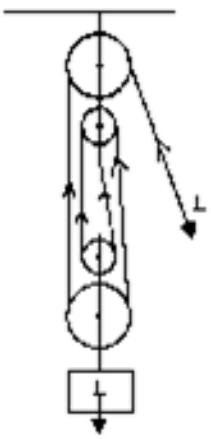
a numerical to arrive at the answer.

- *Give adequate practice to solve diagram-based questions / conceptual questions in class so that students can learn to apply the concept of conservation of energy.*
- *Clarify the concept of centripetal and centrifugal forces.*
- *Teach students that centripetal and centrifugal forces are equal in magnitude but opposite in direction.*
- *Train students to draw pulley related diagrams and how to mark the tension force in the strings. Practice should be given with odd and even velocity ratios.*
- *Clarify the concept of velocity ratio for a given design of machine and effect of friction or weight of the parts of the machine on the velocity ratio.*

MARKING SCHEME

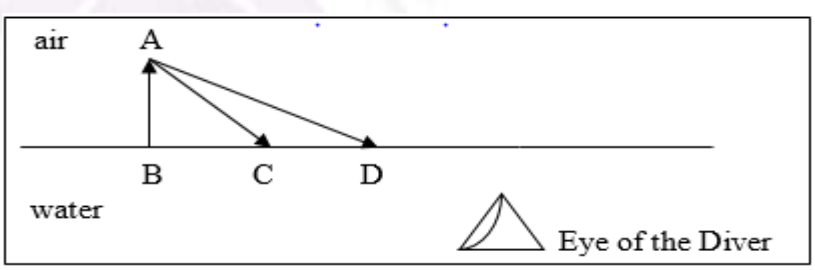
Question 5

(a)	(i)	PE = mgh = 0.2 x 10 x 5 = 10 J
	(ii)	10 J

	(iii)	v^2 = 2 x E/m = 2 x 10 /0.2 = 100 $\therefore v$ =10 m/s Or ½ $m v^2 = mgh$ $\therefore v = \sqrt{2gh}$
(b)	(i)	Centripetal force acts radially inward and centrifugal force acts radially outward.
	(ii)	No.
	(iii)	1: 1
(c)	(i)	
	(ii)	Velocity Ratio does not change and remains 4.

Question 6

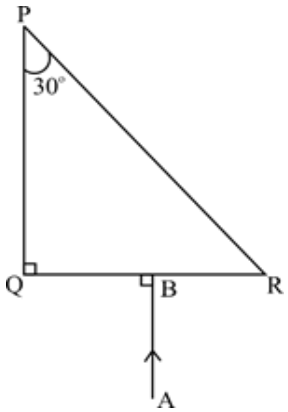
(a) A diver in water looks obliquely at an object AB in air. **[3]**



(i) Does the object appear taller, shorter or of the same size to the diver?

(ii) Show the path of two rays AC & AD starting from the tip of the object as it travels towards the diver in water and hence obtain the image of the object.

(b) Complete the path of the ray AB through the glass prism in PQR till it emerges out of the prism. Given the critical angle of the glass as 42^o. **[3]**



(c) A lens of focal length 20 cm forms an inverted image at a distance 60 cm from the lens. **[4]**

(i) Identify the lens.

(ii) How far is the lens present in front of the object?

(iii) Calculate the magnification of the image.

Comments of Examiners

(a) (i) Many candidates answered the part correctly. A few candidates made mistakes as they could not establish the relation of between the size image and change in medium. Some candidates considered the light ray passing from denser medium to rarer medium. Some wrote that the object appears *shorter* while others wrote, *of the same size*.

(ii) Candidates made several mistakes like:

1. Not marking arrows on rays.
2. Showing partial reflection with refraction.
3. Not showing extension of rays and dotted image.
4. Showing incorrect image position and incorrect refraction.

(b) Following errors were observed in this part:

– The ray entering the prism was shown bending.
– No angle of incidence was marked.
– After total internal reflection, the ray was shown coming out un-deviated.

Suggestions for Teachers

- *Give repeated practice of drawing ray diagrams.*
- *Train students to draw diagrams applying laws of refraction at every surface when the ray changes medium, rather than remembering the diagram by rote.*
- *Advise students to draw the diagram keeping in mind the refractive index of the medium, e.g. for water as 4/3.*
- *Lay stress on drawing arrows on rays before and after the refraction.*
- *Point out that virtual images should be dotted. Also, apparent intersection should be shown by dotted lines.*
- *Teach students the method to identify a given lens from the description given in the question.*
- *Clarify the following to students.*

– Refraction was shown at the second surface.
– The diagram was completed by treating it as right-angled isosceles prism.

(c) (i) Barring a few, all candidates identified the lens correctly.

(ii) Some candidates got incorrect answers due to improper sign convention and incorrect substitution.

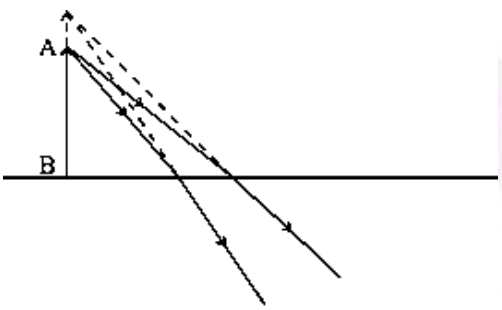
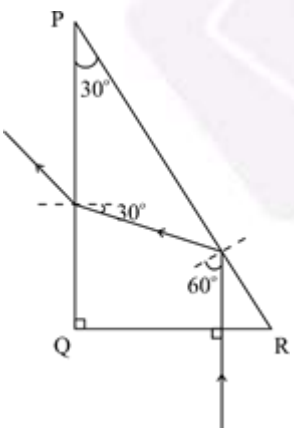
(iii) Some candidates did not consider the sign convention. A few candidates wrote unit for magnification.

– *Sign convention*
– *That pure ratio has no unit.*
– *Concept of linear magnification for both types of lenses.*

▪ *Adequate practice of numerical problems on the lens formula should be given.*

MARKING SCHEME

Question 6

(a)	(i)	Taller
	(ii)	 Eye of the diver
(b)		 – Ray travelling undeviated at QR – Total Internal Reflection at surface PR – Bending away at PQ.

(c)	(i)	Convex lens
	(ii)	f = 20 cm, v = 60 cm $\frac{1}{f}=\frac{1}{v}-\frac{1}{u} \quad \therefore \frac{1}{20}=\frac{1}{60}-\frac{1}{u}$ $\therefore \frac{1}{u}=\frac{1}{60}-\frac{1}{20}=\frac{1-3}{60}=\frac{-2}{60} \quad \therefore u=-30\ cm$
	(iii)	$m=\frac{v}{u}=\frac{60}{-30}=-2$

Question 7

(a) Give reasons for the following: **[3]**

During the day:

(i) Clouds appear white.

(ii) Sky appears blue.

(b) (i) Name the system which enables us to locate underwater objects by transmitting ultrasonic waves and detecting the reflecting impulse. **[3]**

(ii) What are acoustically measurable quantities related to pitch and loudness?

(c) (i) When a tuning fork [vibrating] is held close to ear, one hears a faint hum. The same [vibrating tuning fork] is held such that its stem is in contact with the table surface, then one hears a loud sound. Explain. **[4]**

(ii) A man standing in front of a vertical cliff fires a gun. He hears the echo after 3.5 seconds. On moving closer to the cliff by 84 m, he hears the echo after 3 seconds. Calculate the distance of the cliff from the initial position of the man.

Comments of Examiners

(a) (i) Many candidates used the term *reflection* or *dispersion* instead of *scattering*. The *size* of the particles and *uniform scattering* was not mentioned by some candidates. Some candidates were confused between the white colour of the sky at noon and white colour of clouds. They mixed both concepts and wrote the answer.

(ii) Most of the candidates explained this part correctly. However, some candidates did not

Suggestions for Teachers

- *Lay stress on key words like dispersion and scattering.*
- *Explain dependence of extent of scattering with respect to wavelength of light.*
- *Give sufficient practice on conceptual / reasoning-based questions.*
- *Clarify the difference between a process and a system.*

compare the wavelength. A few candidates gave incorrect reasons.

(b) (i) Most of the candidates gave the correct answer 'SONAR'. However, some candidates wrote the process as 'echo depth sounding'.

(ii) Some candidates wrote the unit for pitch while some gave the answer as *quality*. For *loudness* many candidates wrote *amplitude* which was incorrect.

(c) (i) Some candidates related it to resonance rather than surface area.

(ii) Most candidates were able to form correct equations but could not solve the same correctly.

- *Explain the subjective nature of characteristics of sound and the objective nature of the physical quantities on which they depend, with relevant examples.*
- *Explain about free vibrations, forced vibrations and resonance. Also discuss conceptual problems.*
- *Give adequate practice on echo based conceptual / numerical problems.*
- *Advise students to draw a rough diagram for better comprehension and for framing correct equations.*

MARKING SCHEME

Question 7

(a)	(i)	Due to greater size of particles of clouds all colours scatter equally/uniformly.
	(ii)	Due to smaller size of particles of atmosphere blue with shorter wavelength scatters more than colours of longer wavelength.
(b)	(i)	SONAR/ Sound Navigation and Ranging
	(ii)	For pitch – it is frequency For loudness – it is intensity of sound
(c)	(i)	A tuning fork held close to ear, disturbs a small volume of air and hence, sound heard is faint. When the handle of the vibrating tuning fork is held against table it sets up forced vibrations in the tabletop. As tabletop has a large surface area large volume of air is set into vibration transmitting more energy thereby producing loud sound.
	(ii)	Let the distance between cliff and initial position of the man be x *m.* Total distance travelled by the sound = $2x$ Time taken = 3.53 Speed of sound = $\frac{2x}{3.5}$ ……..…1 When the moves 84 m closer to cliff Distance travelled = 2 (x – 84) Time taken to hear echo = 3 s

Speed of sound = $\frac{2(x-84)}{3}$ ……..2

From 1 and 2

$\frac{2x}{3.5} = \frac{2(x-84)}{3}$

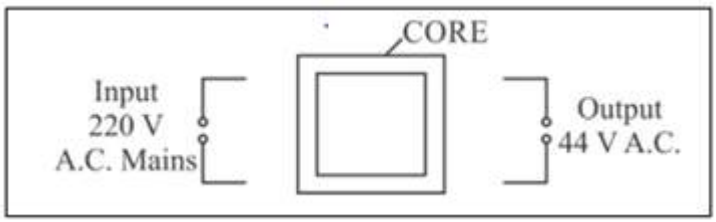
$7x - 588 = 6x$

$x = 588\ m$

The required distance = 588 m

Question 8

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



(i) State the material used for the core.

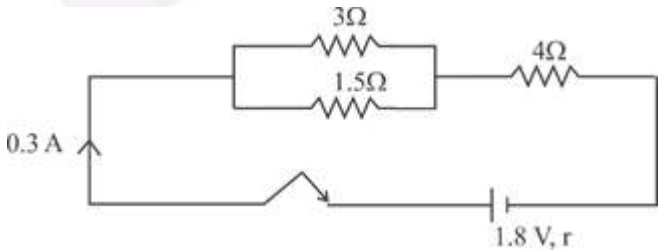
(ii) Copy and complete the diagram of the transformer by drawing input and output coils.

(b) (i) What are superconductors? **[3]**

(ii) Calculate the current drawn by an appliance rated 110 W, 220 V when connected across 220 V supply.

(iii) Name a substance whose resistance decreases with the increase in temperature.

(c) **[4]**



The diagram above shows three resistors connected across a cell of e.m.f. 1.8 V and internal resistance *r*. Calculate:

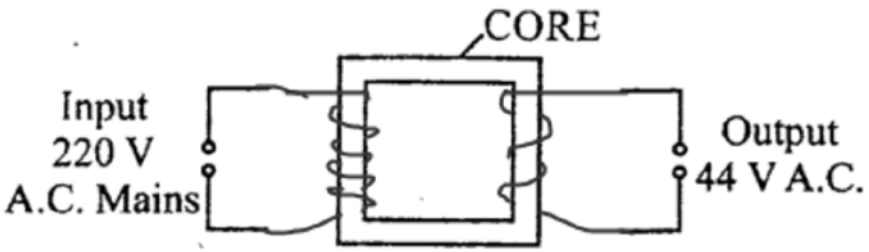
(i) Current through 3 W resistor.

(ii) The internal resistance *r*.

Comments of Examiners	Suggestions for Teachers
(a) (i) Most of the candidates answered correctly but a few candidates stated the wrong material to be used for the core. (ii) Many candidates did not connect the coil to the terminals shown in the diagram. Some showed the coils in the incorrect arms or showed incorrect number of turns of the coil i.e. more turns for less voltage and vice-versa. A few candidates labelled it correctly. (b) (i) Most of the candidates answered this part correctly but some candidates were confused between *superconductors* and *semiconductors*. (ii) A large number of the candidates solved this problem correctly. However, following errors were noticed in many scripts: - errors in copying the given data - error in calculation - unit not written - incorrect unit given (iii) Almost all candidates answered correctly, but some wrote random names such as, galvanized rubber, metals, copper, aluminium, tungsten, constantan, mangnanin, nichrome, which were incorrect. (c) (i) Some candidates solved this question correctly. However, a few candidates took potential difference across 3 Ω as 1.8 V. Several candidates did incorrect calculation of external resistance. Hence, the calculation for current through the given resistor was also incorrect. A few candidates either used incorrect formula or made calculation errors. Some candidates did not write the unit. (ii) Some candidates considered the *emf* as the terminal voltage. A few candidates wrote incorrect unit of the asked physical quantity.	▪ *The construction and working of a transformer should be explained clearly to students.* ▪ *Sufficient practice of drawing labelled diagrams should be given to students with clear explanation of the working.* ▪ *In the definition of superconductors, instead of 'very low resistance' it is advisable to write 'at temperatures closer to the absolute zero', as very low is vague. The concept of superconductivity with infinite conductance must be explained clearly.* ▪ *Help students by giving regular practice of solving numerical.* ▪ *Discuss variation of resistance with temperature in detail.* ▪ *Explain the combination of resistors in series and parallel thoroughly to students.* ▪ *Give adequate practice of conceptual / numerical problems based on combination of resistors.* ▪ *Comparison of the EMF, terminal voltage with the voltage drop should be explained in detail.*

MARKING SCHEME

Question 8

(a)	(i)	laminated soft iron
	(ii)	
(b)	(i)	A superconductor is a substance whose resistance is zero at temperature closer to absolute zero.
	(ii)	P = VI 110 = 220 X I $I = \frac{110}{220} = \frac{1}{2} = 0.5\ A$
	(iii)	Carbon/ silicon/germanium or a semi-conductor
(c)	(i)	$I_{3\Omega} = \frac{0.3 \times 1.5}{3 + 1.5} = \frac{0.45}{4.5}$ $\therefore I_{3\Omega} = 0.1\ A$
	(ii)	$R_1 = \frac{1.5 \times 3}{1.5 + 3} = 1\Omega \quad E = I(R + r) \quad \therefore 1.8 = 0.3(5 + r)$ $\therefore r = \frac{1.8}{0.3} - 5 = 6 - 5 = 1\Omega$ OR Terminal voltage = $0.3\ [(0.3\times1.5)/(3+1.5) + 4]$ $= 1.5$ V $\therefore 1.8 - 1.5 = 0.3 \times r$ $\therefore r = 1\Omega$

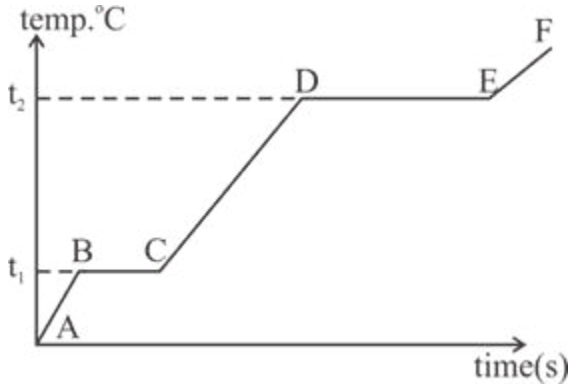
Question 9

(a) (i) Define heat capacity of a substance. **[3]**

(ii) Write the SI unit of heat capacity.

(iii) What is the relationship between heat capacity and specific heat capacity of a substance?

(b) The diagram below shows the change of phases of a substance on a temperature vs time graph on heating the substance at a constant rate. **[3]**



(i) Why is the slope of CD less than slope of AB?

(ii) What is the boiling and melting point of the substance?

(c) A piece of ice of mass 60 g is dropped into 140 g of water at 50°C. **[4]**
Calculate the final temperature of water when all the ice has melted.
(Assume no heat is lost to the surrounding)
Specific heat capacity of water = 4.2 $Jg^{-1}k^{-1}$
Specific latent heat of fusion of ice = 336 Jg^{-1}

Comments of Examiners

(a) (i) Almost all candidates answered correctly barring a few, who wrote the definition of specific heat capacity. Instead some candidates wrote the definition assuming the substance to be water.

(ii) Most candidates answered correctly but a few wrote the unit of specific heat capacity.

(iii) Some candidates wrote the relationship between heat capacity and specific heat capacity of a substance in the form of symbols without giving the meaning of the symbols.

(b) (i) Many candidates could not answer this question correctly. They related it with the time.

Suggestions for teachers

- *Clarify the difference between heat capacity and specific heat capacity.*
- *Insist on writing the SI unit of temperature kelvin, (K) for example, unit of heat capacity as J/K instead of J/C.*
- *Train students to learn the correct SI unit of a given physical quantity.*
- *Encourage students to write the relation between different physical quantities in words. If it is expressed in symbols, give the meaning of the symbols.*
- *Give more practice on graph-based questions.*

(ii) Most of the candidates answered correctly but a few wrote vague values such as, 100°C, 90 °C, etc. Some also wrote BC, DE as answers. A few candidates interchanged the values of melting point and boiling point of the substance. Some answered assuming the substance to be water.

(c) Majority of the candidates attempted this numerical correctly. However, the following errors were observed in other scripts:

- Not taking into consideration the heat absorbed by ice after melting to reach equilibrium temperature.
- Not substituting the change in temperature correctly.
- Not writing the unit for the final answer.

- *Point out the how specific heat capacity is different for different states of matter.*
- *Train students on how to read the information from the graph and interpret it correctly.*
- *Give sufficient practice on numerical problems based on the topic Calorimetry.*

MARKING SCHEME

Question 9

(a)	(i)	The amount of heat energy absorbed to raise the temperature of a body by unit degree is called as heat capacity.
	(ii)	unit - $J\ K^{-1}$
	(iii)	Heat capacity = mass × specific heat capacity
(b)	(i)	Specific heat capacity in liquid state is greater than specific heat capacity in solid state
	(ii)	Boiling point t_2 °C Melting point t_1 °C
(c)		$ml + mct = mct \ \therefore 60(336 + 4.2 \times x) = 140 \times 4.2 \times (50 - x)$ $\therefore 60 \times 4.2(80 + x) = 140 \times 4.2(50 - x)$ $3(80 + x) = 7(80 - x) \therefore 240 + 3x = 350 - 7x$ $\therefore 10x = 350 - 240 = 110 \quad \therefore x = \frac{110}{10} = 11°C$

Question 10

(a) (i) Draw a neat labeled diagram of a d.c. motor. **[3]**

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

(b) (i) Differentiate between nuclear fusion and nuclear fission. **[3]**

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

(c) An atomic nucleus A is composed of 84 protons and 128 neutrons. The nucleus **A** emits an alpha particle and is transformed into a nucleus **B**. **[4]**

(i) What is the composition of B?

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

(iii) What is mass number of the nucleus A?

(iv) Does the composition of C change if it emits gamma radiations?

Comments of Examiners

(a) (i) Many candidates drew the diagram of a d.c. motor correctly. However, in some scripts the following errors were observed:

- drew diagram of AC generator.
- did not label the diagram or labeled incorrectly.
- drew slip rings instead of split rings.
- drew the diagram with the load.
- did not draw the field magnet.

(ii) Most of the candidates answered it correctly, except for a few who wrote *energy conversion* as the answer.

(b) (i) A number of candidates answered correctly. Some candidates mixed up the definitions of *fission* and *fusion*. The words *bigger* and *smaller* were used in place of *heavier* and *lighter*, respectively. Vague statement was written by a few candidates such as, *large energy is given out during nuclear fusion* without comparing the quantity of nuclear material.

Suggestions for Teachers

- *Give sufficient practice to students in drawing diagrams. Comparison of DC motor with AC generator should be done while explaining the diagrams.*
- *Differentiate between the function of a device and its usage clearly. For example, conversion of electrical to mechanical energy is the function of a DC motor but it is used in devices such as washing machine, mixer, toy-fans, etc.*
- *Stress on correct use of key words in definitions.*
- *Clarify the difference between safety precaution taken in handling of radioactive materials and safety precaution in disposal of nuclear waste.*
- *Help students understand the effect on the nucleus during alpha, beta and gamma emission. Discuss it as the effect on number of protons and*

(ii) Some candidates gave precautions to be taken while handling the radioactive substances.

(c) This part of the question was well attempted by most candidates. Some of the common mistakes made in the subparts are as follows:

(i) A few candidates did not write number of neutrons. Some forgot to add the *number of protons and neutrons* to get the *mass number*. They subtracted *4* from the *neutron number* and *2* from the *proton number* instead of *subtracting 4* from *the mass number*.

(ii) Some candidates used neutrons as atomic mass for beta emission. For candidates who made mistakes in the first part, the second part also went incorrect, since the second part was related to the first part.

(iii) Most of the candidates answered correctly but some forgot to add the number of protons and neutrons and some wrote only the number of protons as mass number.

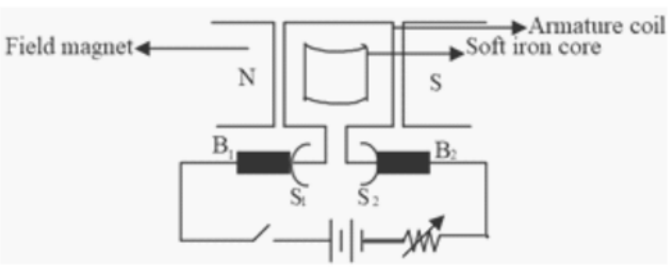
(iv) A few candidates answered this subpart as *Yes*, which was incorrect.

neutrons as well as atomic number and mass number.

- *Explain the composition of an element explicitly with atomic number and mass number.*
- *Explain the change in atomic number and mass number during an alpha decay or beta decay from a nucleus, with reactions.*
- *Instruct students that when a nucleus emits a gamma radiation, there is no change in the mass number and atomic number.*

MARKING SCHEME

Question 10

(a)	(i)	 Coil, field magnet, split rings with brushes and D.C. supply
	(ii)	Washing machine, mixers etc.
(b)	(i)	Combining two or more lighter nuclei to form a heavy nucleus is nuclear fusion whereas splitting a heavy nucleus into two or more lighter nuclei is nuclear fission.
	(ii)	Should be disposed in thick lead casks away from colonies and deep into the earth.

(c)	(i)	The composition of B is No. of proton = 82 No of neutron = 126
	(ii)	The composition of C is No. of proton = 83 No. of neutron = 125
	(iii)	Mass number of the nucleus A = 212.
	(iv)	No, the composition of a nucleus does not change if it emits gamma radiation.

NOTE: For questions having more than one correct answer/solution, alternate correct answers / solutions, apart from those given in the marking scheme, have also been accepted.

GENERAL COMMENTS

Topics found difficult/ by candidates

- Work done when a body moves in a circular path.
- Diagram of refraction from denser to rarer medium to show the formation of an image.
- Completing the path of a ray through 30^o,60^o and 90^o prism.
- Scattering of light
- Refraction through any refracting medium when opposite faces are parallel and when they are not parallel.
- Numerical problems based on light using sign convention.
- Graphs on calorimetry.
- Numerical problems based on Heat.
- Numerical problems based on Electricity, especially in finding the current in parallel branches.
- Completing the nuclear reactions in reverse order.

Concepts in which candidates got confused

- Meaning of 'without changing the length of the lever'.
- Frequency being constant when a wave enters from one medium to another.
- Maximum force experienced by a current carrying coil and a straight conductor when placed in a magnetic field.
- ‘Dispersion of light' and 'scattering of light'.

- The appearance of an object when viewed from a denser medium.
- The path of light through a right isosceles prism and a 30^o,60^o and 90^o prism.
- Reason-based questions related to heat capacity and specific heat capacity.
- Giving reasons for a loud sound in both resonance and non- resonance cases.
- Drawing a graph between displacement from mean position and time for a body executing free vibration in a vacuum.
- Using formula to decide whether sound is audible in air.
- Semiconductor and Superconductor.
- Diagram of a d.c. motor and a d. c. generator.

Suggestions for Students

- Try to understand the concept and try to apply it to the immediate surrounding.
- Try to relate the concepts from Mathematics with Physics and vice-versa.
- Avoid rote learning. Answer in your own words and then verify whether you have covered all points.
- Watch related videos on YouTube and try to make some projects/models which work on the principles which you have learnt.
- Pay equal attention to all chapters.
- Take out time for self-study.
- Periodic revision of the topics completed should be done.
- Practice previous years' question papers.
- Analyse your errors during practice papers and work accordingly.
- Use the reading time of 15 minutes judiciously to decide the questions that you are going to attempt.
- Keep your answer paper presentable by keeping your handwriting legible and by avoiding unnecessary scratching and striking off.
- Write the formula in the beginning while solving numerical.
- Definitions along with key words must be practiced.
- Practice conversion of CGS units to SI units and *vice-versa*.
- Practice drawing block and tackle system of pulleys, by drawing string straight, showing rigid support and tension in the string opposite to the direction of load.
- Practice ray diagrams with arrows marked.
- Show virtual images by dotted lines.
- Do not leave the answer in fractional form. Express it in decimal form.