SAMPLE QUESTION PAPER 3

A HIGHLY SIMULATED SAMPLE QUESTION PAPER FOR ICSE CLASS X

PHYSICS (FULLY SOLVED)

Time : 2 Hrs   **Max. Marks : 80**
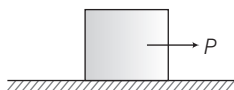
Section-A   [40 *Marks*

1. (a) An object of weight w is pulled along a rough, horizontal surface by a force P, as shown in the diagram.

   (i) Name the force (F) acting parallel to the surface except P.
   (ii) Draw a diagram which correctly shows the direction of forces P, w and F. *[2]*

(b) (i) The refractive index of glass with respect to air is 1.5. What is the value of the refractive index of air with respect to glass?
   (ii) A ray of light is incident as a normal ray on the surface of separation of two different mediums. What is the value of the angle of incidence in this case? *[2]*

(c) (i) Can the centre of gravity be situated outside the material of a body? Give an example.
   (ii) Why is it easier to open a door by applying the force at the free end of it? *[2]*

(d) (i) Write one way to obtain a greater moment of force about a given axis of rotation.
   (ii) A planet moving around the sun is in a state of _____ equilibrium. *[2]*

(e) Differentiate between heat and temperature. *[2]*

2. (a) State the units of work in
   (i) SI unit
   (ii) CGS unit *[2]*

(b) What kind of energy is possessed by a body in following cases?
   (i) A stone at rest at a certain height above the Earth's surface.
   (ii) Water at the top of the reservoir of a dam. *[2]*

(c) Where does the position of centre of gravity lie for
   (i) a circular lamina and
   (ii) a triangular lamina? *[2]*

(d) What is centrifugal force? *[2]*

(e) The diagram shows a small car of mass 500 kg approaching a hill. It moves up the hill with uniform speed.
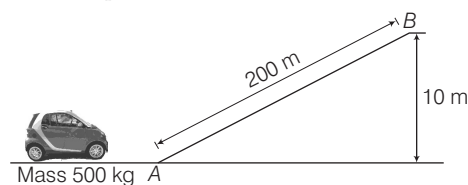
Ignore friction and take the value of g to be 10 N/kg.
How much work is done in moving the car up the hill? *[2]*

3. (a) (i) Write an expression for the mechanical advantage of an inclined plane in terms of its length l and vertical height h.
   (ii) What is the value of VR for a class II lever? *[2]*

(b) The table shows measurements taken during an experiment in which a ray of light is incident at one of the sides of a rectangular block of glass.

Angle of incidence, i	26.0°	39.0°
Angle of refraction, r	15.5°	22.5°
$\sin i$	0.438	0.629
$\sin r$	0.267	0.383

What is the refractive index of the glass? **[2]**

(c) (i) Why loud sound is heard at resonance?

(ii) What do you mean by level of sound zero dB? **[2]**

(d) (i) How does the resistance of a metallic wire depend on its temperature?

(ii) Material used for making filament of an electric bulb is .... **[2]**

(e) (i) Write name of a source of ultraviolet light.

(ii) Which colour of white light travels fastest in glass? **[2]**

4. (a) Distinguish between evaporation and boiling. **[2]**

(b) (i) Why is the core of a transformer made of iron?

(ii) The diagram shows how the emf of a simple generator varies with time.
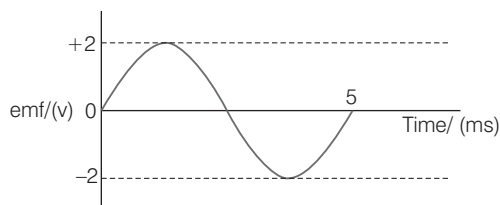
What is the frequency and the maximum value of the emf ? **[2]**

(c) The terminals of a battery are joined by a length of resistance wire.

Which change, on its own, will increase the current through the battery? **[2]**

(d) What is the role of split rings in electric motor? **[2]**

(e) Complete the following nuclear changes.

(i) $_{11}\text{Na}^{24} \longrightarrow \ldots \text{Mg}^{\cdots} + {}_{-1}\beta^{0}$

(ii) $_{92}\text{U}^{238} \longrightarrow {}_{90}\text{Th}^{234} + \ldots + \text{Energy}$ **[2]**

Section-B [40 *Marks*]

5. (a) In a single movable pulley, if the effort moves by a distance x upwards, by what height is the load raised? **[3]**

(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) Which of the following remains constant in uniform circular motion, speed or velocity or both?

(iii) Name the force required for uniform circular motion. State its direction. **[3]**

(c) A scooter mechanic can open a nut by applying. 120 N force while using a lever of 50 cm in length.

(i) What is the moment of the force in first case?

(ii) How long handle is required if he wishes to open it by applying a force of only 40 N? **[4]**

6. (a) An object is placed in front of a lens between its optical centre and the focus and forms a virtual, erect and diminished image.

(i) Name the lens which formed this image.

(ii) Draw a ray diagram to show the formation of the image with the above stated characteristics. **[3]**

(b) (i) Which colour of white light is deviated
   • least?
   • most?

(ii) Draw a diagram to illustrate the use of a total reflecting prism to turn the ray of light through 180°. Name an instrument in which the device is used. **[3]**

(c) (i) Can the absolute refractive index of a medium be less than one? **[2]**

(ii) A coin placed at the bottom of a beaker appears to be raised by 4.0 cm. If the refractive index of water is 4/3, find the depth of the water in the beaker.

(iii) Draw the ray diagram also. **[2]**

7. (a) (i) Three musical instrument give out notes at the frequencies listed below. Flute: 400 Hz Guitar: 20 Hz, Trumpet: 500 Hz. Which one of these has the highest pitch?

(ii) With which of the following frequencies does a tuning fork of 256 Hz resonate? 288 Hz, 341 Hz, 333 Hz, 512 Hz. **[3]**

(b) A student stands 330 m from a tall cliff which is 990 m from another tall cliff.
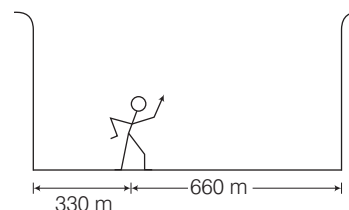
The student fires a starting pistol and hears some echoes.

If the speed of sound between the cliffs is 330 m/s.

(i) What is the time taken by first echo to reach the student ?

(ii) Find the interval between the first echo and the second echo. **[3]**

(c) (i) How does a stretched string on being set into vibrations, produce the audible sound?

(ii) Will the sound be audible, if the string is set into vibration on the surface of the moon? Give reason for your answer. **[4]**

8. (a) (i) Name two systems of wiring used in a household electricity.

(ii) What is an AC generator or dynamo used for?

(iii) Name the principle on which it works. **[3]**

(b) (i) Explain, why are thick wires used in the leads of an electric radiator?

(ii) What is the effect of temperature on semiconductors?

(iii) At what voltage is the alternating current supplied to our houses? **[3]**

(c) The diagram shows two lamps in parallel in a circuit.
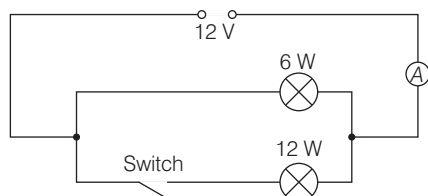
When the switch is open, the ammeter reads 0.5 A.

(i) What is the reading when the switch is closed?

(ii) Find potential difference across 12 W lamp. **[4]**

9. (a) Give reasons for the following :

(i) In cold countries, the steam pipes warm a building more effectively than the hot water pipes, both being at 100°C.

(ii) The heat supplied to a substance during its change of state, does not cause any rise in its temperature. **[3]**

(b) (i) Explain, why the weather becomes very cold after a hailstorm?

(ii) Write an expression for the heat liberated by a hot body.

(iii) Same amount of heat is supplied to two liquids A and B. The liquid A shows a greater rise in temperature. What can you say about the heat capacity of A as compared to that of B ?

(iv) Define specific latent heat of vaporisation of a substance. **[3]**

(c) A hot solid of mass 60 g at 100°C is placed in 150 g of water at 20°C. The final steady temperature recorded is 25°C. Calculate the specific heat capacity of the solid. (Take, specific heat capacity of water $= 4200 \text{ J kg}^{-1\,\circ}\text{C}^{-1}$) **[4]**

10. (a) Mention two possible sources of background radiations. **[3]**

(b) A certain nucleus X has a mass number 14 and atomic number 6. The nucleus X changes to $_7Y^{14}$ after the loss of a particle.

(i) Name the particle emitted.

(ii) Represent this change in the form of an equation.

(iii) A radioactive substance is oxidised. What change would you expect to take place in the nature of its radioactivity? Give reason for your answer. **[3]**

(c) (i) Why do doctors wear lead aprons and spectacles while working near X-ray machine?

(ii) A radioactive nucleus undergoes a series of decays according to the sequence

$$X \xrightarrow{\beta} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\alpha} X_3$$
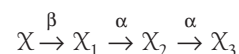
If the mass number and atomic number of X_3 are 172 and 69 respectively, what is the mass number and atomic number of X ?

(iii) Which radiation produces maximum biological damage? **[4]**

ANSWERS

1. (a) (i) The force (F) is frictional force which always opposes the direction of pulling force P. **[1]**

(ii) The direction of friction F always opposes the direction of the pulling force, P.
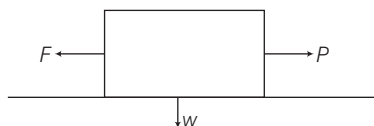
The weight of object, w is always acting vertically downwards from the centre of gravity of the object. **[1]**

(b) (i) Given, refractive index of glass w.r.t air, $_a\mu_g = 1.5$. Refractive index of air w.r.t glass, $_g\mu_a = ?$

$$_g\mu_a = \frac{1}{_a\mu_g} = \frac{1}{1.5} = \frac{10}{15} = \frac{2}{3} = 0.667$$ **[1]**

(ii) The value of the angle of incidence in this case is zero. **[1]**

(c) (i) Yes, e.g., of a ring. **[1]**

(ii) At the free end of the door, torque is more due to longer arm and it becomes easier to open the door. **[1]**

(d) (i) The force is applied at a point on the body for which the perpendicular distance of line of action of the force from the axis of rotation is maximum so that the given force may provide the maximum torque to turn the body.

(ii) The planet is in state of unstable equilibrium. **[1 × 2]**

(e) *Differences between heat and temperature are given below*

Heat	Temperature
It is the internal energy of a body.	It is the degree of hotness or coldness of a body.
Its SI unit is joule.	Its SI unit is kelvin.
Other unit of heat is cal, kcal.	Its other unit is °C, °F.

[2]

2. (a) (i) SI unit of work is joule. Work is said to be one joule, if a force of one newton displaces, its point of application through one metre in its own direction. Thus, 1 joule (J) = 1 newton (N) × 1 metre (m). **[1]**

(ii) CGS unit of work is erg. Work is said to be one erg, if a force of 1 dyne displaces its point of application through one centimetre in its own direction.

Thus, 1 erg = 1 dyne × 1 cm **[1]**

(b) (i) PE **[1]**

(ii) PE **[1]**

(c) (i) The position of centre of gravity for a circular lamina lie at the centre of the circle.

(ii) The position of centre of gravity for a triangular lamina is at the centroid or the point of intersection of the medians. **[1 × 2]**

(d) It is a pseudo force assumed to be exist in a rotating frame. It acts away from the centre and along the radius of the circular path. **[2]**

(e) The work done by the car is equal to the gain in gravitational potential energy of the car up the hill.

∴ Work done = mgh = (500) (10) (10) = 50000 J

Note The distance along the slope is not required in this calculation. **[2]**

3. (a) (i) Mechanical Advantage, $\text{MA} = \dfrac{l}{h}$

(ii) For class II lever,
effort arm > load arm
∴ MA and VR are always greater than one. **[1 × 2]**

(b) Refractive index of glass $= \dfrac{\sin i}{\sin r}$

$$= \frac{\dfrac{0.438}{0.267} + \dfrac{0.629}{0.383}}{2} = 1.64$$ **[2]**

(c) (i) At resonance amplitude increases, so a loud sound is heard.

(ii) Zero dB sound represents the lower limit of the sound level which can be heard by listener. **[1 × 2]**

(d) (i) Resistance of a wire increases with increase in temperature.

(ii) Material used for making filament of an electric bulb is tungsten. **[1 × 2]**

(e) (i) Carbon arc-lamp.

(ii) Red colour of white light travels fastest in glass. **[1 × 2]**

4. (a)

Evaporation	Boiling
It takes place at the surface of liquid.	It takes place throughout the mass of liquid.
It takes place at all temperatures.	It takes place at a definite and constant temperature.

[2]

(b) (i) Iron can concentrate and increase the magnetic field without being magnetised.

(ii) Maximum emf = Peak to peak voltage
$$= 2 - (-2) = 4 \text{ V}$$
Frequency $= \dfrac{1}{T}$
$$= \dfrac{1}{5 \times 10^{-3}} = 200 \text{ Hz}$$
[1 × 2]

(c) Resistance of wire is directly proportional to length but inversely proportional to cross-sectional area. To increase current, we must reduce resistance of the connecting wire. Hence, we either reduce length or increase thickness of wire. *[2]*

(d) The split rings reverse the direction of current passing through the coil. This helps to change the direction of force acting on coil. *[2]*
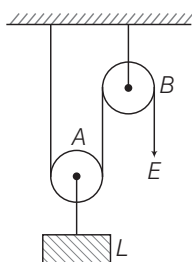
(e) (i) $_{11}Na^{24} \longrightarrow {}_{12}Mg^{24} + {}_{-1}\beta^{0}$ *[1]*

(ii) $_{92}U^{238} \longrightarrow {}_{90}Th^{234} + {}_{2}He^{4}$

(α-particle) + Energy *[1]*

5. (a) The height raised by load $= \dfrac{1}{2} \times$ Distance moved by effort upward, i.e., $\dfrac{x}{2}$

[3]

(b) (i) Velocity ratio will not change for a machine of a given design, because the distance moved by load in the same time is equal to the distance moved by the effort. *[1]*

(ii) Speed remains constant in uniform circular motion. *[1]*

(iii) Centripetal force. It is directed radially inwards. *[1]*

(c) (i) In first case, the moment of force
$= 120 \text{ N} \times 0.5 \text{ m} = 60 \text{ N-m}$

(ii) In second case,
if he uses handle of length l m, then
the moment of force $= 40 \text{ N} \times l$ m
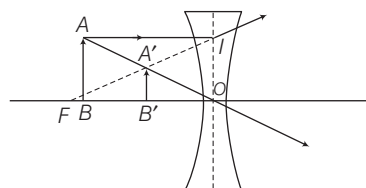$60 \text{ N-m} = 40 \text{ N} \times l$ m

$\Rightarrow \quad l = \dfrac{60 \text{ N-m}}{40 \text{ N}} = 1.5 \text{ m}$
[2 × 2]

6. (a) (i) Concave/diverging lens. *[1½]*

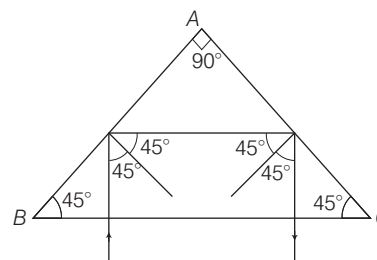(ii) *Ray diagram is given below*

[1½]

(b) (i) • The red colour light is deviated least.
• The violet colour light is deviated most. *[1]*

(ii)

This device is used in binoculars. *[2]*

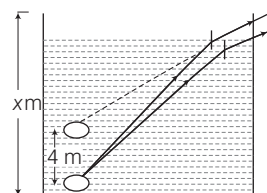(c) (i) Absolute refractive index cannot be less than 1. *[1]*

(ii) Let the depth of water in the beaker be x m.
∴ Real depth of water $= x$ cm
Apparent depth $= (x - 4)$ cm
We know, $\mu = \dfrac{\text{Real depth}}{\text{Apparent depth}}$

$\Rightarrow \quad \dfrac{4}{3} = \dfrac{x}{x-4}$

$\Rightarrow \quad 4x - 16 = 3x \Rightarrow 4x - 3x = 16$

$\Rightarrow \quad x = 16$

∴ Depth of water in the beaker $= 16$ cm. *[3]*

7. (a) (i) Trumpet having highest frequency of 500 Hz have highest pitch, because pitch is directly proportional to the frequency. *[1½]*

(ii) The frequency 512 Hz will resonate a tuning fork of 256 Hz as 512Hz is an integral multiple of the natural frequency of the tuning fork. *[1½]*

(b) (i) Time taken by first echo to reach student,

$$t_1 = \frac{\text{Distance}}{\text{Speed}}$$

$$= \frac{2 \times 330}{330} = 2 \text{ s}$$ **[1½]**

(ii) Time for second echo to reach student,

$$t_2 = \frac{\text{Distance}}{\text{Speed}} = \frac{2 \times 660}{330} = 4 \text{ s}$$

$$\therefore \text{ Time interval} = (t_2 - t_1) \text{ s} = 2 \text{ s}$$ **[1½]**

(c) (i) On striking, a vibrating string produces a very weak sound which cannot be heard at distance. Thus, all the stringed instruments are provided with a sound box. The vibrating string produces forced vibrations of large amplitude as now a larger volume of air is set into vibrations. Hence, this sound becomes audible. **[2]**

(ii) The sound produced on the surface of the moon by a vibrating string cannot be heard, because there is absence of any medium and we know that sound travels only in a medium. **[2]**

8. (a) (i) *The two systems are*
  • tree system   • ring system

(ii) An AC generator or dynamo is used to obtain electrical energy from the mechanical energy.

(iii) It works on the principle of electromagnetic induction. **[1×3]**

(b) (i) Thick wires are used in high power instruments like electric iron, electric heater, heating rod, electric radiator, etc., because for the given voltage V,

$$P \propto I$$

Thus, the higher is the power of the electric appliance, larger is the current drawn by it and for given voltage V,

$$P \propto \frac{1}{R}$$ **[1½]**

i.e., if resistance is low, power will be more and for low resistance, area of cross-section will be more.

(ii) In case of metals resistance increases with the rise in temperature while in case of semiconductors, it decreases with the rise in temperature. **[1]**

(iii) 220 V **[1/2]**

(c) (i) As, P and V are given, current (I) can be calculated by using

power, $P = $ voltage $(V) \times$ current (I)

Once the switch is closed, pd across 12 W is 12 V,

$$\therefore \qquad I = \frac{P}{V} = \frac{12 \text{ W}}{12 \text{ V}} = 1.0 \text{ A}$$

The ammeter will read $(0.5 + 1.0) = 1.5$ A. **[2]**

(ii) As, the lamps are connected in parallel combination.

Hence, the potential across each lamp would be same which is equal to the potential difference across the terminal of the source. Therefore, pd across 12W lamp is 12V. **[2]**

9. (a) (i) Because 1g of steam at 100°C imparts an additional 2268 J of heat energy, than that imparted by 1 g of hot water at 100°C.

(ii) Because this heat is used in increasing the potential energy of the molecules (in case of melting) and increasing potential energy of the molecules and for doing work for expansion (in case of boiling). **[1½×2]**

(b) (i) After the hailstorm the ice balls begin to melt and require 336 J of heat energy per gram to melt which is taken from the atmosphere thereby decreasing the temperature of atmosphere.

(ii) Expression for the heat energy liberated by hot body $= mc\,\Delta T$

where, $m = $ mass of body,

$c = $ specific heat of body

and $\Delta T = $ change in temperature of body.
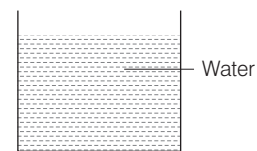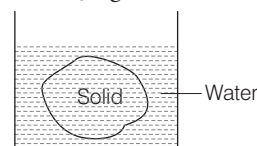
(iii) Heat capacity of A is less than liquid B.

(iv) Specific latent heat of vaporisation (or heat of vaporisation) of a substance is the amount of heat required to convert unit mass of the liquid into vapour at its boiling point without any change in its temperature. **[3]**
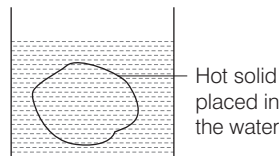
(c) Given, $m_1 = 60$ g$= \dfrac{60}{1000}$ kg, $t_1 = 100°\text{C}$

$$c_1 = ?$$

$$m_2 = 150 \text{ g}= \frac{150}{1000} \text{ kg} \Rightarrow t_2 = 20°\text{C}$$

$$c_2 = 4200 \text{ J kg}^{-1}{}^{\circ}\text{C}^{-1}$$

Hot solid placed in the water

Final temperature, $t_3 = 25°C$

According to principle of calorimetry,

heat lost by solid = head gained by water

$\therefore m_1 \times c_1 \times (t_1 - t_3) = m_2 \times c_2 \times (t_3 - t_2)$

$\Rightarrow \dfrac{60}{1000} \times c_1 \times (100 - 25)$

$= \dfrac{150}{1000} \times 4200 \times (25 - 20)$

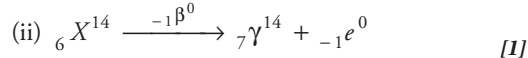$\Rightarrow 6 \times c_1 \times 75 = 15 \times 4200 \times 5$

$\Rightarrow \qquad c_1 = \dfrac{15 \times 4200 \times 5}{6 \times 75}$

$\therefore \qquad c_1 = 700\ \text{J kg}^{-1}\,°C^{-1}$ **[4]**

10. (a) *The two possible sources of background radiations are as follows*
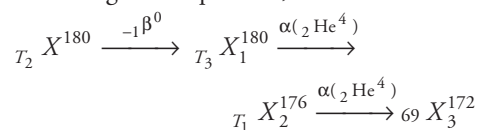
• earth and   • cosmic radiations. **[3]**

(b) (i) Since during the $_{-1}\beta^{0}$-emission, there is gain in atomic number. **[1]**

(ii) $_{6}X^{14} \xrightarrow{\ _{-1}\beta^{0}\ } _{7}\gamma^{14} + _{-1}e^{0}$ **[1]**

(iii) There is no change in the nature of radioactivity during oxidation. Because oxidation is a phenomena in which involvement of electrons takes place, whereas in radioactivity nucleons takes part in reaction. **[1]**

(c) (i) X-rays do not penetrate through lead and thus doctor's body is not exposed to X-rays. **[2]**

(ii) According to the question,

$_{T_2}X^{180} \xrightarrow{\ _{-1}\beta^{0}\ } _{T_3}X_1^{180} \xrightarrow{\ \alpha(_2He^4)\ }$

$_{T_1}X_2^{176} \xrightarrow{\ \alpha(_2He^4)\ } _{69}X_3^{172}$

Mass number of $X = 180$

Atomic number of $X = 72$ **[1]**

(iii) γ-radiations are responsible for biological damages. **[1]**