ICSE Paper 2006

PHYSICS

SECTION–I (40 Marks)

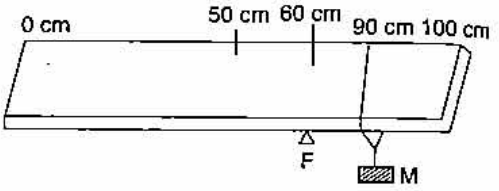
***Compulsory** : Attempt **all** questions from this Section.*

Question 1.

(a) *Mention any two differences between the mass and weight of a body.* **[2]**

(b) *State the amount of work done by an object when it moves in a circular path for one complete rotation. Give a reason to justify your answer.* **[2]**

(c) *A uniform metre scale is kept in equilibrium when supported at the 60 cm mark and a mass M is suspended from the 90 cm mark as shown in the figure. State with reasons, whether the weight of the scale is greater than, less than or equal to the weight of mass M.* **[2]**

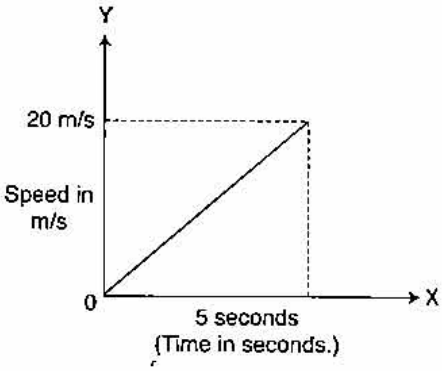


(d) *Draw a graph showing the relationship between acceleration and mass for a constant force.*** **[2]**

(e) *The speed-time graph of a moving car is as shown in the figure below :*** *Calculate :*

(i) *the distance covered by the car in 5 seconds.*

(ii) *the acceleration of the car.* **[2]**



Answer.

(a) Two differences between the mass and weight of the body :

Mass	Weight
(1) It is a scalar quantity.	It is a vector quantity.
(2) It is the quantity of matter contained in a body.	It is the force with which the earth attracts a body.

(b) The amount of work done will be equal to zero.

Reason : Work is said to be done only when there is displacement produced. In case of a body moving in a circular path, the body comes to its original place, therefore, there is no displacement and hence work is zero.

(c) Let the load be M.

$\therefore$ Load arm $(d_L) = 90 - 60 = 30$ cm

Since wt. of scale will act at centre of gravity of scale which is the midpoint of the scale (*i.e.*, 50 cm mark)

$\therefore$ Effort arm $(d_E) = 60 - 50 = 10$ cm

Let wt. of scale be W.

** *Answer has not given due to out of present syllabus.*

By principal of moments,

$$L \times d_L = E \times d_E$$
$$M \times 30 = W \times 10$$
$$W = 3M$$

∴ Since weight of scale is three times that of M.

∴ Weight of scale is greater than weight of M.

Question 2.

(a) *Will the pressure exerted by water on a diver at a certain depth in the sea, be the same, more, or less than the pressure exerted on him in a river at the same depth ? Justify your answer.*** [2]

(b) *Mention one similarity and one difference between the lens of a photographic camera and that of the human eye.*** [2]

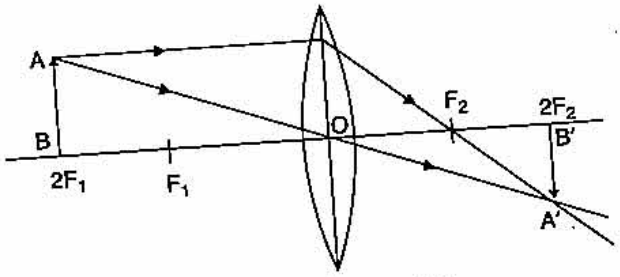
(c) *An object is placed in front of a convex lens such that the image formed has the same size as that of the object. Draw a ray diagram to illustrate this.* [2]

(d) *Give two reasons as to why copper is preferred over other metals for making calorimeters.* [2]

(e) *Calculate the height through which a body of mass 0·5 kg should be lifted if the energy spent for doing so is 1·0 joule. ($g = 10\ ms^{-2}$).* [2]

Answer.

(c)



(d) Copper is preferred over other metals because :

(1) It has a low specific heat capacity.

(2) It takes negligible amount of heat from its contents to attain the temperature of the contents.

(e) *Given* : $m = 0·5$ kg, PE = 1·0 J, $g = 10$ m/s^2

$$PE = mgh$$
$$h = \frac{PE}{mg} = \frac{1}{0·5 \times 10} = \frac{1}{5}$$
$$= 0·2 \text{ maa}$$

Ans.

Question 3.

(a) *Explain why musical instruments like the guitar are provided with a hollow box.* [2]

(b) *A wire of uniform thickness with a resistance of 27Ω is cut into three equal pieces and they are joined in parallel. Find the resistance of the parallel combination.* [2]

(c) *Draw a labelled diagram of a three-pin socket.* [2]

(d) *A room has window panes made of a special glass which can reflect green light,*

** *Answer has not given due to out of present syllabus.*

*transmit red light, scatter blue light and absorb all the other colours of light. The room is illuminated with white light from the inside. What colour will the window pane appear when seen from :***

(i) *inside the room*

(ii) *outside the room ?* [2]

(e) *What is Newton's colour disc ? What does the Newton's colour disc experiment establish about the nature of white light ?*** [2]

Answer.

(a) Musical instruments like guitar are provided with a hollow box sc that when the strings are set into vibration, forced vibrations are produced in box. Since the box has a large area, it sets a large volume of air into vibration which produces a loud sound of same frequency as that of the string.

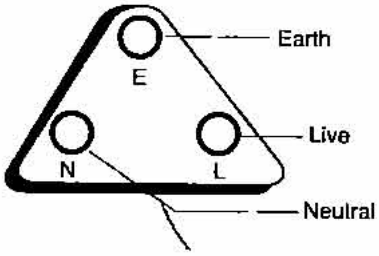
(b) *Given* : Resistance of given wire = 27 Ω

$\therefore$ Resistance of each small wire $= \frac{27}{3} = 9\Omega$

Let R_P be equivalent resistance for parallel combination.

Then
$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$
$$= \frac{1}{9} + \frac{1}{9} + \frac{1}{9}$$
$$= \frac{3}{9}$$
$$R_P = \frac{9}{3}\ \Omega$$
$$R_P = 3\Omega$$ Ans.

(c)



Question 4.

(a) *State two advantages of an electromagnet over a permanent magnet.* [2]

(b) *Calculate the amount of heat released when 5·0 g of water at 20°C is changed into ice at 0°C.*

(Specific heat capacity of water = 4·2 J/g°C

Specific latent heat of fusion of ice = 336 J/g). [2]

(c) *Mention two factors on which the resistance of a wire depends.* [2]

(d) *A certain radioactive nucleus emits a particle that leaves its mass unchanged but increases its atomic number by one. Identify the particle and write its symbol.* [2]

(e) *What is a nuclear chain reaction ?*** [2]

** *Answer has not given due to out of present syllabus.*

Answer.

(a) (i) An electromagnet can produce a stronger magnetic field than permanent magnet.

(ii) The polarity of an electromagnet can be reversed whereas that of a permanent magnet cannot be reversed.

(b) 5 g water at 20°C $\xrightarrow{mc\theta}$ 5 g water at 0°C $\xrightarrow{mL}$ 5 g ice at 0°C.

$\therefore$ Amount of heat released $= mc\theta + mL$

$= 5 \times 4{\cdot}2 \times (20° - 0°) + 5 \times 336$

$= 21{\cdot}0 \times 20 + 1680$

$= 420 + 1680$

$= 2100$ Joule **Ans.**

(c) Resistance of a wire depends on :

(i) length of wire

(ii) Area of cross-section of wire.

(d) Particle is beta. Symbol—β.

SECTION–II (40 Marks)

*Answer any **four** questions from this Section.*

Question 5.

(a) *Show that for the free fall of a body, the sum of the mechanical energy at any point in its path is constant.* **[4]**

(b) *Name the type of single pulley that can act as a force multiplier. Draw a labelled diagram of the above named pulley.* **[3]**

(c) *A pulley system has a velocity ratio of 4 and an efficiency of 90%. Calculate :*

(i) the mechanical advantage of the system.

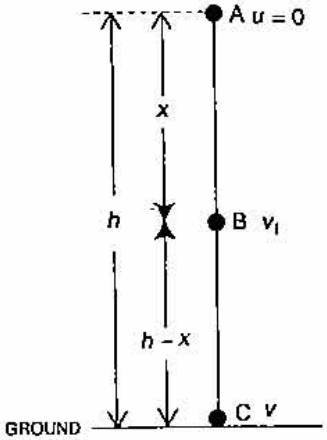
(ii) the effort required to raise a load of 300 N by the system. **[3]**

Answer.

(a) Let a body of mass m fall freely under gravity from height h above ground.

Let A, B and C be the positions of body.

Let x be the distance fallen from A to B



At position A :

KE $= 0$ (body is at rest)

PE $= mgh$

$\therefore$ Total energy $= 0 + mgh = mgh$ ...(i)

At position B :

Let v_1 be velocity of body, then $u = 0$, $S = x$.

From equation, $v^2 = u^2 + 2aS$

$v_1^2 = 0 + 2gx$

$v_1^2 = 2gx$

$KE = \frac{1}{2}mv^2$

$= \frac{1}{2}m \times 2gx$

$= mgx$

$$PE = mg(h - x)$$
$$= mgh - mgx$$

$\therefore$ Total energy $= mgx + mgh - mgx$
$= mgh$ ...(ii)

At position C :

Let velocity of body be v, then $u = 0$, $S = h$.

From equation, $v^2 = u^2 + 2gS$

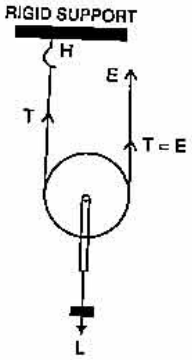
$$v^2 = 0 + 2gh$$
$$v^2 = 2gh$$
$$KE = \frac{1}{2}mv^2$$
$$= \frac{1}{2}m \times 2gh = mgh$$
$$PE = 0 \quad \text{(body at ground)}$$

$\therefore$ Total energy $= mgh + 0 = mgh$ ...(iii)

$\therefore$ From (i), (ii) and (iii) it is clear that sum of mechanical energy remains same at any point in the path of free fall of a body.

(b) Single Movable Pulley.

Diagram :



(c) *Given* : VR = 4, $\eta = 90\%$

(i) $MA = VR \times \eta\%$

$$= \frac{4 \times 90}{100}$$
$$= 3{\cdot}6 \quad \textbf{Ans.}$$

(ii) $MA = \frac{\text{Load}}{\text{Effort}}$

$\therefore$ $\text{Effort} = \frac{\text{Load}}{MA} = \frac{300}{3{\cdot}6}$

$= 83{\cdot}33$ N **Ans.**

Question 6.

(a) *A wooden cylinder of length 40·0 cm and area of cross-section 5·0 cm^2, floats in a liquid of density 0·72 g cm^{-3} such that 4·0 cm of the cylinder is above water. Calculate :***

** *Answer has not given due to out of present syllabus.*

(i) *the density of the wood;*
(ii) *the mass of the wood.* **[4]**

(b) (i) *What is the approximate numerical value of the normal atmospheric pressure in units of Pascals ?***
(ii) *Why is the barometric pressure of a place expressed in centimetres of mercury rather than in Pascals ?*** **[3]**

(c) *Define Newton, the S.I. unit of force. State its relationship with the C.G.S. unit of force.* **[3]**

Answer.

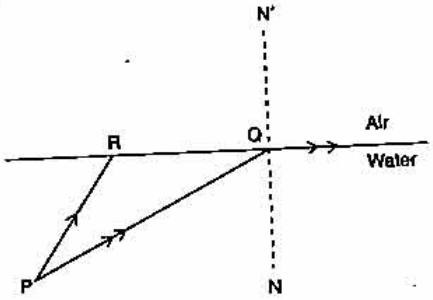
(c) One newton is defined as the force with which a body of mass 1 kg moves with an acceleration of 1 m/s^2.

$$1 \text{ Newton} = 1 \text{ kg} \times 1 \text{ m/s}^2$$
$$= 1000 \text{ g} \times 100 \text{ cm/s}^2$$
$$= 10^5 \text{ g cm/s}^2$$
$$= 10^5 \text{ dyne}$$

$\therefore$ $1 \text{ N} = 10^5 \text{ dyne}$ **Ans.**

Question 7.

(a) *PQ and PR are two light rays emerging from the object P as shown in the figure alongside :*



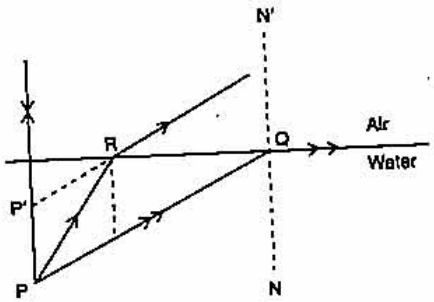
(i) *What is the special name given to the angle of incidence ($\angle PQN$) of ray PQ ?*
(ii) *Copy the ray diagram and complete it to show the position of the image of the object P when seen obliquely from above.*
(iii) *Name the phenomenon that occurs if the angle of incidence $\angle PQN$ is increased still further.* **[4]**

(b) *When a tuning fork, struck by a rubber pad, is held over a length of air column in a tube, it produces a loud sound for a fixed length of the air column.*
(i) *Name the above phenomenon.*
(ii) *How does the frequency of the loud sound compare with that of the tuning fork ?*
(iii) *State the unit for measuring loudness.* **[3]**

(c) *Give one use each of the electromagnetic radiations given below :*
(i) *Microwaves*
(ii) *Ultraviolet radiation*
(iii) *Infrared radiation.* **[3]**

Answer.

(a) (i) Critical angle.
(ii) See alongside figure.
(iii) Total internal reflection of light.



(b) (i) Resonance.
(ii) Frequency of loud sound is either equal to or an integer multiple of the natural frequency of tuning fork.
(iii) Decibel.

** *Answer has not given due to out of present syllabus.*

(c) (i) Microwaves are used for communication.
(ii) Ultraviolet waves are used for sterilizing purposes.
(iii) Infrared waves are used as signals during war.

Question 8.

(a) *A piece of iron of mass 2·0 kg has a thermal capacity of 966 J / °C.*
(i) *How much heat is needed to warm it by 15°C ?*
(ii) *What is its specific heat capacity in S.I. units ?* [4]

(b) (i) *Define specific latent heat of vaporization of a substance.*
(ii) *What is the principle of calorimetry ?* [3]

(c) *Explain why water is used in hot water bottles for fomentation and also as a universal coolant.* [3]

Answer :

(a) *Given* : $m = 2{\cdot}0$ kg, Thermal capacity = 966 J/°C

(i) Rise in temp. $= 15°C$

$$\text{Thermal capacity } C = \frac{\text{Heat required}}{\text{Rise in temp.}}$$

$$\therefore \quad \text{Heat needed} = 966 \times 15$$

$$= 14490 \text{ J} \quad \text{Ans.}$$

(ii) $$\text{Specific heat capacity } C = \frac{\text{Amount of heat}}{\text{Mass} \times \text{Rise in temp.}}$$

$$= \frac{14490}{2{\cdot}0 \times 15}$$

$$= \frac{14490}{30} = 483 \text{ J/kg/°C} \quad \text{Ans.}$$

(b) (i) Specific latent heat of vapourization is the quantity of heat required to convert unit mass of a substance from liquid to vapour state without change of temperature.

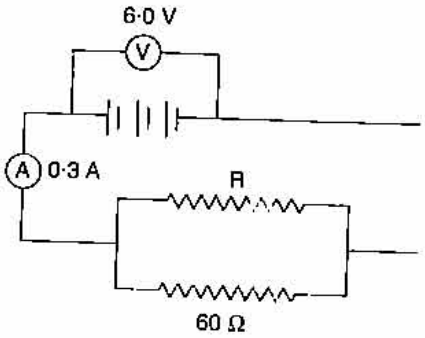
(ii) Principle of calorimetry states that when a hot body is mixed with a cold body, then heat passes from hot body to cold body till both attain same temeprature *i.e.*,

Heat lost by hot body = Heat gained by cold body
(if system is fully insulated)

(c) Hot water bottles are used for fomentation since water does not cool quickly due to its large specific heat capacity.
Water is used as an effective coolant because of its large specific heat capacity due to which it can extract more heat.

Question 9.

(a) *In the figure given alongside, the ammeter A reads 0·3 A. Calculate :*
(i) *the total resistance of the circuit.*
(ii) *the value of R.*
(iii) *the current flowing through R.* [4]



(b) *Find the cost of operating an electric toaster for two hours if it draws 8 A current on a 110 volt circuit. The cost of electrical energy is Rs. 2·50 per kWh.* [3]

(c) (i) *What will happen to a compass needle when the compass is placed below a wire and a current is made to flow through the wire ? Give a reason to justify your answer.*

(ii) *What energy conversion takes place during the working of a d.c. motor ?* **[3]**

Answer :

(a) (i) $\because \quad V = IR$

$\therefore \quad R = \frac{V}{I}$

$= \frac{6{\cdot}0}{0{\cdot}3}$

$= 20\ \Omega$ **Ans.**

(ii) Total resistance $= 20\ \Omega$

$\because$ Resistances are in parallel.

$\therefore \quad \frac{1}{20} = \frac{1}{R} + \frac{1}{60}$

$\frac{1}{R} = \frac{1}{20} - \frac{1}{60}$

$\frac{1}{R} = \frac{3-1}{60}$

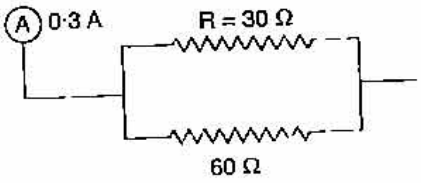
$R = \frac{60}{2} = 30\ \Omega$ **Ans.**

(iii) $\because \quad V = IR$

and potential (V) is equal at the two ends *i.e.*, A and B.

Let I_1 be current flowing through R.

$\therefore$ $(0{\cdot}3 - I_1)$ is current flowing through 60Ω resistance.



Now $V = V \Rightarrow I_1R_1$

$= I_2R_2$

$I_1 \times 30 = (0{\cdot}3 - I_1) \times 60$

$I_1 = 0{\cdot}6 - 2I_1$

$3I_1 = 0{\cdot}6$

$I_1 = \frac{0{\cdot}6}{3} = 0{\cdot}2$

$\therefore$ Current flowing through R $= 0{\cdot}2$ A

(b) *Given* : Time = 2 hrs, I = 8A, V = 110 volt

Power $= I \times V = 8 \times 110 = 880$ Watt

Electrical energy (in kWh) $= \frac{\text{Power (in Watt)} \times \text{Time (in hrs)}}{1000}$

$= \frac{880 \times 2}{1000} = 1{\cdot}76$ kWh

Cost of 1 kWh energy $=$ Rs. 2·50 (given)

$\therefore$ Cost of 1·76 kWh energy $= 2{\cdot}50 \times 1{\cdot}76 =$ Rs. 4·40 **Ans.**

(c) (i) The compass needle will show deflection. This happens because when current is passed through a conductor (here, wire) a magnetic field is produced around the conductor due to which the compass needle gets deflected.

(ii) Electrical energy to mechanical energy.

Question 10.

(a) (i) *Name the material used for making the control rods in a nuclear fission reaction. Why is the material named by you suitable for this purpose ?***

(ii) *State one difference and one similarity between a nuclear bomb and a nuclear reactor.*** [4]

(b) (i) *Define thermionic emission.*

(ii) *Mention one use of thermionic emission.*

(iii) *Name a substance which is a good thermionic emitter.* [3]

(c) *State three properties that are common to and shown by both beta rays and cathode rays.* [3]

Answer.

(b) (i) The emission of electrons from a metal surface when heat energy is imparted to it, is called thermionic emission.

(ii) Thermionic emission is used in hot cathode ray tube which has many uses.

(iii) Tungsten.

(c) (i) Both carry a negative charge.

(ii) Both are deflected by electric and magnetic fields.

(iii) Both produce fluorescence on striking a fluorescent material.

** *Answer has not given due to out of present syllabus.*