Sample Question Paper - 2

Physics

Time Allowed: 2 hours **Maximum Marks: 80**

General Instructions:

Answers to this Paper must be written on the paper provided separately.

You will not be allowed to write during first 15 minutes. This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

Section A is compulsory. Attempt any four questions from Section B.

The intended marks for questions or parts of questions are given in brackets [ ].

Section A

1. **Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)** **[15]**

(a) Force in linear motion has its analogue in rotational motion? **[1]**

a) Weight b) Moment of inertia

c) Angular momentum d) Torque

(b) If two convex lenses are in contact with each other. **[1]**

a) the diverging power decreases b) the converging power decreases

c) the converging power increases d) the diverging power increases

(c) When a flash light is switched on the electric energy **[1]**

a) first changes to light energy and then to heat energy b) directly changes to heat energy

c) directly changes to light energy d) first changes to heat energy and then to light energy

(d) Which of the following radiation gets deflected most in electric or magnetic field? **[1]**

a) X-rays b) β-particles

c) γ-radiation d) α-particles

(e) **Assertion (A):** A duster lying on the table is an example of static equilibrium. **[1]**
Reason (R): When a body remains in the same state of motion under the influence of several forces then the body is in static equilibrium.

a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false. d) A is false but R is true.

(f) An isosceles totally reflecting prism can reflect rays through an angle of: **[1]**

a) 60^o b) 180^o

c) both 90^o and 180^o d) 90^o

(g) A man stands in between two cliffs, such that he is at a distance of 133.6 m from nearer cliff. He fires a gun and hears first echo after 0.8 s and second echo after 1.8 s. Calculate: (i) speed of sound (ii) distance between two cliffs. **[1]**

a) 334.2 m b) 434.2 m

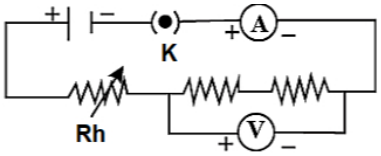
c) 234.2 m d) 134.2 m

(h) During night, distant sounds such as that of the traffic and the loudspeakers become louder than during day. This is due to **[1]**

a) reflection of sound waves b) absence of other sounds

c) refraction of sound waves d) clear perception of hearing

(i) To determine the equivalent resistance of two resistors when connected in series, a student arranged the circuit components as shown in the diagram. But he did not succeed to achieve the objective. **[1]**



Which of the following mistakes has been committed by him in setting up the circuit?

a) Position of voltmeter is incorrect b) Terminals of ammeter are wrongly connected

c) Terminals of voltmeter are wrongly connected d) Position of ammeter is incorrect

(j) In an a.c. generator the magnitude of induced current can be increased by: **[1]**

a) increasing the area of cross-section of the coil b) increasing the strength of field magnets

c) increasing number of turns in the coil d) all of these

(k) A door is 1 m wide. It can be closed by an effort of 25 N, when effort is applied at a distance of 0.4 m from the hinge. What effort is needed, if it is applied at its extreme end? **[1]**

a) 40 N b) 80 N

c) 5 N d) 10 N

(l) Global warming will result in: **[1]**

a) increase in agricultural production b) increase in the level of sea water

c) decrease in disease caused by bacteria d) decrease in the level of sea water

(m) What mass of a solid of specific heat capacity 0.75 $Jg^{-1}\,{}^oC^{-1}$ will have heat capacity 93.75 $Jg^{-1}\,{}^oC^{-1}$? **[1]**

a) 225 g b) 325 g

c) 125 g d) 25 g

(n) A prism has: **[1]**

a) two rectangular and three triangular surfaces

b) four rectangular and three triangular surfaces

c) two triangular and three rectangular surfaces

d) three rectangular and three triangular surfaces

(o) The highest refractive index is of: **[1]**

a) water

b) cold air

c) diamond

d) glass

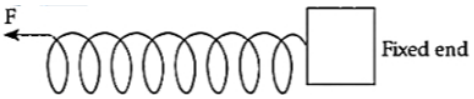
2. **Answer the following questions:** **[15]**

(a) i. If a machine is used to lift a load of 50 N such that resistance due to friction and movable part of machine is 15 N, then the total lifted load is 65 N, i.e., (50 + 15) N. If the displacement is caused through 2 m, then find actual and useful output. **[1]**

ii. Why is a jack screw provided with a long arm? **[1]**

iii. Considering that simple physical balance can work as an ideal lever, what can be said about its mechanical advantage? **[1]**

(b) One end of a spring is kept fixed while the other end is stretched by a force as shown in the diagram **[2]**



i. Copy the diagram and mark on it the direction of the restoring force.

ii. Name the instrument.

(c) To use a machine as a force multiplier, what type (class) of lever should preferably be used? Draw a sketch of such a lever. **[2]**

(d) i. Define one Newton. **[2]**

ii. Write the relation between S.I. unit and C.G.S. unit of force.

(e) A body of mass 5 kg is moving with a velocity of 10 m/s. 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]**

(f) What are the factors on which resistance of a conductor depends? **[2]**

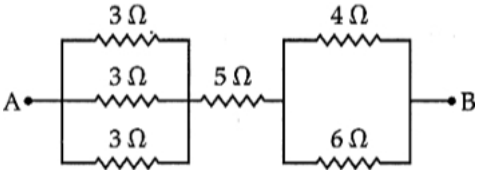
(g) i. Name the system which enables us to locate underwater objects by transmitting ultrasonic waves and detecting the reflecting impulse, **[2]**

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

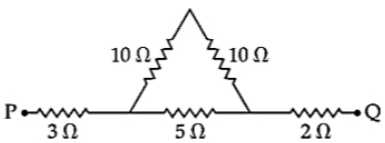
3. **Answer the following questions;** **[10]**

(a) Define the power of a lens. Write its formula expression and its SI unit. **[2]**

(b) Find the resistance between points A and B. **[2]**



(c) Calculate the equivalent resistance between P and Q from the following diagram. **[2]**



(d) The specific heat capacity of a substance A is 3,800 J kg^{-1} K^{-1} and that of a substance B is 400 J kg^{-1} K^{-1}. Which of the two substances is a good conductor of heat? Give a reason for your answer. **[2]**

(e) A radioactive nucleus undergoes a series of decays according to the sequence. **[2]**

$$X \xrightarrow{\beta} X_1 \xrightarrow{\alpha} X_2 \xrightarrow{\alpha} X_3$$

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?

Section B

Attempt any 4 questions

4. **Answer the following questions:** **[10]**

(a) A lens forms an upright and diminished image of an object when the object is placed at the focal point of the given lens. **[3]**

i. Name the lens.

ii. Draw a ray diagram to show the image formation.

(b) i. How is the transference of heat energy by radiation prevented in a calorimeter? **[3]**

ii. You have a choice of three metals A, B and C, of specific heat capacities 900 $Jkg^{-10}C^{-1}$, 380 Jkg^{-1} $^oC^{-1}$ and 460 Jkg^{-10} $°C^{-1}$ respectively, to make a calorimeter. Which material will you select? Justify your answer.

(c) Draw a ray diagram to illustrate the action of a convergent lens as a reading lens or a magnifying glass. **[4]**

5. **Answer the following questions:** **[10]**

(a) How does the value of angle of deviation produced by a prism change with an increase in the **[3]**

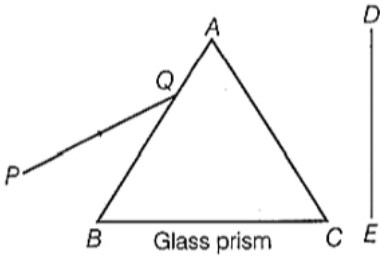
i. Value of angle of incidence?

ii. Wavelength of incident light?

(b) i. Explain, why in daylight an object appears red when seen through a red glass and black when seen through a blue glass? **[3]**

ii. Name the extreme colours in pure spectrum of light.

(c) A narrow beam of white light is passing through a glass prism ABC as shown in the diagram. **[4]**



Trace it on your answer sheet and show the path of the emergent beam as observed on the screen DE.

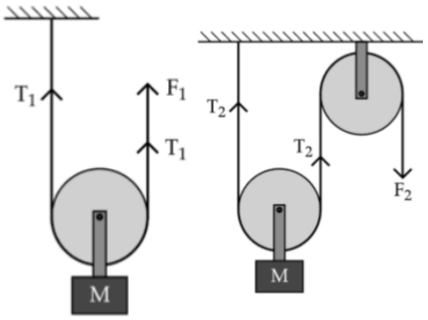
i. Write the name and cause of the phenomenon observed.

ii. Where else in nature is this phenomenon observed?

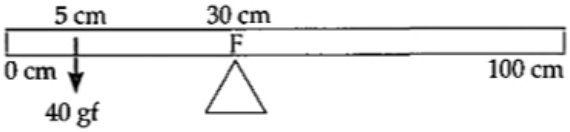
iii. Based on this observation state the conclusion which can be drawn about the constituents of white light.

6. **Answer the following questions:** **[10]**

(a) A load M = 200 kg is supported in two different ways shown in the given figure. F_1 and F_2 are the forces needed in two cases. Calculate $\frac{F_1}{F_2}$. **[3]**



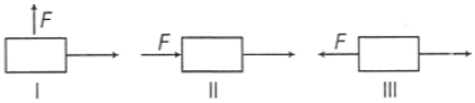
(b) A uniform meter scale is in equilibrium as shown in the diagram: **[3]**



i. Calculate the weight of the meter scale.

ii. Which of the following options is correct to keep the ruler in equilibrium when 40 gf wt is shifted to 0 cm mark? F is shifted towards 0 cm. or F is shifted to wards 100 cm.

(c) In each of the following a force, F is acting on an object of mass m. The direction of displacement is from West to East shown by the longer arrow. Observe the diagrams carefully and state whether the work done by the force is negative, positive or zero. **[4]**



7. **Answer the following questions:** **[10]**

(a) A rear view mirror of motorbike starts vibrating violently at some particular speed of motorbike. **[3]**

i. Why does this happen?

ii. What is the name of the phenomenon taking place?

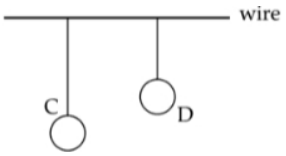
iii. What could be done to stop the violent vibrations?

(b) i. When does the nucleus of an atom tend to be radioactive? **[3]**

ii. How is the radioactivity of an element affected, when it undergoes a chemical change to form a chemical compound?

iii. Mention one use and one harmful effect of radioactivity.

(c) Two pendulums C and D are suspended from a wire as shown in the figure given below. Pendulum C is made to oscillate by displacing it from its mean position. It is seen that D also starts oscillating. **[4]**



i. Name the type of oscillation, C will execute.

ii. Name the type of oscillation, D will execute.

iii. If the length of D is made equal to C, then what difference will you notice in the oscillations of D?

iv. What is the name of the phenomenon when the length of D is made equal to C?

8. **Answer the following questions:** **[10]**

(a) i. Write an expression for the electrical energy spent in the flow of current through an electrical appliance in terms of I, R and t. **[3]**

ii. At what voltage is the alternating current supplied to our houses?

iii. How should the electric lamps in a building be connected?

(b) In heavy nuclei, number of neutrons is greater than the number of protons. Why? **[3]**

(c) A circuit is made from a combination of 4 cells, a resistor of 1.8 Ω an unknown resistor X and an ammeter, all connected in series. Draw a diagram of this circuit. If the cells are of emf 1.5 V each and internal resistance 0.05 Ω each, find the total resistance of the circuit. If the ammeter reads 1 A, find the value of X and the p.d. across it. **[4]**

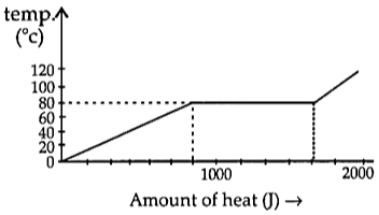
9. **Answer the following questions:** **[10]**

(a) i. When 1g of ice at 0°C melts to form 1g of water at 0°C then, is the latent heat absorbed by the ice or given out by it? **[3]**

ii. Give one example where high specific heat capacity of water is used as heat reservoir.

iii. Give one example where high specific heat of water is used for cooling purposes.

(b) A substance is in the form of a solid at 0°C. The amount of heat added to this substance and the temperature of the substance are plotted on the following graph **[3]**



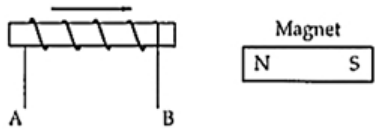
If the specific heat capacity of the solid substance is 500 J/kg°C, find from the graph

i. The mass of the substance

ii. The specific latent heat of fusion of the substance in the liquid state.

(c) i. Name two factors on which magnitude of an induced emf in the secondary coil depends. **[4]**

ii. In the following diagram an arrow shows the motion of the coil towards the bar magnet.



a. State in which direction the current flows, A to B or B to A?

b. Name the law used to come in the conclusion.

Solution

Section A

1. Choose the correct answers to the questions from the given options. (Do not copy the question, write the correct answers only.)

(i) **(d)** Torque

Explanation: {

Force in linear motion has its analogue with torque in rotational motion, because moment of force = force $\times$ the perpendicular distance of the line of action of the force moving towards the point.

(ii) **(c)** the converging power increases

Explanation: {

If two convex lenses are in contact with each other, the equivalent focal length (f) and power of the combination (P) can be calculated as

$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ and $P = P_1 + P_2$

It increases the sharpness of image and converging power.

(iii) **(a)** first changes to light energy and then to heat energy

Explanation: {

first changes to light energy and then to heat energy

(iv) **(b)** β-particles

Explanation: {

β-particles

(v) **(c)** A is true but R is false.

Explanation: {

When a body remains in a state of rest under the influence of several forces, then the body is in static equilibrium. Thus, the duster which lie on the table in state of rest is the example of static equilibrium.

When a body remains in the same state of motion under the influence of several forces then the body is said to be in dynamic equilibrium.

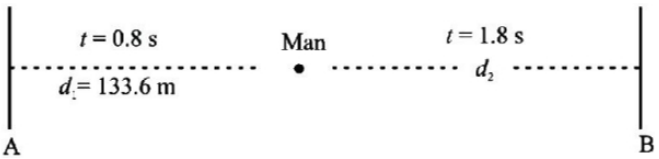
(vi) **(c)** both 90^o and 180^o

Explanation: {

both 90^o and 180^o

(vii) **(b)** 434.2 m

Explanation: {



For nearer cliff A

t = 0.8 s t = 1.8 s

d_1 = 133.6 m

Speed of sound $v = \frac{2d_1}{t}$

$V = \frac{2\times133.6}{0.8} = 334\ ms^{-1}$

For cliff B

$v = 334\ ms^{-1}$

$d_2 = \frac{Vt}{2}$

$= \frac{334\times1.8}{2}$

$\therefore$ distance between two cliffs = $d_1 + d_2 d_2 = 300.6$ m

= 133.6 + 300.6 = 434.2 m

(viii) **(c)** refraction of sound waves

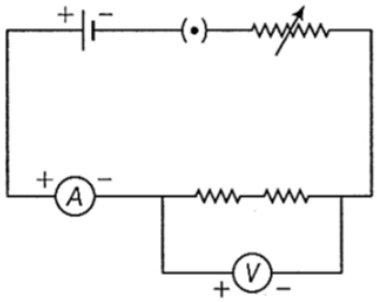
Explanation: {

Sound is louder at night due to change in direction of sound due to refraction. During night, sound bends towards the ground, whereas in day bends away from ground. Hence, at night ground starts releasing heat, hot air rises, the air closer to the ground is cooler. Hence, change of direction is caused by the reversal of temperature gradient from day to night.

(ix) **(b)** Terminals of ammeter are wrongly connected

Explanation: {

According to the diagram, student has connected the apparatus, but terminals of the ammeter is wrongly connected because ammeter is in series. Hence, positive terminal of ammeters should be connected with positive terminal of cell. Diagram is given below,



(x) **(d)** all of these

Explanation: {

all of these

(xi) **(d)** 10 N

Explanation: {

E $\times$ Effort arm

25 N $\times$ 0.4 m

$\because$ work done in both cases is same

Now effort EN $\times$ 1 m = 10

E = $\frac{10}{1}$ = 10 N

(xii) **(b)** increase in the level of sea water

Explanation: {

increase in the level of sea water

(xiii) **(c)** 125 g

Explanation: {

Heat capacity = mass $\times$ sp. heat capacity

93.75 = mass $\times$ 0.75

mass = $\frac{93.75}{0.75}$ = 125 g

(xiv) **(c)** two triangular and three rectangular surfaces

Explanation: {

two triangular and three rectangular surfaces

(xv) **(b)** cold air

Explanation: {

cold air

2. Answer the following questions:

(i) i. Actual output = total load $\times$ distance

= 65 N $\times$ 2 m = 130 J

and useful output = useful work $\times$ distance

= 50 N $\times$ 2 m = 100 J

ii. Jack screw is provided with a long arm so that by applying less effort to this long arm, a heavy load can be lifted.

iii. For a simple physical balance, the two arms are equal in length.

Also, M.A. = $\frac{\text{Load}}{\text{Effort}}$

$= \frac{\text{Effort Arm}}{\text{Load Arm}}$

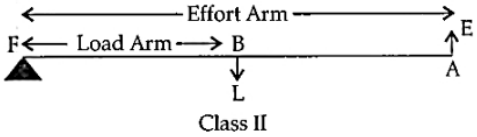
= 1

(ii) i.

F' is the restoring force

ii. Spring balance.

(iii) Levers of class II are used as a force multiplier in a machine. The sketch is given as follows:



Class II

(iv) i. **One Newton:** It is the amount of force acting on a body of mass 1 kg which produces an acceleration of 1 m/s^2 in it.

ii. 1 Newton = 10^5 dynes.

(v) Here, m_1 = 5 kg

$v_1 = 10\ ms^{-1}$

m_2 = 10 kg

$v_2 = 5\ ms^{-1}$

K.E.$_1 = \frac{1}{2} \times 5 \times (10)^2$ = 250 J

K.E.$_2 = \frac{1}{2} \times 10 \times (5)^2$ = 125 J

$\frac{K \cdot E_{\cdot 1}}{\text{K} \cdot \text{E}_2} = \frac{250}{125} = \frac{2}{1}$

(vi) The resistance of a conductor depends on the following factors

i. Length of the wire (l).

Resistance is directly proportional to the length of wire, i.e., $R \propto l$.

ii. Area of cross-section of wire

Resistance is inversely proportional to the area of cross-section i.e., $R \propto \frac{1}{A}$.

iii. Nature of wire i.e., the material of which the wire is made of. It also depends on temperature.

(vii) i. SONAR, i.e., Sound Navigation and Ranging is a system.

ii. Frequency and Amplitude are respectively measurable quantities related to pitch and loudness.

3. Answer the following questions;

(i) It is defined as the ability of a lens to converge or diverge light rays. It is the reciprocal of focal length in metre.

$P = \frac{1}{f(\text{ in metre })}$

Its SI unit is diopter (D).

(ii) The three resistances of 3 Ω are in parallel.

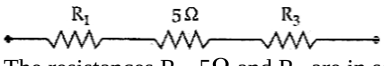
$\frac{1}{R_1} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}$ = 1 Ω

$\Rightarrow R_1$ = 1 Ω

and the resistance 4 Ω and 6 Ω are in parallel.

$\frac{1}{R_3} = \frac{1}{4} + \frac{1}{6} = \frac{3+2}{12} = \frac{5}{12}\Omega$

$\Rightarrow R_3 = \frac{12}{5}$ = 2.4 Ω

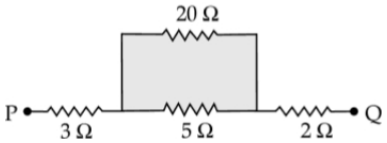


The resistances R_1, 5Ω and R_3 are in series. So, total resistance

$R = R_1 + 5 + R_3 = 1 + 5 + 2.4 = 8.4\ \Omega$.

(iii) The two resistances 10 Ω are in series

R = 10 + 10 = 20 Ω



The resistances 5 Ω and 20 Ω are in parallel.

$\frac{1}{R_1} = \frac{1}{5} + \frac{1}{20} = \frac{4+1}{20} = \frac{5}{20} = \frac{1}{4}$

$\Rightarrow R_1 = 4\ \Omega$

The resistance 4 Ω, 3 Ω and 2 Ω are in series

∴ Equivalent resistance

$R_{eq} = 3 + 4 + 2 = 9\ \Omega$

(iv) Substance B is a good conductor of heat because specific heat capacity of B is less than that of A. Specific heat capacity is the amount of heat energy required to raise the temperature of 1 kg of a substance by 1°C. So substance B gets heated faster.

(v) According to the question,

$_{72}X^{180} \xrightarrow{-1\beta^0}\ _{73}X_1^{180} \xrightarrow{\alpha(_2He^4)}\ _{71}X_2^{176} \xrightarrow{\alpha(_2He^4)}\ _{69}X_3^{172}$

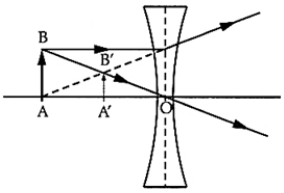
The atomic number (Z) of X is 72 and mass number (A) of X is 180.

Section B

4. Answer the following questions:

(i) i. Concave lens.

ii.



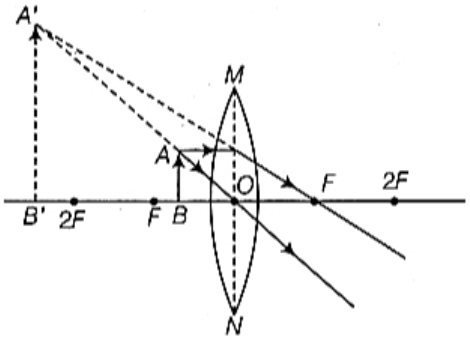
AB is the object and A'B' is the image.

(ii) i. Both (inner and outer) surfaces of calorimeter are highly polished to prevent the transference of heat energy by radiation.

ii. Material B (380 J/kg°C)

By selecting metal B, the heat capacity of the calorimeter will be reduced and the amount of heat energy consumed by the contents filled in to acquire their final temperature will also be negligible or low.

(iii) A convex lens of small focal length can be used as a magnifying glass.



When an object is placed within the focal length of the lens, then a virtual, erect and magnified image on the same side of object is produced.

5. Answer the following questions:

(i) i. As the value of angle of incidence increases, there is a decrease in the angle of deviation till a certain value of angle of incidence and ultimately the angle of deviation becomes minimum. After that, it starts rising with further increase in the value of angle of incidence.

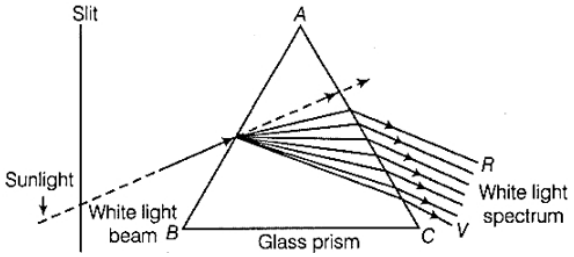
ii. When the wavelength of the light increases, refractive index decreases and the angle of deviation decreases.

(ii) i. In day or white light, when an object is seen through a red glass, it transmits only red light, which is reflected by the object.

But when the same object is seen through blue glass, the red light reflected by the object is not transmitted through the blue glass and the object appears black since, no light reaches our eyes.

ii. The extreme colours in a pure spectrum are violet at one end and red at the other end.

(iii) The path of the light incident on the prism is as shown below



i. The phenomenon of splitting of white light into its constituent colours is called dispersion of light as different constituent colours of white light travel with different speeds in the medium other than air/vacuum and bend through different angles.

ii. This phenomenon is observed as formation of rainbow.

iii. From the dispersion phenomenon, we can conclude that

a. white light consists of seven colour and

b. violet light suffers maximum deviation and red light suffers minimum deviation.

6. Answer the following questions:

(i) Here, M = 200 kg

Mg = 200 × 10

= 2000 N

In first case, $2T_1$ = 2000 N

$\Rightarrow T_1$ = 1000 N

$\therefore F_1$ = 1000 N

In second case, $2T_2$ = 2000 N

$\Rightarrow T_2$ = 1000 N

$\therefore F_2$ = 1000 N

Here, $\frac{F_1}{F_2} = 1$

(ii) i. By principle of moments, 40 × 25 = w × 20

$\therefore$ w = 50 gf

ii. F is shifted towards 0 cm

(iii) Case I: The force and displacement are at right angle to each other, so $\theta = 90°$

Work done, W = Fs cosθ

= Fs cos90°

$= Fs \times 0 = 0 \ (\because \cos 90^\circ = 0)$

therefore, the work done is zero

Case II: The force and displacement are in the same directions, so $\theta = 0°$

$\therefore$ Work done, W = Fs cos θ = F s cos 0°

= Fs × 1 = Fs ($\because$ cos0° = 1)

therefore., the work done in this case is positive

Case III: The force and displacement are in opposite directions, so $\theta = 180°$.

$\therefore$ Work done, W = Fs cosθ = F s cos 180°

= Fs × -1 = -F s

($\because$ cos 180° = - 1)

i.e., the work done is negative in this case.

7. Answer the following questions:

(i) i. This happens when the frequency of vibrating piston of the engine becomes equal to the natural frequency with which the body of the motorbike is vibrating.

ii. The phenomenon is called as resonance.

iii. The speed of the vehicle should be changed in order to control this types of violent vibrations.

(ii) i. The nucleus of an atom tends to be radioactive when the atomic number is greater than 82 and imbalance of proton and neutron as compared to a normal stable atom.

ii. There is no change in the radioactivity during a chemical reaction because the chemical reaction involves electrons of shell whereas radioactivity involves nucleons (i.e., neutrons and protons).

iii. Uses of radioactivity is in the production of electricity in a nuclear reactor and carbon dating by (C^{14}) and the harmful effect is it causes skin cancer and eye diseases.

(iii) i. Free vibration/damped vibrations.

ii. Forced vibrations.

iii. D vibrates with the same amplitude as C or C and D vibrate with maximum amplitude alternately.

iv. Resonance.

8. Answer the following questions:

(i) i. The expression for the electrical energy

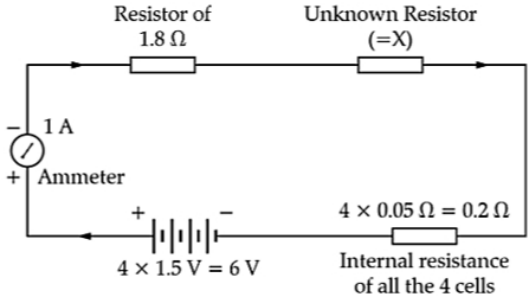
$E = I^2Rt$

ii. Alternating current supplied in our houses is at voltage 220 V.

iii. The electric lamp in a building should be connected in parallel.

(ii) Electrostatic repulsive forces between protons are very high in heavy nuclei due to presence of large number of protons. The attraction due to nuclear forces cannot hold so much protons together in the nucleus. Thus, large number of neutrons separate the protons, weakening the repulsion between them.

(iii) The labelled diagram of the given circuit is as shown below:



We have

i. Total resistance = (1.8 + 0.2 + X) Ω = (2 + X) Ω

ii. Total emf = 4 × 1.5 V = 6 V

$\therefore$ Current = $\frac{6}{(2+X)}$ = 1 A (given)

This gives X = 4 Ω

Hence, total resistance = (2 + X) Ω = (2 + 4) Ω = 6 Ω

iii. The p.d. across X = (1 A × 4 Ω) = 4 V

9. Answer the following questions:

(i) i. Latent heat of fusion is absorbed by the ice.

ii. Hot water bottles used for fermentation.

iii. Drinks get cooled more quickly by adding pieces of ice at 0°C than the ice cold water at 0°C.

(ii) i. According to the question,

Suppose the mass of the substance be m kg

As we know that, Q = mcΔt. From the graph,

Q = 800 J, Δt = 80°C,

c = 500 J/kg°C

$\Rightarrow$ 800 = m × 500 × 80

So, m = $\frac{800}{500\times80} = \frac{1}{50}$ kg

ii. Latent heat of fusion i.e., Q = mL

$\Rightarrow$ (1600 - 800) = L × $\frac{1}{50}$

$\Rightarrow$ L = 800 × 50 = 40000 J/kg

(iii) i. The two factors on which magnitude of an induced emf in the secondary coil depends are:

a. The change in magnetic flux.

b. The time in which magnetic flux changes

ii. a. The current flows from B to A.

From B to A

If current is flowing from A to B, it would create a south pole on the bar magnet side of the solenoid. It would attract the solenoid towards the bar magnet. As per Lenz's law, it should oppose the motion of the solenoid. If the current is flowing from B to A, it would create a north pole on the side of the solenoid towards the bar magnet. This would cause a repulsion between solenoid and bar magnet preventing it from moving towards bar magnet and hence oppose the cause of e.m.f. as per the Lenz's law.

b. The law used to come to the conclusion is Lenz's law.