

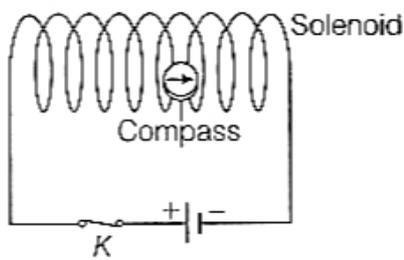
Reason (R): In uniform circular motion, an object moves with constant speed but variable velocity.

- 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) Both A and R are true
- (g) Global warming will result in: [1]
- a) increase in the level of sea water b) decrease in the level of sea water
- c) decrease in disease caused by bacteria d) increase in agricultural production
- (h) A convex lens forms a real image 4 times magnified when placed at a distance of 6 cm from the lens. [1]
Calculate the focal length of the lens.
- a) 4.8 cm b) 2.8 cm
- c) 6.8 cm d) 8.8 cm
- (i) When four hydrogen nuclei combine to form a helium nucleus in the interior of sun, what amount of [1]
energy released per nucleon in this process?
- a) 24.5 MeV b) 46.3 MeV
- c) 26.7 MeV d) 18.5 MeV
- (j) In an a.c. generator the magnitude of induced current can be increased by: [1]
- a) increasing the strength of field magnets b) increasing the area of cross-section of the coil
- c) all of these d) increasing number of turns in the coil
- (k) A lever which can have mechanical advantage either less than one or more than one depending upon [1]
the position of fulcrum is a lever of:
- a) Third order b) Forth order
- c) First order d) Second order
- (l) A conductor at 4.2 K is found to offer no resistance. Such a conductor is called [1]
- a) zero conductor b) absolute conductor
- c) superconductor d) Semiconductor
- (m) A solid of mass 0.15 kg is heated from 10°C to 90°C. If the specific heat capacity of the solid is 390 [1]
Jkg⁻¹⁰ C⁻¹, find the heat absorbed by the solid.
- a) 9850 J b) 6280 J
- c) 4680 J d) 5740 J
- (n) Kilocalorie is the amount of heat required to raise the temperature of: [1]
- a) one kg of water through 1°C b) 1 kg of water through 10°C
- c) one gram of water through 1°C d) 1 kg of water through 100°C
- (o) The angle of refraction in a glass block of refractive index 1.5 is 19°. Calculate the angle of incidence. [1]
- a) 3.5 sin 19 b) 4.5 sin 19

c) $2.5 \sin 19$

d) $1.5 \sin 19$

2. **Answer the following questions:** [15]
- (a) i. Using the SONAR, sound waves are emitted at the surface of water, which after being reflected from bottom of water, are detected. If the time interval from the emission to the detection of the sound waves is 4s. Calculate the depth of the water. (Take, speed of sound in water is 1450 m/s) [1]
- ii. Name one factor which affects the frequency of sound emitted due to vibrations in an air column. [1]
- iii. Calculate the minimum distance at which a person should stand in front of a reflecting surface so that he can hear a distinct echo. (Take speed of sound in air = 350 m/s). [1]
- (b) A mixture of radioactive substances gives off three types of radiations. [2]
- i. Name the radiation which travels with the speed of light.
- ii. Name the radiation which has the highest ionizing power.
- (c) Which class of levers has a mechanical advantage always greater than 1? What change can be brought about in their lever to increase its mechanical advantage? [2]
- (d) The moment of a force of 10 N about a point X is 4 N-m. Find the distance of point of application of the force from the point X. [2]
- (e) State the amount of work done by an object, when it moves in a circular path for one complete rotation. Give your reason to justify your answer. [2]
- (f) A family uses a light bulb of 100 W, a fan of 100 W, and a heater of 1000 W, each for 8 h a day. If the cost of electricity is ₹2 per unit, what is the expenditure for the family per day on electricity? [2]
- (g) State the fundamental principle of gear tooth action. [2]
3. **Answer the following questions;** [10]
- (a) Does the depth of the tank of a water appear to change or remains the same when viewed normally from the above? [2]
- (b) One end of a spring is kept fixed while the other end is stretched by a force as shown in the diagram [2]
- The diagram shows a coiled spring. On the right end, there is a rectangular box labeled 'Fixed end'. On the left end, an arrow labeled 'F' points to the left, indicating an applied force stretching the spring.
- i. Copy the diagram and mark on it the direction of the restoring force.
- ii. Name the instrument.
- (c) The potential difference between the terminals of an electric heater is 75 V when it draws a current of 5 A from the source. What current will the heater draw, if the potential difference is increased to 150 V? [2]
- (d) If a liquid A of specific heat capacity $1050 \text{ J kg}^{-1}\text{K}^{-1}$ and at 90°C is mixed with liquid B of specific heat capacity $2362.5 \text{ J kg}^{-1}\text{K}^{-1}$ and at 20°C , when the final temperature recorded is 50°C . Determine in what proportion of the weights of liquids are mixed? [2]
- (e) A plotting compass is placed inside a solenoid and the compass needle is pointing in the direction as shown. [2]



- i. Complete the diagram by drawing arrow heads to indicate the direction of the current flow.
- ii. Describe the direction of the magnetic field inside the solenoid.

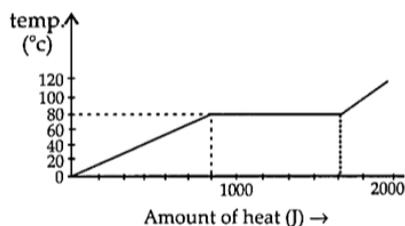
Section B

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

(a) A ray of monochromatic light is incident from air on a glass slab. [3]

- i. Draw a labelled ray diagram showing the change in the path of the ray till it emerges from the glass slab.
- ii. Name the two rays that are parallel to each other.
- iii. Mark the lateral displacement in your diagram.

(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 $500 \text{ J/kg}^{\circ}\text{C}$, 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. Centre of gravity of a body on the earth coincides with its centre of mass for a small object and for a large object, it may not. What is qualitative meaning of small and large in this regard. [4]

For which of the following two of them coincides, a building, a pond, a lake, a mountain.

- ii. The bottom of a ship is made heavy. Why?

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

(a) 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 $900 \text{ Jkg}^{-1}\text{C}^{-1}$, $380 \text{ Jkg}^{-1}\text{C}^{-1}$ and $460 \text{ Jkg}^{-1}\text{C}^{-1}$ respectively, to make a calorimeter. Which material will you select? Justify your answer.

(b) i. Can the absolute refractive index of a medium be less than 1? [3]

- ii. A coin placed at the bottom of a beaker appears to be raised by 4 cm. If the refractive index of water is $\frac{4}{3}$. Find the depth of the water in the beaker.

(c) If a man raises a box of 50 kg mass to a height of 2 m, while the other man raises the same box to a same height in 5 min. Compare [4]

- i. the work done.
- ii. the power developed by them.

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

(a) An effort of 10 kgf is applied on a machine through a distance of 100 cm when a load of 100 kgf moves through a distance of 5 cm. [3]

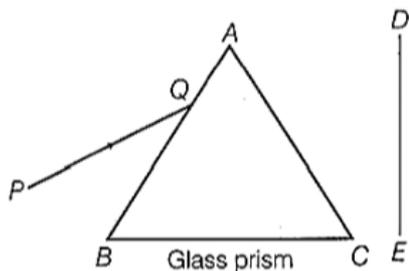
Calculate the

- i. velocity ratio
- ii. mechanical advantage
- iii. efficiency of the machine

(b) A coil of insulated copper wire is connected to a galvanometer. What will happen, if a bar magnet is [3]

- i. pushed into the coil
- ii. withdrawn from inside the coil and
- iii. held stationary inside the coil?

(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.

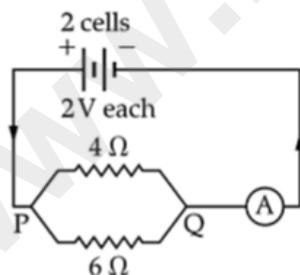
- i. Write the name and cause of the phenomenon observed.
- ii. Where else in nature is this phenomenon observed?
- iii. Based on this observation state the conclusion which can be drawn about the constituents of white light.

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

(a) i. What is meant by resonance? [3]

ii. State two ways in which resonance differs from forced vibrations.

(b) With reference to the diagram given below, [3]



Calculate

- i. The equivalent resistance between P and Q.
- ii. The reading of the ammeter.
- iii. The electrical power between P and Q.

(c) i. State three characteristics of musical sound. [4]

ii. How does the musical sound differ from noise?

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

(a) i. What happens to the atomic number of an element, when it emits [3]

a. an α -particle and

- b. a β -particle?
- ii. Explain, why α - and β -particle are deflected in an electric or a magnetic field but γ -rays are not deflected in such a field.
- (b) i. What are background radiations? [3]
ii. Write an equation of an α emission from U_{92}^{238} .
iii. What will be the change in the rate of radioactivity if the temperature of the radioactive substance is raised to four times the initial temperature?
- (c) Two coils of resistances $R_1 = 3 \Omega$ and $R_2 = 6 \Omega$ are connected in series across a battery of p.d. 12 V, [4]
Draw the circuit diagram. Find
i. the electrical energy consumed in 1 minute in each resistance,
ii. the total electrical energy supplied by the battery in 1 minute.
9. **Answer the following questions:** [10]
- (a) i. Write a relationship between angle of incidence and angle of refraction for a given pair of media. [3]
ii. When a ray of light enters from one medium to another having different optical densities it bends. Why does this phenomenon occur?
iii. Write one condition where it does not bend when entering a medium of different optical density.
- (b) While performing an experiment, it is observed that when 300 g of hot water at 50°C is added to 600 g of cold water, then its temperature rises by 15°C . Find the initial temperature of cold water. [3]
- (c) Draw a labelled diagram of an alternating current generator. Write the function of its two main parts. [4]

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) (c) 13.54

Explanation:

Given, kinetic energy of electron = 10 keV

Kinetic energy of proton = 100 keV

Mass of electron, $m_e = 9.11 \times 10^{-31}$ kg

Mass of proton, $m_p = 1.67 \times 10^{-27}$ kg

As, $K = \frac{1}{2}mv^2$ or $v = \sqrt{\frac{2K}{m}}$

Hence, $\frac{v_e}{v_p} = \sqrt{\frac{K_e}{K_p} \times \frac{m_p}{m_e}}$

$$= \sqrt{\frac{10 \times 1.67 \times 10^{-27}}{100 \times 9.11 \times 10^{-31}}}$$

$$= \sqrt{\frac{167}{911} \times 10^3} = 13.54$$

$$\Rightarrow v_e = 13.54v_p$$

Hence, electron is travelling faster.

(ii) (c) 3 : 2

Explanation:

As both the wire are made of same material, have same sp. resistance

$$\therefore \rho = \frac{R \frac{a}{l}}{l} = \frac{R_1 \frac{a}{3l}}{3l} \text{ or } \frac{R_2}{R_1} = \frac{l_2}{l_1}$$

$$\therefore \frac{R_1}{R} = \frac{6}{4} = \frac{3}{2} \therefore R_1 : R = 3 : 2$$

(iii) (c) less than 2, but more than 1

Explanation:

less than 2, but more than 1

(iv) (d) Nm

Explanation:

Nm

(v) (d) free vibrations

Explanation:

free vibrations

(vi) (d) Both A and R are true

Explanation:

In uniform circular motion, the body moves with constant speed in circular path, but its direction of motion keeps on changing continuously. Thus, the velocity of the object in uniform circular motion is variable and such motion is called accelerated motion.

(vii) (a) increase in the level of sea water

Explanation:

increase in the level of sea water

(viii) (a) 4.8 cm

Explanation:

$$m = 4$$

$$u = 6 \text{ cm}$$

$$v = ?$$

$$m = \frac{v}{u}$$

$$\Rightarrow u = \frac{v}{6} \therefore v = 4 \times 6 = 24 \text{ cm}$$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

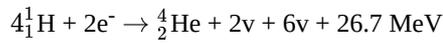
$$\Rightarrow \frac{1}{f} = \frac{1}{24} - \left(\frac{1}{-6} \right) = \frac{1}{24} + \frac{1}{6} = \frac{1+4}{24}$$

$$\Rightarrow \frac{1}{f} = \frac{5}{24} \therefore f = \frac{24}{5} = 4.8 \text{ cm}$$

- (ix) (c) 26.7 MeV

Explanation:

When four hydrogen nuclei combine to form a helium nucleus in the interior of the sun, nuclear fusion takes place its a multi-step process in which hydrogen is fused into helium. The proton-proton (p, p) cycle by which this occurs is represented as



Hence, energy released per nucleon is 26.7 MeV.

- (x) (c) all of these

Explanation:

all of these

- (xi) (c) First order

Explanation:

First order

- (xii) (c) superconductor

Explanation:

superconductor

- (xiii) (c) 4680 J

Explanation:

Given, $m = 0.15 \text{ kg} = \frac{15}{100} \text{ kg}$; $C = 390 \text{ Jkg}^{-1}\text{C}^{-1}$

Rise in temp. $\Delta t = 90 - 10 = 80^\circ\text{C}$

\therefore Heat absorbed by solid = $mc \Delta t$

$= \frac{15}{100} \times 390 \times 80 = 4680 \text{ J}$

- (xiv) (a) one kg of water through 1°C

Explanation:

one kg of water through 1°C

- (xv) (d) $1.5 \sin 19$

Explanation:

Refractive index of glass = $\frac{\sin i}{\sin r}$

$1.5 = \frac{\sin i}{\sin 19^\circ}$

$\sin i = 1.5 \sin 19$

2. Answer the following questions:

- (i) i. Time taken by sound waves to travel from surface to bottom, $t = \frac{4}{2} = 2\text{s}$

and speed of sound waves, $v = 1450 \text{ m/s}$

\therefore Depth of water = $vt = 1450 \times 2 = 2900 \text{ m}$

ii. The frequency of sound emitted due to vibrations in air column is affected by the length of air column.

iii. Speed of sound, $v = 350 \text{ m/s}$

Distance, $d = ?$

Time, $t = 0.1 \text{ s}$ [persistence of hearing]

$2d = vt$

$= 350 \times 0.1$

$= 35$

$d = \frac{35}{2} = 17.5 \text{ m}$

- (ii) i. γ radiation.

ii. $\alpha({}_2\text{He}^4)$ particle.

(iii) Class II levers have mechanical advantage always greater than 1.

To increase the mechanical advantage, length of effort arm must be increased and length of load arm should be decreased.

(iv) Given, moment of force = 4 N-m, $F = 10 \text{ N}$

If the distance of point of application of force from the point X is d metre, then

moment of force = force \times distance

$$4 = 10d \Rightarrow d = \frac{4}{10} = \frac{2}{5} = 0.4 \text{ m}$$

(v) Work done = Force \times displacement

Here after one complete revolution, displacement is zero.

\therefore Work done = zero.

(vi) Given, $P_b = 100 \text{ W}$, $P_f = 100 \text{ W}$

$$P_h = 1000 \text{ W},$$

$T = 8 \text{ h}$ (each), rate = ₹2/unit

$$P = P_b + P_f + P_h = 100 + 100 + 1000$$

$$= 1200 \text{ W} = 1.2 \text{ kW}$$

$$E = P \times t = 1.2 \times 8 = 9.6 \text{ kWh}$$

$$\therefore \text{Cost of energy consumed per day} = 9.6 \times 2$$

$$= ₹19.20$$

(vii) The fundamental principle of gear and tooth action depends upon the Velocity Ratio (VR). Velocity ratio is also defined as the ratio of speed of rotation of driver gear to the speed of rotation of driven gear.

$$VR = \frac{\text{Speed of rotation of driver gear } (v)_{\text{driver}}}{\text{Speed of rotation of driven gear } (v)_{\text{driven}}}$$

3. Answer the following questions;

(i) No, when the depth of a tank of water is viewed normally, no refraction takes place as the light rays pass through the medium undeviated. Thus, the depth of the tank remains the same because it is a case of normal incidence, where $\angle i = \angle r = 0^\circ$.



F' is the restoring force

ii. Spring balance.

(iii) Given, potential difference, $V = 75 \text{ V}$

Current, $I = 5 \text{ A}$

We know that, $R = \frac{V}{I}$

$$\Rightarrow R = \frac{75}{5} = 15 \Omega$$

When potential difference is increased to 150 V, then current is

$$I' = \frac{V'}{R} = \frac{150}{15} = 10 \text{ A}$$

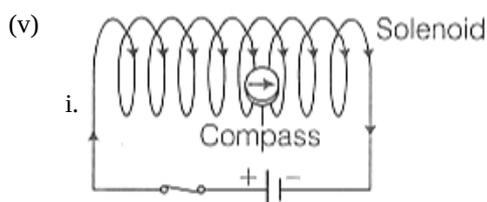
So, the current through the heater becomes 10 A.

(iv) By principle of method of mixture,

Heat lost by A = Heat gained by B

$$m_1 \times 1050 \times (90^\circ - 50^\circ) = m_2 \times 2362.5 \times (50^\circ - 20^\circ)$$

$$\Rightarrow \frac{m_1}{m_2} = \frac{2362.5 \times 30}{1050 \times 40} = \frac{27}{16}$$

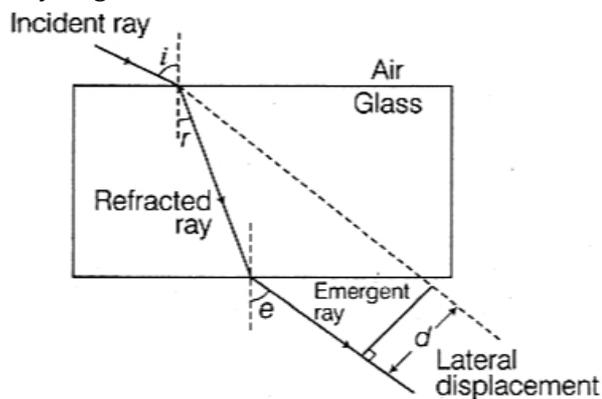


ii. The direction of the magnetic field inside the solenoid always points from the induced South pole towards the induced North pole.

Section B

4. Answer the following questions:

(i) i. Ray diagram



- ii. The rays parallel to each other are incident ray and emergent ray.
iii. The perpendicular distance between the incident ray and emergent ray is called the lateral displacement, which is marked as d in the above diagram.

(ii) i. According to the question,

Suppose the mass of the substance be m kg

As we know that, $Q = mc\Delta t$. From the graph,

$$Q = 800 \text{ J}, \Delta t = 80^\circ\text{C},$$

$$c = 500 \text{ J/kg}^\circ\text{C}$$

$$\Rightarrow 800 = m \times 500 \times 80$$

$$\text{So, } m = \frac{800}{500 \times 80} = \frac{1}{50} \text{ kg}$$

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

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

$$\Rightarrow L = 800 \times 50 = 40000 \text{ J/kg}$$

(iii) i. Centre of mass and centre of gravity are two concepts. But, if g remains same from one part of body to other than CG and CM will coincide each other. So, when vertical height of the object is very small compared to radius of earth, we call object small, otherwise we call it extended.

For example, buildings and ponds are small objects and a deep lake and a mountain are large extended objects.

ii. The bottom of a ship is made heavy, so that its centre of gravity remains low. This ensures the stability of its equilibrium and avoids the ship from sinking.

5. Answer the following questions:

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

ii. Material B ($380 \text{ J/kg}^\circ\text{C}$)

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.

(ii) i. No, the absolute refractive index of a medium can't be less than 1, because the speed of light in any medium is always less than that in vacuum.

ii. Given, shift = 4.0 cm.

$$\text{Refractive index, } \mu = \frac{4}{3}$$

$$\text{Shift} = \text{Real depth} \times \left(1 - \frac{1}{\mu}\right)$$

$$\Rightarrow 4 = \text{Real depth} \left(1 - \frac{3}{4}\right)$$

$$\Rightarrow 4 = \text{Real depth} \times \frac{1}{4}$$

$$\Rightarrow \text{Real depth} = 16 \text{ cm.}$$

(iii) i. For the first man, mass $m = 50 \text{ kg}$

Height from ground, $h = 2 \text{ m}$

Time taken, $t_1 = 2 \text{ min} = 2 \times 60 \text{ s} = 120 \text{ s}$

For the second mass, $m = 50 \text{ kg}$

Height, $h = 2 \text{ m}$

Time, $t = 5 \text{ min} = 5 \times 60 = 300 \text{ s}$

Let work done by the first man be W .

Since, $W = mgh$

Therefore, the work done by the second man is the same as mass and height are same.

$$\therefore W_1 : W_2 = 1 : 1$$

ii. Let power developed by the first man = P_1

$$\therefore W = mgh = 50 \times 10 \times 2 = 1000 \text{ J}$$

$$P_1 = \frac{W}{t_1} = \frac{1000}{120} \text{ W} = \frac{25}{3} \text{ W}$$

Let P_2 be the power developed by the second man = P_2 .

Therefore, power developed,

$$P_2 = \frac{W}{t} = \frac{1000}{300} \text{ W} = \frac{10}{3} \text{ W}$$

$$\therefore \frac{P_1}{P_2} = \frac{25}{3} : \frac{10}{3}$$

$$\therefore \frac{P_1}{P_2} = \frac{5}{2}$$

$$\Rightarrow P_1 : P_2 = 5 : 2 \quad (\because t_2 = 5 \text{ min})$$

6. Answer the following questions:

(i) Given, effort, $E = 10 \text{ kgf}$, load, $L = 100 \text{ kgf}$

Distance moved by effort, $d_E = 100 \text{ cm}$ and distance moved by load, $d_L = 5 \text{ cm}$

i. From the formula of Velocity Ratio (VR)

$$\begin{aligned} &= \frac{\text{Distance through which the effort moves } (d_E)}{\text{Distance through which the load moves } (d_L)} \\ &= \frac{100 \text{ cm}}{5 \text{ cm}} = 20 \end{aligned}$$

ii. By using formula of Mechanical Advantage (MA)

$$= \frac{\text{Load } (L)}{\text{Effort } (E)} = \frac{100 \text{ kgf}}{10 \text{ kgf}} = 10$$

iii. Percentage efficiency, $\eta = \frac{MA}{VR} \times 100$

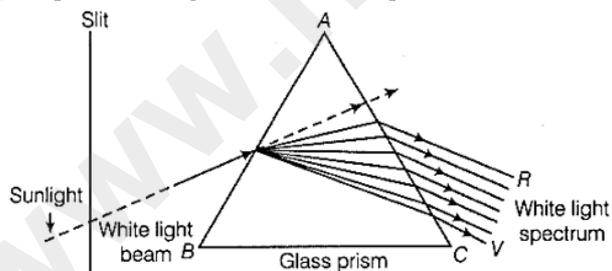
$$= \frac{10}{20} \times 100 = 50\%$$

(ii) i. The deflection in the galvanometer shows that current is induced in the coil. Current is induced in the coil due to the relative motion between coil and magnet.

ii. The galvanometer shows a deflection in the opposite direction which means the current gets induced in opposite direction. In this case, the direction of motion is in the opposite directions w.r.t. coil.

iii. There is no deflection in the galvanometer as no current is induced in the coil. There is no relative motion between coil and current, so no current will be induced in the coil.

(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.

7. Answer the following questions:

(i) i. The phenomenon in which body vibrates under the influence of periodic force, where frequency of the applied periodic force is equal to the natural frequency of the vibrating body. Then, the body begins to vibrate with increased amplitude and the phenomenon is called resonance.

ii. Resonance differs from forced vibrations in the following ways

--

Resonance	Forced Vibrations
This is the phenomenon of setting a body (A) into vibrations with the help of another body (B), where frequency of (B) is equal to the natural frequency of (A).	In this, a body (A) is set into vibrations under the influence of periodic force of body (B). Frequency of vibrations of body (E) does not match with the natural frequency of the body (A).
Vibrations are of larger amplitude.	Vibrations are of smaller amplitude.

- (ii) i. $\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{6} = \frac{3+2}{12} = \frac{5}{12}$
 $\Rightarrow R_{eq} = \frac{12}{5} = 2.4 \Omega$
- ii. Emf, $E = 2 \times 2 = 4 \text{ V}$, $E = IR_{eq}$
 $\Rightarrow I = \frac{E}{R_{eq}} = \frac{4}{2.4} = 1.67 \text{ A}$
- iii. Power, $P = I^2 R_{eq} = (1.67)^2 \times 2.4 = 6.69 \text{ W}$

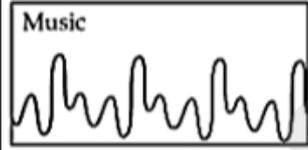
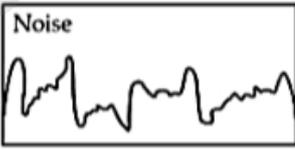
- (iii) i. The three characteristics of a musical sound are.

Pitch: It is the frequency of sound perceived by human ear. A high frequency gives rise to high pitch note and a low frequency produces a low pitch note.

Loudness (Intensity): It is the property by virtue of which a loud sound can be distinguished upon the amplitude of wave ($I \propto A^2$)

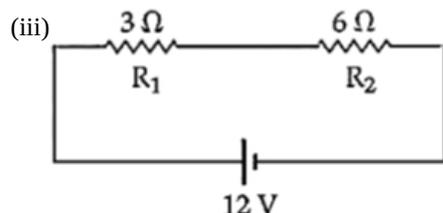
Quality (Timbre): It is the characteristics of musical sound which distinguish between two sounds of same loudness and same pitch but emitted by two different instruments.

- ii. The musical sound differs from noise in the following ways:

Musical sound	Noise
It is produced by vibrations which are periodic.	It is produced by irregular or non-periodic disturbance in succession.
It is pleasant and smooth to ear.	It is discordant to ear.
	

8. Answer the following questions:

- (i) i. When an α -particle is emitted, then atomic number gets decreased by 2 and mass number gets decreased by 4.
a. During β -emission, atomic number gets increased by 1 as it consists of ${}_{-1}\beta^0$
- ii. Since, α -particle is a helium nucleus (${}_{2}\text{He}^4$) and is a positively charged particle and β -particle is (${}_{-1}\beta^0$), a negatively charged particle. So, in an electric field they experience force so, get deflected.
- (ii) i. **Background radiations:** These are ionizing radiations present in environment originating from earth crust, atmosphere, cosmic radiation, nuclear weapons. We all are exposed to them even in the absence of actual radiation source.
- ii. ${}_{92}^{238}\text{U} \xrightarrow{\alpha\text{-emission}} {}_{90}^{234}\text{X} + {}_{2}^4\text{He} + \text{Energy}$
- iii. No change. Radioactivity does not depend on temperature.



Given, $R_1 = 3 \Omega$, $R_2 = 6 \Omega$, $V = 12 \text{ volt}$, $t = 1 \text{ minute} = 60 \text{ s}$

- i. Total resistance of circuit, $R = R_1 + R_2 = 3 + 6 = 9 \Omega$

Current in circuit, $I = \frac{V}{R} = \frac{12}{9} = \frac{4}{3} \text{ A}$

Since the resistances are in series, so same current flows in each resistance.

Electrical energy consumed in R_1 will be

$$W_1 = I^2 R_1 t = \left(\frac{4}{3}\right)^2 \times 3 \times 60 = 320 \text{ J}$$

Electrical energy consumed in R_2 will be

$$W_2 = I^2 R_2 t = \left(\frac{4}{3}\right)^2 \times 6 \times 60 = 640 \text{ J}$$

ii. Total electrical energy supplied by the battery in 1 minute

$$W = W_1 + W_2 = 320 + 640 = 960 \text{ J}$$

9. Answer the following questions:

(i) i. $\frac{\sin(\text{angle of incidence})}{\sin(\text{angle of refraction})} = \text{Refractive index.}$

ii. The ray bends from its original path due to change in the speed.

iii. The ray does not bend when incident normally at the surface of the second medium.

(ii) Let $t^\circ\text{C}$ be the initial temperature of cold water.

\therefore Heat gained by the cold water = $mc\Delta t$

(Here, $\Delta T = 15^\circ\text{C}$)

$$\Delta Q = 600 \times 4.2 \times 15$$

$$\text{Heat loss by hot water} = 300 \times 4.2 \times [4.2 \times [50 - (T + 15)]]$$

\therefore using the principle of calorimetry,

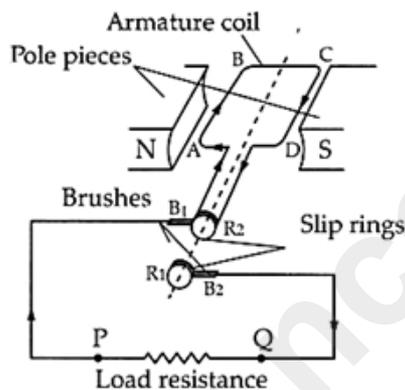
Heat lost = Heat gained

$$600 \times 4.2 \times 15 = 300 \times 4.2(50 - (T + 15))$$

$$37800 = 1260(35 - T)$$

$$\Rightarrow T = 5^\circ\text{C}$$

(iii) The labelled diagram is shown below:



The function of its any two parts are:

- Brushes:** The function of brushes is to pass on current from the armature coil to the external load resistance R.
- Field magnets:** To produce a strong magnetic field.