Physics

CISCE

Academic Year: 2023-2024

(English Medium)

Date & Time: 4th March 2024, 11:00 am

Duration: 2h **Marks: 80**

1. Answers to this Paper must be written on the paper provided separately.
2. You will not be allowed to write during the first 15 minutes.
3. This time is to be spent reading the question paper.
4. The time given at the head of this Paper is the time allowed for writing the answer s.
5. Attempt all questions from Section A and any four questions from Section B.
6. The intended marks for questions or parts of questions are given in brackets [ ].

SECTION-A (40 Marks) (Attempt all questions from this Section.)

Q1. Choose the correct answer to the questions from the given options. (Do not copy the questions. Write the correct answer only.)

1.1. When a bell fixed on a cycle rings, then the energy conversion that takes place is _____.

1. Gravitational potential energy to sound energy.
2. Kinetic energy to sound energy.
3. Sound energy to electrical energy.
4. Sound energy to mechanical energy.

Solution

When a bell fixed on a cycle rings, then the energy conversion that takes place is kinetic energy to sound energy.

Explanation:

This is because ringing a bell typically requires moving a bell component, like a lever or clapper. Mechanical forces initially move these components. This mechanical force is converted into kinetic energy as the clapper moves, and this kinetic energy is then converted into sound energy when it strikes the bell.

1.2. A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is _____.

1. 5 N
2. 10 N
3. 20 N
4. 0.2 N

Solution

A door lock is opened by turning the lever (handle) of length 0.2 m. If the moment of force produced is 1 Nm, then the minimum force required is 5 N.

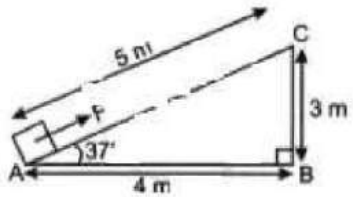
Explanation:

$$\text{Force} = \frac{\text{Moment of force}}{\text{Length of lever}}$$

$$= \frac{1}{0.2}$$

$$= 5 \text{ N}$$

1.3. A force 'F' moves a load from A to C as shown in the figure below. For the calculation of the work done, which of these lengths would you use as the displacement?



1. 3m
2. 4m

3. 5m
4. 7m

Solution

5m

Explanation:

As displacement in the direction of force is used.

1.4. A radioactive nucleus containing 128 nucleons emits a β-particle. After β- emission the number of nucleons present in the nucleus will be _____.

1. 128
2. 129
3. 124
4. 127

Solution

A radioactive nucleus containing 128 nucleons emits a β-particle. After β- emission the number of nucleons present in the nucleus will be 128.

Explanation:

A neutron undergoes β-decay, converting it into a proton and releasing a β-particle. As a result, the mass number stays constant while the atomic number increases by 1. Therefore, there will still be 128 nucleons (the mass number).

1.5. Assertion (A): Ultraviolet radiations is scattered more as compared to the microwave radiations.

Reason (R): Wavelength of ultraviolet radiation is more than the wavelength of microwave radiation.

1. Both A and Rare true.
2. A is true but R is false.
3. A is false but R is true.

4. Both A and Rare false.

Solution

A is true but R is false.

Explanation:

Because UV radiation has shorter wavelengths than microwave radiation, it scatters more.

1.6. When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are definitely an example of _____.

1. Resonance
2. Natural vibrations
3. Forced vibrations
4. Damped vibrations

Solution

When the stem of vibrating tuning fork is pressed on a table, the tabletop starts vibrating. These vibrations are definitely an example of **Forced vibrations**.

Explanation:

This occurs because the tuning fork forces the tabletop to vibrate at its own frequency.

1.7. Which of the following is a class III lever?

1. Pair of scissors
2. Wheelbarrow
3. Crowbar
4. Human forearm

Solution

Human forearm

Explanation:

Considering that the human forearm is an example of a class III lever. The load and the fulcrum are where the effort is applied.

1.8. The specific resistance of a conductor depends on its _____.

1. Length
2. Material
3. Area of cross section
4. Radius

Solution

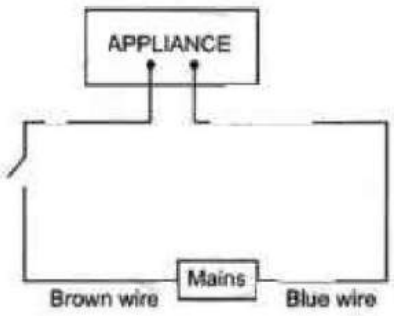
The specific resistance of a conductor depends on its **material**.

Explanation:

It depends on the material and is independent of the wire's dimensions, including area, radius, length, and form.

1.9. Identify the option that displays the correct wiring with correct colour code:

1.



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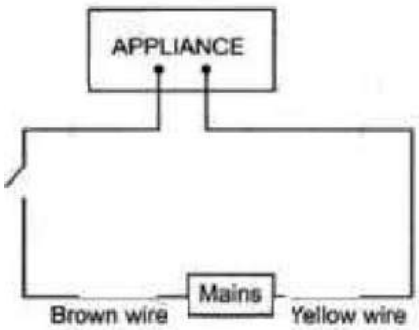

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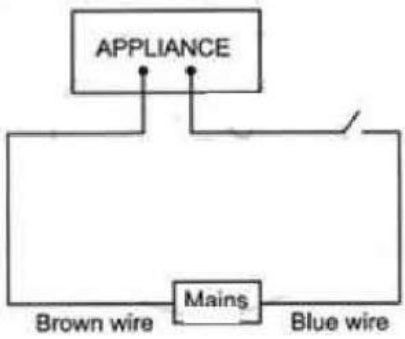

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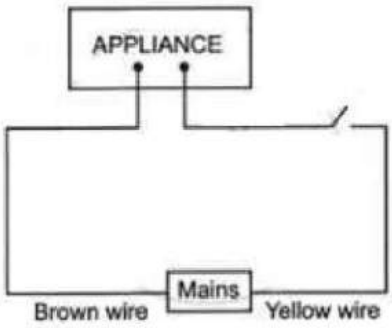
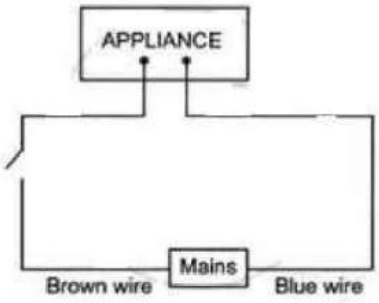


Solution



Explanation:

The switch is attached to the live wire, which is coloured brown on the left and blue on the right.

1.10. The potential difference between terminals of a cell in a closed electric circuit is _____.

1. Terminal voltage

2. Electro motive force
3. Voltage drop
4. None of these

Solution

The potential difference between terminals of a cell in a closed electric circuit is **Electro motive force.**

Explanation:

This is so because the potential difference between its electrodes when current is pulled from them is known as the terminal voltage. Because when charge flows in a circuit, it is always less than the e.m.f.

1.11. During melting of ice at 0°C the _____.

1. Energy is released and temperature remains constant.
2. Energy is absorbed and temperature remains constant.
3. Energy is released and temperature decreases.
4. Energy is absorbed and temperature increases.

Solution

During melting of ice at 0°C the **energy is absorbed and temperature remains constant.**

Explanation:

The latent heat of fusion causes energy to be absorbed during ice melting at 0°C, maintaining a constant temperature.

1.12. Linear magnification (m) produced by a concave lens is _____.

1. $m < 1$
2. $m > l$
3. $m = 1$
4. $m = 2$

Solution

Linear magnification (m) produced by a concave lens is $m < 1$.

Explanation:

Because an object appears smaller in the image created by a concave lens.

1.13. A radioactive element is placed in an evacuated chamber. Then the rate of radioactive decay will _____.

1. Decrease
2. Increase
3. Remain unchanged
4. Depend on the surrounding temperature

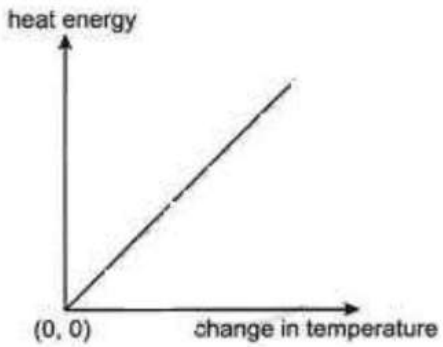
Solution

A radioactive element is placed in an evacuated chamber. Then the rate of radioactive decay will **remain unchanged**.

Explanation:

The properties of the atom's nucleus, not external factors, determine an element's rate of radioactive decay.

1.14. The graph given below shows heat energy supplied against change in temperature when no energy is lost to the surroundings. The slope of this graph will give:



1. Specific heat capacity
2. Latent heat of fusion

3. Latent heat of vaporization
4. Heat capacity

Solution

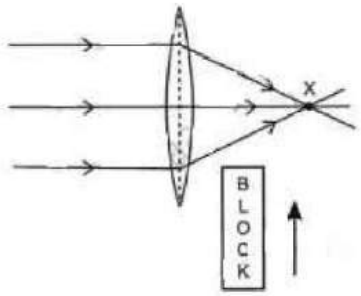
Heat capacity

Explanation:

Specific heat capacity of a unit mass of substance

$$= \frac{\text{Amount of heat energy supplied}}{\text{Difference in temperature}}$$

1.15. A block of glass is pushed into the path of the light as shown below. Then the converging point x will:



1. Move away from the slab.
2. Move towards the slab.
3. Not shift.
4. Move towards the left side of the lens.

Solution

Move away from the slab.

Explanation:

As light travelling through glass bends towards the glass slab, the point of convergence or focus will move away from the normal, and light will converge at a location away from the glass slab in the direction of the light after emerging in the air.

Q2.

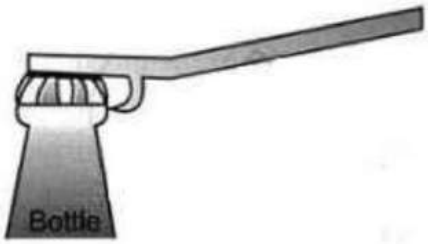
2.1. (a) In the following atoms, which one is a radioisotope? Give one use of this isotope.

O^{16}, C^{14}, N^{14}, He^{4}

Solution

It is used in biological research, agriculture, pollution control, and archaeology and so on.

2.1. (b) Name the class of the lever shown in the picture below:



Solution

The simple machine shown in the figure is a bottle opener. It is a class II lever, as it always acts as a force multiplier.

2.2. (a) When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides _____ force necessary for circular motion.

Solution

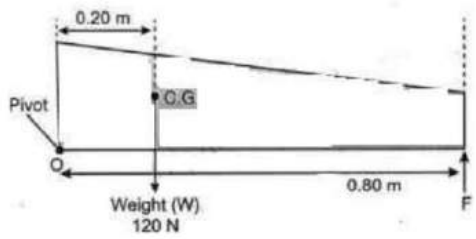
When a stone tied to a string is rotated in a horizontal plane, the tension in the string provides centripetal force necessary for circular motion.

2.2. (b) Work done by this force at any instant is _____.

Solution

Work done by this force at any instant is **zero**.

2.3. A non uniform beam of weight 120 N pivoted at one end is shown in the diagram below. Calculate the value of F to keep the beam in equilibrium.



Solution

To balance the beam with a weight of 120 N, force F is applied.

∴ Anticlockwise moment = Clockwise moment

$F \times OF = W \times CO$

$F \times 0.80 = 120 \times 0.20$

$$F = \frac{120 \times 0.20}{0.80}$$

$F = 30$ N

Hence, the required force is 30 N.

2.4. (a) Meera chose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load.

What is the advantage of using a block and tackle system over a single movable pulley?

Solution

The single movable pulley is better for the block and tackle system because the effort multiplies by '9' times, where the total number of the system's pulleys serves as a force multiplier as a result. As stated differently, she gains greater mechanical benefits.

2.4. (b) Meera chose to use a block and tackle system of '9' pulleys instead of a single movable pulley to lift a heavy load.

Why should she connect more number of pulleys in the upper fixed block?

Solution

In the upper fixed block, she adds extra pulleys to increase the mechanical advantage.

2.5. Sumit does 600 J of work in 10 min and Amit does 300 J of work in 20 min. Calculate the ratio of the powers delivered by them.

Solution

Sumit: Work done, w_1 = 600 J

Time taken, t_1 = 10 min = 600 sec

$$\text{Power, } p_1 = \frac{w_1}{t_1}$$

$$= \frac{600}{600}$$

$$= 1 \text{ W}$$

Amit: Work done, w_2 = 300 J

Time taken, t_2 = 20 min = 1200 sec

$$\text{Power, } p_2 = \frac{w_2}{t_2}$$

$$= \frac{300}{1200}$$

$$= \frac{1}{4}$$

$$= 0.25 \text{ W}$$

$$\therefore \text{ Ratio of Powers} = \frac{p_1}{p_2}$$

$$= \frac{1}{\frac{1}{4}}$$

$$= 4 : 1$$

2.6. 5 bulbs are connected in series in a room. One bulb is fused. It is removed and remaining 4 bulbs are again connected in series to the same circuit. What will be the effect on the following physical quantities?

(Increases, Decreases, Remain Same).

a. Resistance
b. Intensity of light

Solution

a. When one lightbulb is removed, the circuit's overall resistance falls because the equivalent resistance in a series is equal to the sum of all the resistances.

b. More current will flow through the circuit, and the light's intensity will rise as the electric circuit's resistance falls.

2.7. Rohan conducted experiments on echo in different media. He observed that a minimum distance of 'x' meters is required for the echo to be heard in oxygen and 'y' meters in benzene. Compare 'x' and 'y'. Justify your answer.

Speed of sound in oxygen: 340 ms^{-1}

Speed of sound in benzene: 200 ms^{-1}

Solution

Since, d = $\frac{vt}{2}$

Where, d is the distance between the source of sound and the reflecting surface.

t be the time after which echo is heard

v is the speed of the sound

t = 0.1 sec for echo, It is constant for both

∴ d α v

Hence, $v_{oxygen} > v_{benzene}$

Hence, x > y

Q3.

3.1. (a) In a reading glass what is the position of the object with respect to the convex lens used?

Solution

The object is positioned between the lens's focus and pole while using a reading glass. This enables the thing to be magnified.

3.1. (b) In a reading glass what is the position of the object with respect to the concave lens used?

Why can't we use the concave lens to position the object in the reading glass?

Solution

A concave lens is a diverging lens that constantly forms a virtual, diminished picture. Therefore, using it for magnification was not possible.

3.2. A fuse is rated 5 A. Can it be used with a geyser rated 1540 W, 220 V Write Yes or No. Give supporting calculations to justify your answer.

Solution

Here, power of geyser is P = 1540 W

Voltage, V = 220 V

Now, P = VI

$$\text{or current drawn, I} = \frac{P}{V}$$

$$= \frac{1540}{220}$$

$$= 7A$$

Because a geyser pulls more current than the fuse can handle, a 5A fuse will blow if used with one. No, you cannot use a 5A fuse.

3.3. State two factors affecting the coil's rotation speed in a D.C. motor.

Solution

The factors that affect the speed of rotation of the coil in a D.C. motor are:

a. Strength of magnetic field.

b. Number of turns in the coil.

c. Strength of magnetic field.

d. Area of the coil.

3.4. How much heat is required to convert 500 g of ice at 0°C to water at 0°C? The latent heat of fusion of ice is 330 Jg^{-1}.

Solution

Here, mass of ice (m) = 500 g

Latent heat of ice (L) = 330 J/g

Heat required (Q) = mL

= 500 × 330 J

= 165000 J

= 165 kJ

3.5. Copy and complete the nuclear reaction by filling in the blanks.

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba_ + _Kr^{92} + 3\,{}_{0}n^{1}$$

Solution

$$_{92}U^{235} + {}_{0}n^{1} \longrightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3\,{}_{0}n^{1}$$

SECTION-B (40 Marks) (Attempt any four questions from this Section.)

Q4.

4.1. The image of a candle flame placed at a distance of 36 cm from a spherical lens, is formed on a screen placed at a distance of 72 cm from the lens. Calculate the focal length of the lens and its power.

Solution

Object distance u = - 36 cm

Image distance, v = 72 cm

By using lens formula

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

$$\frac{1}{f} = \frac{1}{72} + \frac{1}{36}$$

$$= \frac{1+2}{72}$$

$$= \frac{3}{72}$$

∴ Focal length of the lens = 24 cm = $\frac{24}{100} m$

Then, power of lens, P = $\frac{1}{f(m)}$

$$= \frac{1}{\frac{24}{100}}$$

$$= \frac{100}{24}$$

= 4.17 D

4.2. Below is an incomplete table showing the arrangement of electromagnetic spectrum in the increasing order of their wavelength. Complete the table:

Gamma ray	X - ray	UV rays	Visible rays	Infrared	A	Radio waves

a. Identify the radiation A.
b. Name the radiation used to detect fracture in bones.
c. Name one property common to both A and Radio waves.

Solution

a. Microwaves
b. X-rays
c. Due to their long wavelengths, both microwaves and radio waves are used in long-distance communication.

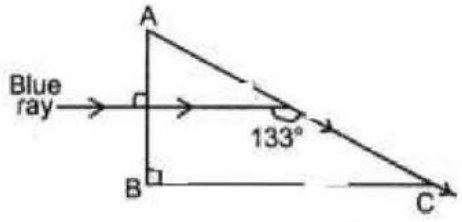
4.3. (a) Why do we use red colour as a danger signal on the top of a skyscraper?

Solution

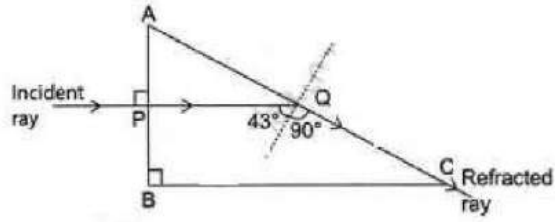
Since red has the longest wavelength of all the colours that make up visible light, it is least dispersed by atmospheric air molecules and may therefore travel farther or be seen more clearly from a distance.

4.3. (b) The diagram below shows the path of a blue ray through the prism:

1. Calculate the critical angle of the material of the prism for blue colour.
2. What is the measure of the angle of this prism (A)?
3. Which colour should replace the blue ray, for the ray to undergo Total Internal Reflection?



Solution



1. Here, the refracted ray PQ is normal to the surface AB of the prism (i.e., $\angle r = 0°$), so the incident ray at the point P should also be normal to the surface AB so that $\angle i = 0°$. At point Q, the angle of incidence for the ray PQ is 133° - 90° = 43°.

Now this angle should be equal to the critical angle because ray PQ is refracted at 90°, i.e., it is refracted along QC.

Hence, the critical angle of the prism is 43°.

2. In ΔAPQ

$\angle APQ + \angle PQA + \angle PAQ = 180°$

$90° + 47° + \angle PAQ = 180°$

$\angle PAQ = 180° - 90° - 47°$

$\angle PAQ = 43°$

$\therefore \angle A = 43°$

3. The light used and its wavelength determine the angle of deviation. With a decrease in the light wavelength, the angle of deviation increases.

Accordingly, the beam will experience total internal reflection if we swap out the blue light for intense light, sometimes known as indigo light.

Q5.

5.1.

a. Refractive index of glass with respect to water is $\frac{9}{8}$. Find the refractive index of water with respect to glass.

b. Name the principle used to find the value in part (a).

c. If we change the temperature of water, then will the ratio $\frac{9}{8}$ remain the same? Write Yes or No.

Solution

a. Given ${}^{w}\mu_{g} = \frac{9}{8}$

Then ${}^{g}\mu_{w} = \frac{1}{{}_{w}\mu_{g}}$

$= \frac{1}{\frac{9}{8}}$

$= \frac{8}{9}$

b. The principle of reversibility of the path of light.

c. No, as the temperature rises, the medium's refractive index falls and vice versa, due to an increase in the speed of light in the medium.

5.2. (a) Light travels a distance of '10x' units in time 't_1' in vacuum and it travels a distance of 'x' units in time 't_2' in a denser medium.

Using this information answer the question that follows:

'Light covers a distance of '20x' units in time 't_1' in diamond'. State true or false.

1. True
2. False

Solution

This statement is **False**.

Reason:

Because light always travels slower in a medium than it does in a vacuum. Within a vacuum, light travels 10x units over time 't_1'. Therefore, it is impossible to travel '20x' units in time 't1' in a diamond.

5.2. (b) Light travels a distance of '10x' units in time 't_1' in vacuum and it travels a distance of 'x' units in time 't_2' in a denser medium. Using this information answer the question that follows:

Calculate the refractive index of the medium in terms of 't_1' and 't_2'.

Solution

Given that light travels a distance 10x units,

Time taken = t_1

$$\text{Speed of light in medium } (v_1) = \frac{10x}{t_1}$$

We know that,

Refractive index of medium

$$\mu_1 = \frac{\text{Speed of light in vacuum}(c)}{\text{Speed of light in medium}(v_1)}$$

$$\mu_1 = \frac{c}{\left(\frac{10x}{t_1}\right)}$$

$$= \frac{ct_1}{10x} \quad \text{...(i)}$$

Same for medium 2

$$\mu_2 = \frac{c}{\left(\frac{x}{t_2}\right)}$$

$$= \frac{ct_2}{x} \quad \text{...(ii)}$$

Ratio of $(R.I)_1$ and $(R.I)_2$

$$^1\mu_2 = \frac{\mu_2}{\mu_1}$$

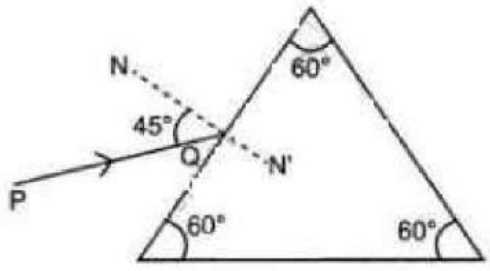
$$= \frac{ct_2}{x} \times \frac{10x}{ct_1}$$

$$= \frac{10t_2}{t_1}$$

$^1\mu_2 = 10t_2 : t_1$

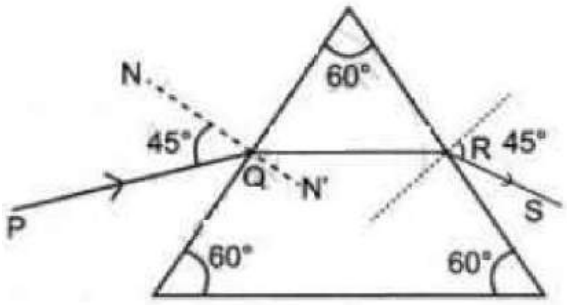
5.3. A monochromatic ray of light is incident on an equilateral prism placed at minimum deviation position with an angle of incidence 45° as shown in the diagram?

a. Copy the diagram and complete the path of the ray PQ.
b. State two factors on which the angle of deviation depends.



Solution

a.



b. Factors on which the angle of deviation depends are:

1. Angle of incidence (i).
2. Material of the prism (μ).
3. Angle of the prism.
4. the colour or wavelength (λ) of light used.
5. refractive index.

Q6.

6.1. (a) Define the centre of gravity of a body.

Define Centre of Gravity.

Solution 1

The point through which the resultant of the weights of all the particles of the body acts is called its centre of gravity

Solution 2

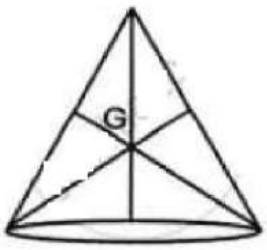
The centre of gravity is an imaginary location where the body's whole weight is assumed to be concentrated.

6.1. (b) A hollow ice cream cone has height 6 cm.

1. Where is the position of its center of gravity from the broad base?
2. Will its position change when it is filled completely with honey? Write Yes or No.

Solution

1. For a hollow cone, the position of center of gravity is at a height of $\frac{h}{3}$ from the base on its axis.



So, position of center of gravity from broad base = $\frac{h}{3}$

$= \frac{6}{3}$

= 2 cm

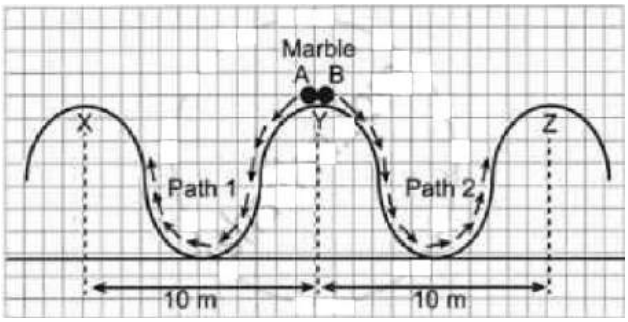
2. Yes, now cone is a solid cone. So, the position of the new center of gravity from the base will be $\frac{h}{4} cm$ i.e., $\frac{6}{4} = 1.5\ cm$ from the base of the cone.

6.2. Two identical marbles A and B are rolled down along Path 1 and Path 2 respectively. Path 1 is frictionless and Path 2 is rough.

a. Which marble will surely reach the next peak?

b. Along which path/s the mechanical energy will be conserved?

c. Along which path/s is the law of conservation of energy obeyed?



Solution

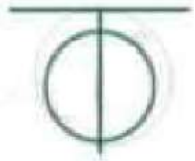
a. Path 2 is rough, and Path 1 is frictionless. Because there will be no energy lost on the frictionless road, marble A will undoubtedly reach the top.\

b. Total mechanical energy = kinetic energy (k) + potential energy (u)

When there is no frictional force, it remains constant; hence, mechanical energy will be preserved along path 1.

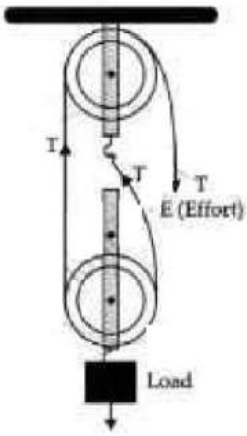
c. Since energy cannot be created or destroyed, the law of conservation of energy applies to both scenarios.

6.3. (a) Copy and complete the labelled diagram connecting the two pulleys with a tackle to obtain Velocity Ratio= 2.



Solution

Here, velocity ratio = n (number of pulleys)



6.3. (b) If Load = 48 kgf and efficiency is 80% then calculate:

1. Mechanical Advantage.
2. Effort needed to lift the load.

Solution

Here, load, L = 48 kgf

Efficiency = 80% = 0.8

1. $\eta = \frac{M.A}{V.R}$

$M.A. = \eta \times V.R.$

$M.A. = 2 \times 0.8$

$M.A. = 1.6$

2. $M.A = \frac{Load}{Effort}$

$Effort = \frac{Load}{M.A}$

$E = \frac{48}{1.6}$

$= 30$ kgf

Q7.

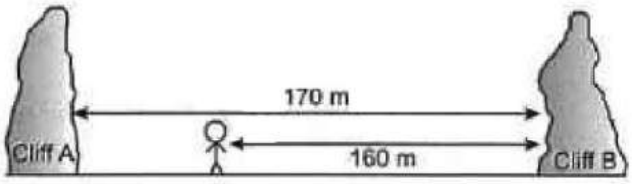
7.1. (a) Name the waves used in SONAR.

Solution

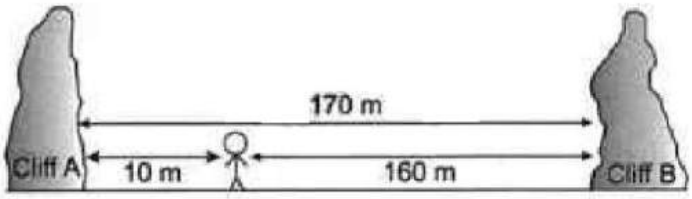
Ultrasonic waves.

7.1. (b) In the above diagram Lata stands between two cliffs and claps her hands.

Determine the time taken by her to hear the first echo. Speed of sound in air 320 ms^{-1}.



Solution



The closest cliff produces the first echo. However, the first cliff, or cliff A, is only 10 meters away from the Lata, and a minimum of 17 meters is required between the cliff and the listener in order to hear an echo.

Then, echo will be heard from Cliff B

∴ Total distance travelled = 2d

= 2 × 160

= 320 m

$$\text{Time} = \frac{2d}{v}$$

$$= \frac{320}{320}$$

= 1 sec.

Hence, the first echo will be heard after 1 second.

7.2. (a) Complete the following radioactive reaction:

$$^{-}_{-}\mathrm{X} \longrightarrow {}^{-}_{-}\mathrm{Y} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{234}_{91}\mathrm{Z} + {}^{0}_{-1}\mathrm{e}$$

Solution

$$\underline{{}^{238}_{92}}\mathrm{X} \longrightarrow \underline{{}^{234}_{90}}\mathrm{Y} + {}^{4}_{2}\mathrm{He} \longrightarrow {}^{234}_{91}\mathrm{Z} + {}^{0}_{-1}\mathrm{e}$$

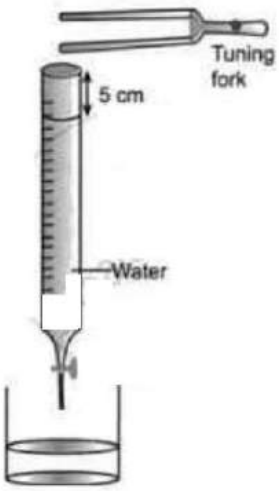
7.2. (b) Uranium is available in two forms U-235 and U-238. Which of the two isotopes of Uranium is more fissionable?

Solution

Comparatively speaking, U-235 is easier to fission than U-238. This is due to the fact that only fast neutrons can cause the fission of U-238, whereas slow neutrons can even trigger the fission of U-235.

7.3. In the given diagram, a vibrating tuning fork is kept near the mouth of a burette filled with water. The length of the air column is adjusted by opening the tap of the burette.

At a length of 5 cm of the air column, a loud sound is heard



a. Name the phenomenon illustrated by the above experiment.

b. Why is a loud sound heard at this particular length?

c. If the present tuning fork is replaced with a tuning fork of higher frequency, should the length of the air column increase or decrease to produce a loud sound? Give a reason.

Solution

a. Resonance

b. The loud sound is audible at this specific length because the tuning fork's frequency and the air column's frequency are equal.

c. Since, $f \propto \frac{1}{l}$

Therefore, in order to create a loud sound, the length of the air column should decrease as the frequency increases.

Q8.

8.1. The voltage - current readings of a certain material are shown in the table given below:

Voltage (V)	10 V	20 V	30 V
Current (I)	2 A	3 A	4 A

Study the table.

a. State whether the conductor used is ohmic or non-ohmic.

b. Justify your answer.

c. State Ohm's law.

Solution

a. Here, the ratio of $\frac{V}{1}$ for different readings is:

(i) $\frac{10V}{2A} = 5\Omega$

(ii) $\frac{20V}{3A} = 6.66\Omega$

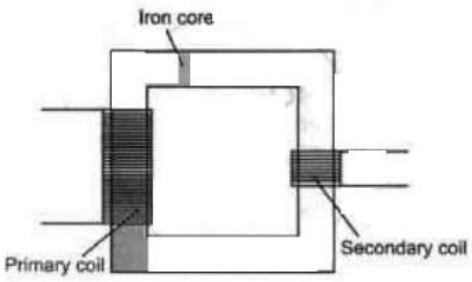
(iii) $\frac{30V}{4A} = 7.5\Omega$

Here, the ratio is not constant, so the conductor is non-ohmic.

b. The ratio of $\frac{V}{I}$ remains constant for all values of V and I in an ohmic conductor. Plotting current I against potential difference V results in a straight line that passes through the origin on a graph. Thus, the conductor in question is not ohmic.

c. Ohm's law states that, under constant physical conditions and conductor temperature, the current flowing in a conductor is directly proportional to the potential difference applied across its ends.

8.2. Below is the diagram of a transformer:



a. Identify the type of transformer.

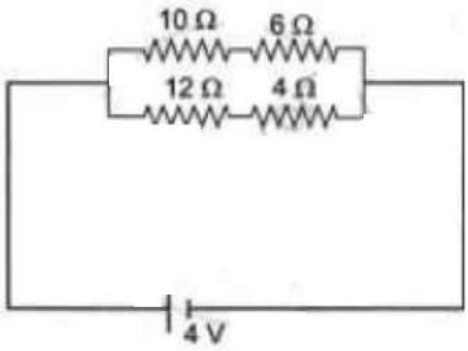
b. In this type of transformer which of the wire is thicker, the primary or the secondary? Give a reason.

Solution

a. Step-down transformer.

b. Due to the step-down transformer's decreased voltage, the secondary coil's wire is thicker than the primary coil's. Hence, the secondary coil's current is greater than the primary coil's. Thus, the secondary coil needs thick wires.

8.3. Study the diagram:



a. Calculate the total resistance of the circuit.

b. Calculate the current drawn from the cell.

c. State whether the current through 10 Ω resistor is greater than, less than or equal to the current through the 12 Ω resistor.

Solution

a. $R_1 = 10 + 6 = 16\ \Omega$ (in series)

$R_2 = 12 + 4 = 16\ \Omega$ (in series)

$$R_{eq} = \frac{R_1 \times R_2}{R_1 + R_2} \text{ (in parallel)}$$

$$= \frac{16 \times 16}{16 + 16}$$

$$= \frac{16 \times 16}{32}$$

$= 8\ \Omega$

b. Current drawn $I = \frac{V}{R}$

$$= \frac{4}{8}$$

$$= \frac{1}{2}$$

$= 0.5$ A

c. Because the equivalent resistance in both arms is 16 Ω, the current in the 10 Ω resistor will be equal to the current in the 12 Ω resistor. Thus, equal current will flow through the 10 Ω and 12 Ω resistors as well as in both arms.

Q9.

9.1. 85 g of water at 30°C is cooled to 5°C by adding certain mass of ice. Find the mass of ice required.

[Specific heat capacity of water = 4 .2 $Jg^{-1}°C^{-1}$, Specific latent heat of fusion = 336 Jg^{-1}]

Solution

Given, for water

mass (m_w) = 85 g

Initial temperature = 30°C

Final temperature = 5°C

For Ice, mass= m_i

Initial temperature = 0°C

Final temperature = 5°C

Now

Heat lost by water = $m_w \times c \times \Delta t$

$= 8.5 \times 4.2 \times (30 - 5)$

$= 85 \times 4.2 \times 25$

= 8925 J

Heat gained by ice = $m_i \times L + m_i \times c \times \Delta t$

$= m_i \times 336 + m_i \times 4.2 \times (5 - 0)$

$= 336\ m_i + m_i \times 4.2 \times 5$

$= 336\ m_i + 21\ m_i$

$= 357\ m_i$

By principle of calorimetry

Heat lost by water = Heat gained by ice

$8925 = 357\ m_i$

$$m_i = \frac{8925}{357}$$

= 25 g

Hence, mass of ice required is 25 g.

9.2. (a) Why does it become pleasantly warm when the lakes start freezing?

Solution

Water's liquid state emits heat into its surroundings as it freezes. This exothermic process emits heat into the environment. Because the specific latent heat of ice fusion is high enough, a significant amount of heat must be lost when lake water freezes, resulting in a nice increase in temperature.

9.2. (b) Water freezes to form ice. What change would you expect in the average kinetic energy of the molecules?

Solution

The average kinetic energy of the molecules decreases as water freezes to produce ice because the temperature of the water molecules drops, and they hold to one another to form a crystal.

9.3. (c) Which has more heat: 1 g ice at 0°C or 1g water 0°C? Give reason.

Which will contain more heat energy 1 g of ice at 0°C or 1 g water at 0°C?

Solution 1

1 g of water at 0°C has more heat than 1 g of ice at 0°C. This is because ice at 0°C absorbs 360 J of heat energy to convert into water at 0°C.

Solution 2

At 0°C, 336 J of heat energy is taken in by ice, turning it into water. Water therefore has higher heat energy at 0°C.

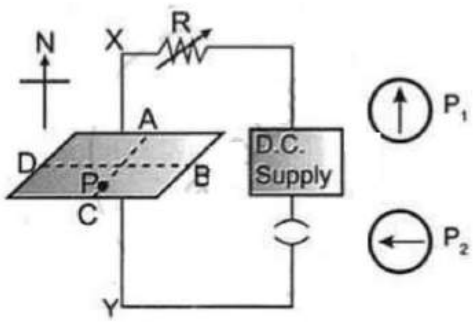
9.3. (a) State one factor that affects the magnitude of induced current in an AC generator.

Solution

Factors on which the magnitude of induced current in an AC circuit depends:

1. Magnetic field intensity.
2. Number of turns in the coil.

9.3. (b) Given below is a circuit to study the magnetic effect of electric current. ABCD is a cardboard kept perpendicular to the conductor XY. A magnetic compass is placed at the point P of the cardboard. P_1 and P_2 are the positions of the magnetic compass, before and after passing a current through XY respectively.



1. Name the rule that is used to predict the direction of deflection of the magnetic compass.
2. State the direction of current in the conductor (X to Y or Y to X) when the circuit is complete.
3. If resistance R is increased, then what will be the effect on the magnetic lines of force around the conductor?

Solution

1. Right hand thumb rule.
2. Since the compass is pointing west, the current will flow from X to Y in an anticlockwise direction.
3. The amount of current flowing through the circuit will decrease if the resistance increases. The magnetic field then decreases as the magnetic lines of force surrounding the conductor grow less dense.