Answers

1. **Answer: d**

Explanation:

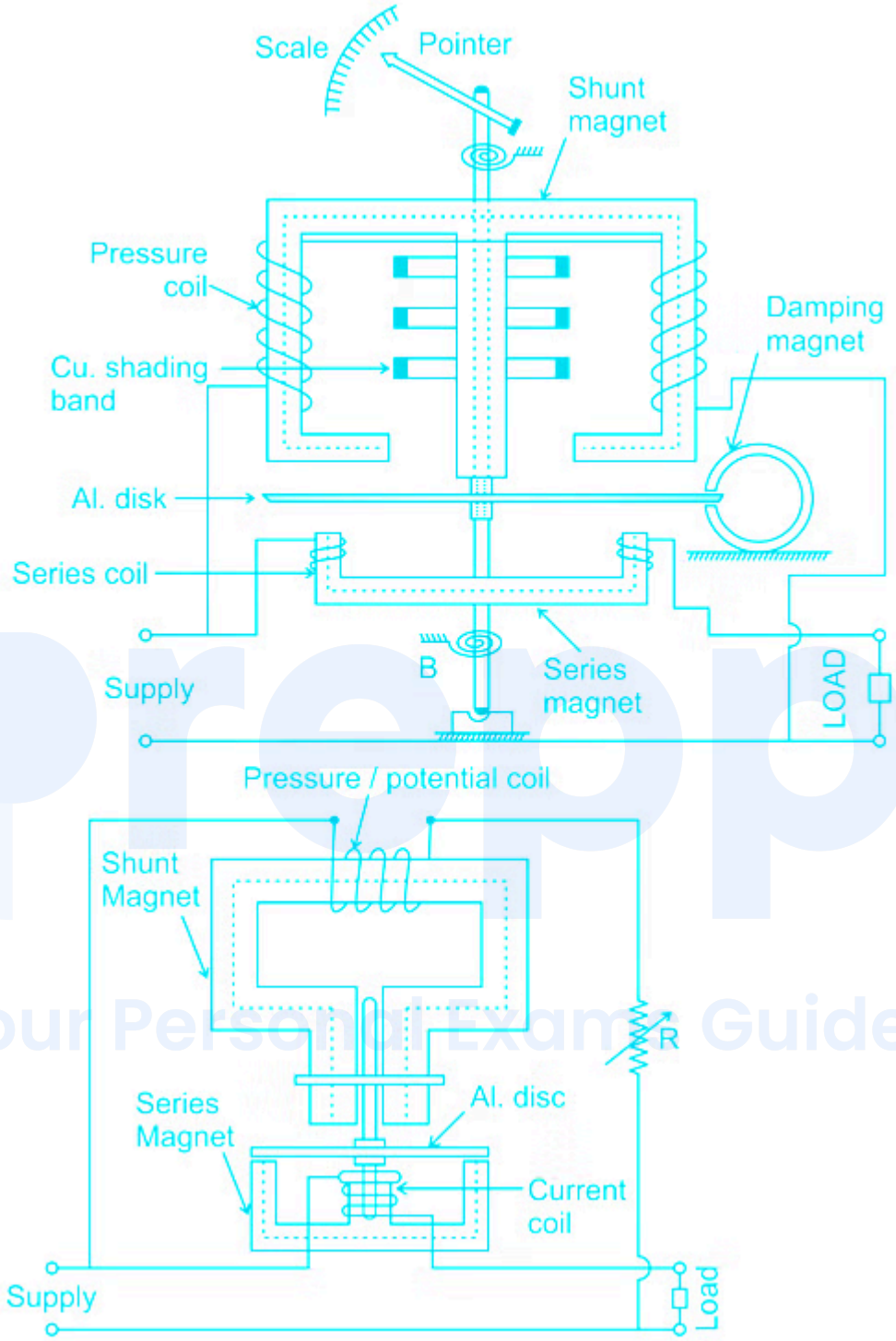
CONCEPT :

Induction type wattmeters:

- Induction type wattmeters work on the induction phenomenon and hence this instrument only measure AC power
- It has two laminated electromagnets, one of which is excited by load current or fraction of it and is connected in series with the circuit, known as **series magnet**
- The second one is excited by the **current proportional to the applied voltage or fraction of it** and is always connected across the supply, known as **shunt magnet** .

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EXPLANATION :

- An **aluminium disc** is so mounted so that it **cuts the fluxes produced by both the magnets** , as a result of which, two e.m.fs are produced which induces two eddy currents in the disc

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- **Deflecting torque** is produced due to the **interaction of these eddy currents and the inducing flux** . Therefore option 4 is correct.
- **Copper shading bands** are provided either on the **central limb or on the outer limb** of the shunt magnet and can be so adjusted as to make the resultant flux in the shunt magnet lag the applied voltage by 90°.

---

2. Answer: c

Explanation:

CONCEPT :

- The difference in the true value and measured value of a quantity is called error of measurement .
- Error in the sum of two quantities: If ΔA and ΔB are the absolute errors in the two quantities A and B respectively. Then,

The measured value of $A = A \pm \Delta A$

The measured value of $B = B \pm \Delta B$

Consider the sum, $Z = A + B$

The error ΔZ in Z is then given by

$\Delta Z = Z \pm (\Delta A + \Delta B)$

CALCULATION :

Given - $R_1 = 36\ \Omega \pm 1.89\ \Omega$ and $R_2 = 75\ \Omega \pm 3.75\ \Omega$

In series combination,

$\Rightarrow R_{eq} = R_1 + R_2$

$\Rightarrow R_{eq} = (36 \pm 1.89) + (75 \pm 3.75) = 111 \pm (1.89 + 3.75) = (111 \pm 5.64)\ \Omega$

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3. **Answer: c**

Explanation:

CONCEPT :

Wattmeter:

- It is an instrument used to measure the electric power in watts of any circuit.
- **Wattmeter** works on both AC and DC power supply (with voltage and frequency are constant or fixed).
- It has one fixed coil which is a current coil and one moving coil which is a potential coil.
- The **current coil is in series** with the circuit and the **potential coil is in parallel** .
- There are two electromagnets whose fluxes are **proportional to the current in the current coil** and the **current in the potential coil respectively** .
- Due to the interaction of these fluxes, there is a torque produced which is proportional to the power of the circuit.
- This torque act on the disc and force is produced in the disc by which it starts moving and the pointer attached to it through spring show readings.

EXPLANATION :

- From the above, it is clear that the **current coil is connected in series** and **potential coil is connected in parallel** .
- So to make very low current in potential coil a very high value of series resistance is required which is connected in series with potential coil . Therefore option 3 is correct.
- So the **current value** is **very low in potential coil** i.e., it can be made up of **thin wire** and **due to high current value in current coil** it can be made up of **thick wire** .

---

4. **Answer: c**

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Explanation:

CONCEPT :

- An ammeter is an instrument which is used to measure the current flowing through the circuit .

Root mean square value of Alternating Current:

- The root mean square (r.m.s.) value of a.c. is defined as that value of steady current, which would generate the same amount of heat in a given resistance in a given time , as is done by the a.c., when passed through the same resistance for the same time .
- The r.m.s. value is also called an effective value of a.c. or virtual value of a.c. It is represented by Irms or Ieff or Iv.
- The relation between the peak value of a.c. value of current (I o) and r .m.s. value of the current is given as

$I_{rms} = \frac{I_o}{\sqrt{2}}$

CALCULATION :

Given - r.m.s. current (I_{rms}) = 20 A

- The relation between the peak value of a.c. value of current (I o) and r .m.s. value of the current is given as

$\Rightarrow I_{rms} = \frac{I_o}{\sqrt{2}}$

$\Rightarrow I_o = 20\sqrt{2}$

---

5. **Answer: c**

Explanation:

CONCEPT :

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Thermocouple:

- The thermocouple is an electrical device containing junctions of two dissimilar metal joints. It is used as a temperature sensor.
- It works on the principle of the thermoelectric effect or the Seeback effect which states that the temperature difference between two dissimilar electric conductors produces a voltage difference between them.
- This potential difference is used to measure temperatures.

EXPLANATION :

- Thermocouple types of instruments can be used **for DC and AC** applications. Therefore option **3 is correct** .
- They can be used for measurements of currents and voltages at high frequencies.
- These instruments are very accurate well above a frequency of 50 MHz.

---

6. **Answer: c**

Explanation:

CONCEPT:

- Viscous force (F): When a layer of fluid slips or tends to slip on adjacent layers in contact, the two layers exert tangential force on each other which tries to oppose the relative motion between them.
    - The property of a fluid due to which it opposes the relative motion between its different layers is called viscosity (or fluid friction or internal friction) and the force between the layers opposing the relative motion is called viscous force .

The force acting between the different layers of a fluid is given by:

$F = -\eta A\frac{dv}{dx}$

Where η = coefficient of viscosity, A = area of the plane and dv/dx = velocity gradient.

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- A negative sign is employed because viscous force acts in a direction opposite to the flow of liquid.

EXPLANATION:

- From the above, it is clear that the **direction of viscous force** is in the **opposite direction to the flow of liquid** . Thus Angle between the viscous force and the direction of flow of the liquid is π .

---

7. **Answer: c**

Explanation:

CONCEPT :

- **Cloud** is a **mass of minute water droplets or tiny crystals of ice formed by the condensation of the water vapour** in free air at considerable elevations.
- As the clouds are formed at some height over the surface of the earth, they take various shapes.
- According to their **height** ,**expanse** ,**density** , and transparency or opaqueness clouds are grouped under four types:
    1. cirrus
    2. cumulus
    3. stratus

EXPLANATION :

- **Clouds** are created when **water gets heated up** ,**evaporates** , and **condenses** in the upper atmosphere.
- The heating effect lifts up the **air and**low pressure (or low density) is created over the area. Therefore option 3 is correct.
- To fill the low pressure the air from the surroundings comes in to fill the void, and it also rises up.
- Thus constant upward air currents of air are created which keep the clouds floating in the sky.

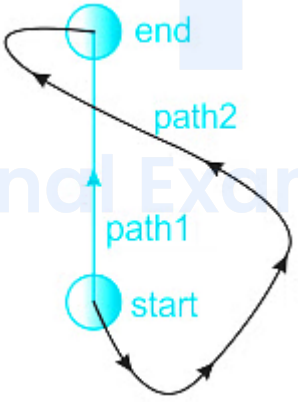
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8. **Answer: b**

Explanation:

CONCEPT:

- State variables are defined as the thermodynamical variables which depend only on the initial and final state of a thermodynamical system .
  - These variables don't depend on how the thermodynamical system changed itself from the initial to the final state .
  - Temperature, Pressure, Internal energy, and Density are the examples of state variables.
  - State variables are also known as state functions .
- Path variables are defined as the thermodynamical variables which depend on the way in which the thermodynamical system achieved the initial and final states .
  - Heat, Work is examples of Path variables



EXPLANATION:

- Internal energy , pressure , density ,**Gibb's energy** , and enthalpy are examples of state variables. Since they depend only on the final and initial states of the thermodynamical system.
- The magnitude of the force multiplied by the distance moved by the object in the direction of the applied force is called work. Hence work is the path variable . Therefore option 2 is the correct answer.

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9. **Answer: c**

Explanation:

Concept:

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Three modes of Transmission of heat/heat flow			
Sl. No	Conduction	Convection	Radiation
1	Heat dissipates from one place to another by molecular vibration	Heat is transfer from one place to another by the transfer of molecules	It transfers heat in the form of electromagnetic wave
2	Conduction is relevant to solid only .	Convection happens in liquid or gases	It can heat any form of material.
3	Need medium to transfer heat	Need medium to transfer heat	No need for medium
4	Good Conductor - The objects which transfer heat easily. Ex- metals, human body etc Bad Conductor - The objects which do not transfer heat easily. Ex- Wood, Air, etc. Thermal Insulator - No heat is transferred by any means.	When molecules are heated they headed upward and upper molecules go downward and this cyclic process continues. Boiling of fluid	Heat travels in terms of energy packets or waves The heat absorbed by the body gain energy Radiations of Sun

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Explanation:	Ex- Abonite, asbestos etc.		

- As we know the radiation travels with the speed of light, thus the **rate of heat transfer** is **maximum in radiation** in form of electromagnetic radiations

---

10. **Answer: d**

Explanation:

CONCEPT:

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Isobaric process	Isochoric process	Adiabatic process	Isothermal process
It allows to set up the relationship between the changes in volume and temperature under constant pressure.	The process in which the volume of the gas remains constant is called the isochoric process. For example: A gas is filled in a closed container then the volume of the gas will remain constant.	The thermodynamic process in a system, during which no heat transfer occurs between thermodynamic systems and surrounding is called an adiabatic process.	It allows to set up the relationship between the changes in pressure and volume under constant temperature :
V 1/T 1 = V 2/T 2 so V ∝ T Where [V 1 and V 2 are volume and T 1 and T 2 are different temperatures]	$\frac{P_1}{T_1} = \frac{P_2}{T_2} = Constant$	PV y = Constant Where y = ratio of specific heat	P 1V 1 = P 2V 2 so P V = Constant Where [P 1 and P 2 are the pressure of gases and V 1 and V 2 are volume]

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EXPLANATION:

- Any process is adiabatic is rapid such that there should not be any heat transfer between the system and its surroundings.
- When a cycle tyre bursts suddenly, this process takes place instantly.
- This leads to a decrease in temperature inside. So, the higher temperature air outside the tyre will transfer heat into it.
- This heat transferdoesn't take place instantly , unlike the expansion of tyre, which is instantaneous.
- Heat transfer takes place after the bursting , due to which one can consider that there is almost no energy exchange during the actual process.
- So we can say that the process of sudden cycle tyre bursting is adiabatic . Hence the correct answer is option 4.

---

11. Answer: c

Explanation:

CONCEPT

- Root Mean Square Speed is defined as the square root of the mean of squares of the speed of different molecules .
  - The root-mean-square speed takes into account both molecular weight and temperature , two factors that directly affect the kinetic energy of a material .
  - The rms speed of any homogeneous gas sample is given by:

$V_{rms} = \sqrt{\frac{3RT}{M}}$

Where R = universal gas constant, T = temperature and M = Molecular mass

CALCULATION:

Given - Initial rms velocity (V_{rms1}) = V, final rms velocity (V_{rms2}) = 2V and initial temperature (T_1) = 0° C = 273 K

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- As the **sample** is the **same** , therefore the **molecular mass will be the same** . Hence,

$\Rightarrow V_{rms} \propto \sqrt{T}$

$\Rightarrow \frac{V_{rms1}}{V_{rms2}} = \sqrt{\frac{T_1}{T_2}}$

$\Rightarrow \frac{V}{2V} = \sqrt{\frac{273}{T_2}} = \frac{1}{2}$

By squaring both sides and rearranging for T_2, we get

$\Rightarrow T_2 = 273 \times 4 = 1092\ K$

$\Rightarrow T_2 = 1092 - 273 = 819^\circ C$

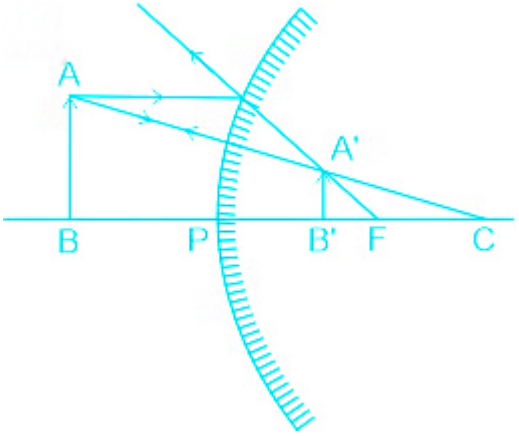
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12. Answer: a

Explanation:

CONCEPT :

- Convex Mirror: Convex mirror is that mirror whose reflecting surface is away from the center of the curvature.
- A convex mirror is also known as a diverging mirror .



- In a convex mirror, object distance (u) is on the left side of the mirror . Therefore object distance (u) is negative .

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- Image distance (v) and focal length (f) are on the right side of the convex mirror . Therefore image distance (v) and focal length (f) will be positive .

EXPLANATION :

Given - Object distance (u)= -2f

- By using the mirror formula

$\Rightarrow \frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$\Rightarrow \frac{1}{v}=\frac{1}{f}-(-\frac{1}{2f})=\frac{3}{2f}$

$\Rightarrow v=\frac{2f}{3}$

- The ratio of image distance to the object distance is called linear magnification .

$\Rightarrow m=\frac{image\ distance\ (v)}{object\ distance\ (u)}=-\frac{v}{u}$

$\Rightarrow m=-\frac{\frac{2f}{3}}{-2f}=\frac{1}{3}$

---

13. Answer: c

Explanation:

CONCEPT:

Total internal reflection (TIR):

- Total internal reflection (TIR) occurs at the interface of two transparent medium when the ray of light travels from a denser medium to a rarer medium .
- The critical angle is the angle of incidence in the denser medium for which the angle of refraction in the rarer medium is 90° .
- Total internal reflection (TIR) of light is the reflection of light within the same medium when a ray of light is incident at the interface of two medium at an

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angle of incidence which is greater than the critical angle for the pair of media i.e. i >i c.

EXPLANATION :

- Diamonds are known for their spectacular brilliance .
- The total internal reflection of light inside the diamond is the main reason for their brilliance. Therefore option 3 is correct.
- For the Diamond-Air interface, the critical angle is (@ 24.4°), which is very small , therefore it is very likely to undergo total internal reflection inside it, once light enters a diamond.
- Naturally found diamonds rarely exhibit the brilliance for which they are known.
- The technical skill of a diamond cutter makes diamonds sparkle so brilliantly.
- This is done by cutting the diamond in different angles suitably, to make sure total internal reflections occur.

---

14. Answer: d

Explanation:

CONCEPT:

- Power of Lens: The inverse of the focal length is known as the power of the lens.
  - It shows the bending strength for the light ray of the lens.
  - The unit of power of a lens is Dioptre when the focal length of the lens is taken in meter (m).

$P = \frac{1}{f}$

where P is the power of the lens and f is the focal length of the lens.

- Concave lens : It is a diverging lens that diverges the parallel beam of light.
  - It can also gather light from all directions and project it as a parallel beam.
  - The focal length of the concave lens is negative .

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    - It has a virtual focus from the diverging rays of light that seem to converge.
- Convex lens : The lens whose refracting surface is upside is called a convex lens .
    - The convex lens is also called a converging lens .
    - The focal length of a convex lens is positive .

CALCULATION:

Given - focal length of convex lens = 50 cm

- The power of a convex lens (P 1) is

$\Rightarrow P_1 = \frac{100}{f_1} = \frac{100}{50} = 2\,D$

---

15. Answer: b

Explanation:

CONCEPT :

Speed of a longitudinal wave in an ideal gas:

- In a longitudinal wave , the particles of the medium oscillate forward and backward in the direction of propagation of the wave .
- They cause compressions and rarefactions of small volume elements of the medium .
- The speed of a sound wave in an ideal gas is given by:

$v = \sqrt{\frac{P}{\rho}}$

where P = Pressure of the gas and ρ = density.

EXPLANATION :

- The relation between the **temperature and the velocity of sound** in a gas is given by

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$\Rightarrow \frac{v_t}{v_o} = \sqrt{\frac{T}{T_o}}$

Where v_t= velocity of sound at temperature T, v_0= velocity of sound at 0°, and T, and To = temperature at 0° and T°

- From the above relation, it is clear that **velocity of sound is directly proportional to the square root of its absolute remperture** .
- Therefore, **velocity** and thus **frequency will be also affected** by **changing the temperature** as **frequency** is **directly proportional to the velocity of sound** .

Relation between Velocity of sound waves and frequency:

$v = f\lambda$

where λ = wavelength and f = frequency.

As the velocity changes due to change in temperature, the frequency also gets changed.

---

16. **Answer: a**

Explanation:

CONCEPT :

- Sound: A sound is a form of energy that produces a sensation of hearing in our ears.
- Loudness is a measure of the response of the ear to the sound .
  - Even when two sounds are of equal intensity , we may hear one as louder than the other simply because our ear detects it better.

EXPLANATION :

- A sound's loudness is measured in decibels (dB) .
- The **decibel** is a **one-tenth unit of the Bel (B)** which is used to describe a **gain of either voltage ,current or power** . Therefore option 1 is correct.
  It is used to describe the **ratio of one magnitude of a power or field quantity to**

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another , on a logarithmic scale, the logarithmic quantity being called a degree of power or a degree of field, respectively.

- It may be used to describe a shift of value (e.g. +1 dB or -1 dB) or an absolute value.

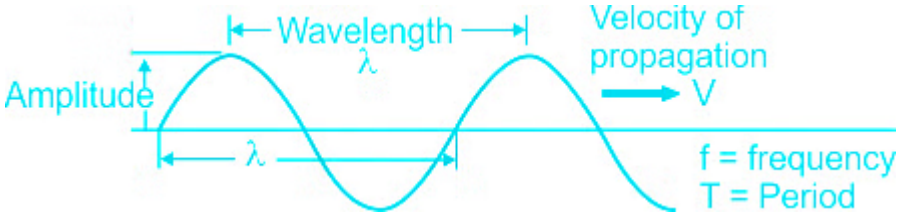
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17. Answer: d

Explanation:

CONCEPT:

- Wave: It can be defined as the transport of energy without the transport of matter.
- The properties of waves are:
  - Wavelength (λ): The distance between two crests or troughs of a wave is known as wavelength. One wavelength equals the distance between two consecutive crests.
  - Frequency (f): The number of oscillations or the number of waves passes a given point in one sec. Its SI unit is Hertz.
  - Time period (T): The time taken by the wave to complete one cycle.
- The relation between velocity, wavelength and frequency and time period of a wave is



$\Rightarrow f = \frac{1}{T} = \frac{v}{\lambda}$

[where f = frequency, T = time period, v = velocity of wave, λ = wavelenght]

CALCULATION :

Given - Frequency (f) = 100 Hz

- The relationship between time period and frequency is given as:

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$\Rightarrow T = \frac{1}{f}$

$\Rightarrow T = \frac{1}{100} = 0.01\ s$

---

18. Answer: a

Explanation:

CONCEPT :

- Echo sound produces due to the **reflection of sound** that arrives at the listener with a delay after the direct sound.
  There must be at least **0.1s to hear a distinct echo** of the time interval between the original sound and the reflected one.

EXPLANATION :

- From the above, it is clear that an **echo is heard** due to the reflection of sound waves. Therefore option 1 is correct.

⭐ Important Points

- For hearing distinct echoes , the minimum distance of the obstacle from the source of sound must be half of this distance i.e., 17.2 m .
- This distancewill change with the temperature of the air .

---

19. Answer: c

Explanation:

The correct answer is **Fossils.**

CONCEPT :

Radiocarbon dating:

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- It also called carbon-14 method was developed by the American physicist Willard F. Libby in about 1946 and has proved to be a versatile technique of dating fossils and archaeological specimens from 500 to 50,000 years old .
- The method is widely used by Pleistocene geologists, anthropologists, archaeologists, and investigators in related fields.
- Radiocarbon dating or Carbon-14 dating method.

⭐ Important Points

EXPLANATION :

- Carbon-14 dating is a method of age determination that depends upon the decay to nitrogen of radiocarbon (carbon-14 isotope) .
- Carbon-14 is continually formed in nature by the interaction of neutrons with nitrogen-14 in the Earth's atmosphere; the neutrons required for this reaction are produced by cosmic rays interacting with the atmosphere.
- Radiocarbon present in molecules of atmospheric carbon dioxide enters the biological carbon cycle : It is absorbed from the air by green plants and then passed on to animals through the food chain .
- Radiocarbon decays slowly in a living organism , and the amount lost is continually replenished as long as the organism takes in air or food and once the organism dies , however, it ceases to absorb carbon-14 , so that the amount of the radiocarbon in its tissues steadily decreases .
- Carbon-14 has a half-life of 5,730 ± 40 years i.e., half the amount of the radioisotope present at any given time will undergo spontaneous disintegration during the succeeding 5,730 years.
- Because carbon-14 decays at this constant rate, an estimate of the date at which an organism died can be made by measuring the amount of its residual radiocarbon .

---

20. Answer: b

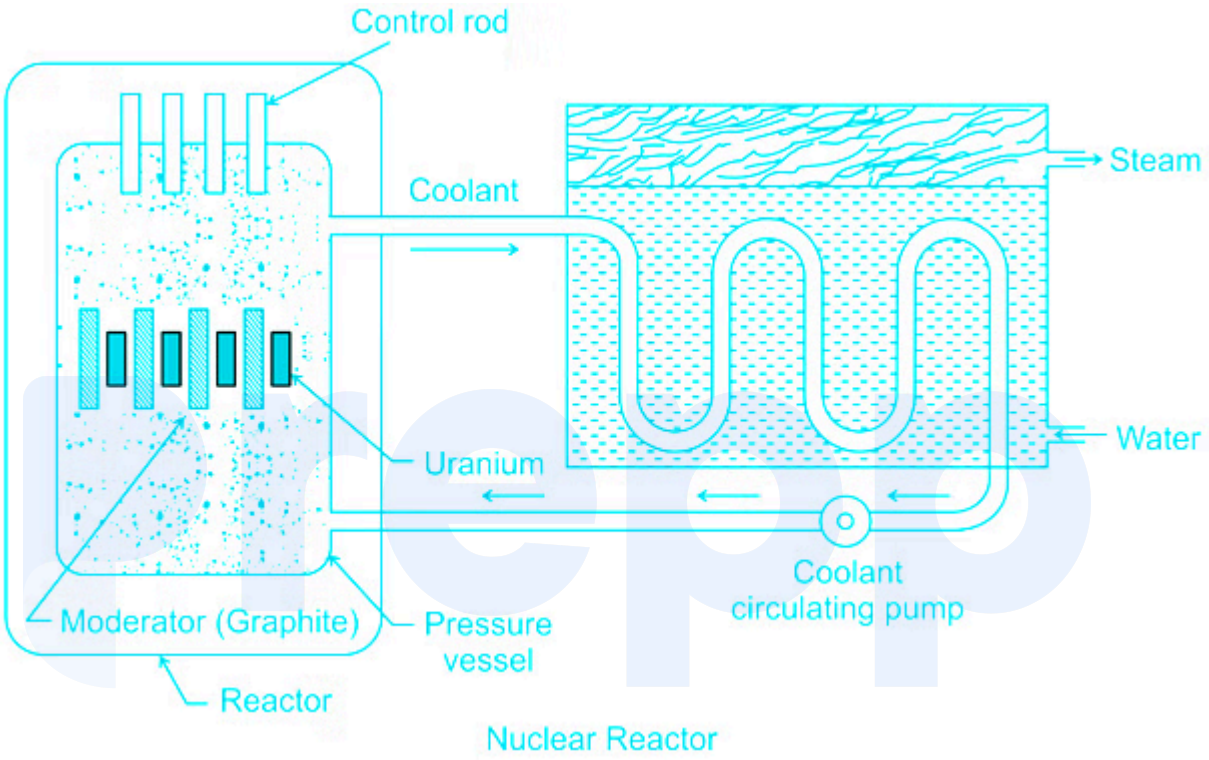
Explanation:

CONCEPT :

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Nuclear reactor:

- It is a device in which a nuclear reaction is initiated , maintained, and controlled .
- It works on the principle of controlled chain reaction and provides energy at a constant rate .



Nuclear Reactor

EXPLANATION :

- Nuclear Fuel: It is a fissionable material to be used for the fission process to take place.
- Commonly used fuels in a nuclear reactor are U233, Enriched U 235, Pu 239 etc. Therefore option 2 is correct.
- Generally, uranium oxide pellets are inserted end to end into long hollow metal tubes constituting the fuel rods.
- When slow neutrons interact with the fuel , fission starts , and energy is released.

★ Important Points

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- The moderator's function is to slow down the fast-moving secondary neutrons produced during fission .
- The material of the moderator should be light and it should not absorb neutrons .
- Usually, heavy water , graphite , deuterium, and paraffin, etc. can act as moderators .

---

21. Answer: a

Explanation:

CONCEPT:

Young's modulus:

- Young's modulus a modulus of elasticity , applicable to the stretching of wire, etc., is equal to the ratio of the applied load per unit area of the cross-section to the increase in length per unit length .
- It is denoted as E or Y .
- The unit of Young's modulus is N m -2.

$$Y = \frac{\sigma}{\epsilon}$$

Where σ = stress, ϵ = strain in wire.

- Young's Modulus Formula by using other quantities:

$$Y = \frac{FL_0}{A\Delta L}$$

Where F = force exerted under tension, A = actual cross-sectional area, L 0 = actual length, ΔL = change in length.

EXPLANATION :

- The **value of Young's Modulus** depends upon the **nature of the material of the body** and the manner in which the body is **deformed** .
- Its value **depends upon the temperature of the body** .

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- Its **value is independent of the dimensions** (length, radius, volume, etc.) of the body.
- As we know **young's modulus of elasticity is a material's property** . Therefore, Young's modulus does not depend upon the length of the radius of the wire. It is constant for the material. So, the required **Young's modulus is Y** .

---

22. Answer: d

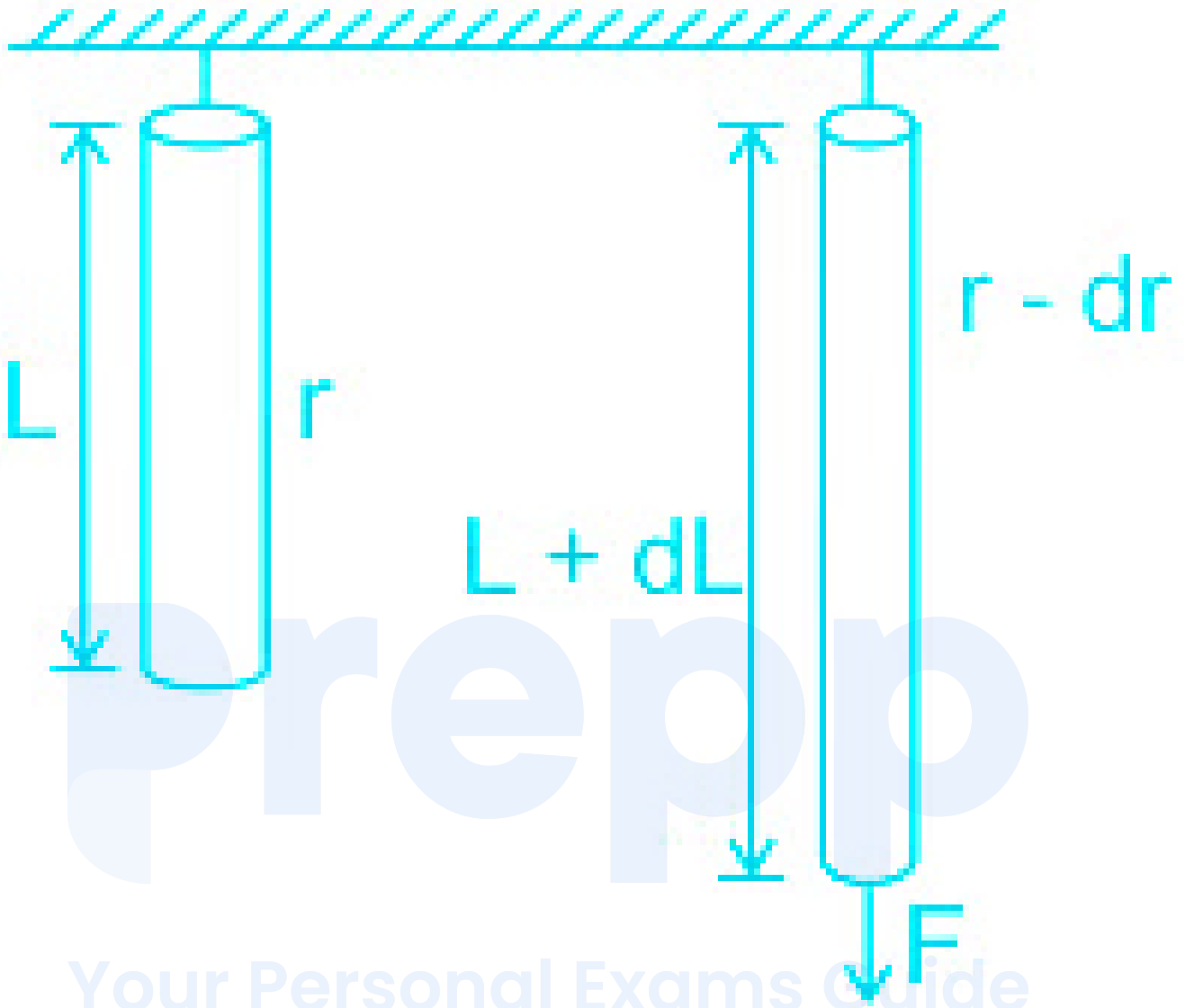
Explanation:

CONCEPT :

- When a long bar is stretched by a force along its length than its length increases and the radius decreases .

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- Lateral strain : The ratio of change in radius or diameter to the original radius or diameter is called lateral strain .
- Longitudinal strain : The ratio of change in length to the original length is called longitudinal strain.
- Poisson's ratio : The ratio of lateral strain to longitudinal strain is called Poisson's ratio (σ). Therefore option 1 is correct.

$$\sigma = \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$$

$$\sigma = \frac{-\frac{dr}{r}}{\frac{dL}{L}} = -\frac{dr \times L}{dL \times r}$$

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- The negative sign indicates that the radius of the bardecreases when it is stretched .

CALCULATION :

Given - dL/L = 2 × 10 -3 and σ = 0.5

- **Poisson's ratio** can be written as

$\Rightarrow \sigma = \frac{-\frac{dr}{r}}{\frac{dL}{L}}$

$\Rightarrow \frac{dr}{r} = 0.5 \times 2 \times 10^{-3} = -10^{-3}$

- The **volume of the rod** is given by,

⇒ V = πr ^{2}L

On differentiating both sides, we get

⇒ dV = π(r ^{2}dL + 2Lrdr)

$\Rightarrow \frac{dV}{V} \times 100 = \frac{\pi(r^2 dL + 2rLdr)}{\pi r^2 L} \times 100 = (\frac{dL}{L} + 2\frac{dr}{r})$

$\Rightarrow \frac{dV}{V} \times 100 = (2 \times 10^{-3} + 2 \times (-10^{-3})) = 0$

---

23. Answer: a

Explanation:

CONCEPT:

Power

- It is the work done in unit time.
- $\text{Power, P} = \frac{\text{Total workdone}}{\text{Total time}} = \frac{\text{Energy}}{\text{Time}}$
- Its unit is Watt

CALCULATION :

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Given - mass (m) = 25 kg, time (t) = 20 sec and g = 10 m/s ^{2}

- The total height to the stair (h) is, h = 25 × 40 = 1000 cm = 10 m
- The power to climb the 25 stairs in 20 sec is

$\Rightarrow P = \frac{mgh}{t} = \frac{25 \times 10 \times 10}{20} = 125\,W$

---

24. Answer: a

Explanation:

CONCEPT :

- Electric Power : The rate at which electrical energy is dissipated into other forms of energy is called electrical power i.e.,

$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$

Where V = Potential difference, R = Resistance and I = current.

EXPLANATION :

Given - W/t = 10 Joule/s

- Mathematically **power can be written as** ,

$\Rightarrow P = \frac{W}{t} = 10\,Joule/s = 10\,watt$

---

25. Answer: c

Explanation:

CONCEPT:

Potential Energy: The energy possessed by a body by virtue of its position or configuration is called potential energy .

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Mathematically it can be written as
PE = mgh
Where, m = mass of the body, g = acceleration due to gravity, and h = height of the body

EXPLANATION:

Given:

Let initial height before drop (h 1) = 20 m and final after bounce (h 2) = 10 m

The **potential energy of the ball before drop** (P_1) is

$\Rightarrow P_1 = mgh_1 = 20gh$ ---- (1)

The potential energy of the ball after bounce (P 2) is

$\Rightarrow P\ 2 = mgh\ 2 = 10gh$ ----- (2)

- As the ball is falling, its **potential energy will decrease continuously** until it reaches the ground and then it will start increasing after the bounce.
- So the **potential energy after dropping will be the fraction of initial potential energy** .

The loss of energy is

$\Rightarrow \Delta P \times 100 = \frac{P_1 - P_2}{P_1} \times 100$

$\Rightarrow \Delta P = \frac{20gh - 10gh}{20gh} \times 100 = 50\%$

---

26. Answer: a

Explanation:

CONCEPT :

- The first law of thermodynamics is a restatement of the law of conservation of energy.

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- It states that energy cannot be created or destroyed in an isolated system ; energy can only be transferred or changed from one form to another.
- When heat energy is supplied to a thermodynamic system or any machine: Two things may occur:
  - The internal energy of the system or machine may change.
  - The system may do some external work .

According to the first law of Thermodynamics :

$\Delta Q = \Delta W + \Delta U$

Where ΔQ = Heat supplied to the system, ΔW = work done by the system, ΔU = change in internal energy of the system

EXPLANATION:

- The First Law of Thermodynamics does signify the general Law of Conservation of Energy that the total energy of a system remains conserved. So option 1 is correct.

---

27. Answer: d

Explanation:

CONCEPT :

The efficiency of the Carnot cycle (η):

- It is defined as the ratio of net mechanical work done per cycle the gas (W) to the amount of heat energy absorbed per cycle from the source (Q_1) i.e.,

$\eta = \frac{W}{Q_1}$

As work done by the engine per cycle is

$\Rightarrow W = Q_1 - Q_2$

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Where, Q 1 = amount of heat energy absorbed per cycle from the source and Q 2 = energy absorbed per cycle from the sink.

$\Rightarrow \eta = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1}$

As $\frac{Q_2}{Q_1} = \frac{T_2}{T_1}$

$\Rightarrow \eta = 1 - \frac{T_2}{T_1}$

Where T 1 = temperature of the source and T 2 = temperature of the sink.

EXPLANATION :

Given - η = 100 %

- The efficiency of the Carnot engine :

$\Rightarrow \eta = 1 - \frac{T_2}{T_1}$

- For the efficiency of the Carnot engine to be 1 i.e. 100 %, either **T_2 (temperature of the sink) should be zero** or **T_1 (temperature of the source) should be infinite** . Therefore option 4 is correct.

---

28. Answer: b

Explanation:

CONCEPT :

- The molar specific heat capacity of a gas at constant volume is defined as the amount of heat required to raise the temperature of 1 mol of the gas by 1 °C at the constant volume .

$C_v = \left(\frac{\Delta Q}{n\Delta T}\right)_{constant\ volume}$

- The molar specific heat of a gas at constant pressure is defined as the amount of heat required to raise the temperature of 1 mol of the gas by 1 °C at the constant pressure .

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$C_p = \left(\frac{\Delta Q}{n\Delta T}\right)_{constant\ pressure}$

- The ratio of the two principal specific heat is represented by γ .

$\therefore \gamma = \frac{C_p}{C_v}$

- The value of γ depends on the atomicity of the gas.

EXPLANATION :

- From the above, it is clear that **gas has two specific heats** . Therefore option 2 is correct.

---

29. Answer: c

Explanation:

CONCEPT:

- Frequency (f): The number of waves that pass a given point per second is called frequency.
  - The unit of frequency is vibration per second or Hertz.
- Time period (T) : The time taken to complete one full oscillation or cycle by the Wave is called time period.
  - The SI unit of the time period is second (s).

Frequency is given by:

Frequency (f) = ω/2π

Where ω is the angular frequency.

⭐ Important Points

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Quantity	Unit
Charge	Coulomb
Time	Second
Current	Amperes
Power	Watts
Energy	Joules
Pressure	Pascal
Frequency	**Hertz**
Angular acceleration	rad/sec 2
Strain	Unitless
Resistance (R)	ohm
Capacitance (C)	Coulomb/volt or Farad

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Resistivity or Specific resistance (ρ)	Ohm-meter

30. Answer: b

Explanation:

CONCEPT:

- Kinetic energy (K.E): The energy possessed by a body by virtue of its motion is called kinetic energy .
- The expression for kinetic energy is

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

Where m = mass of the body and v = velocity of the body

EXPLANATION:

- The energy possessed by a body by virtue of its position or configuration is called potential energy . Therefore option 1 is incorrect.
- The energy possessed by a body by virtue of its motion is called kinetic energy . Therefore option 2 is correct.

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31. Answer: c

Explanation:

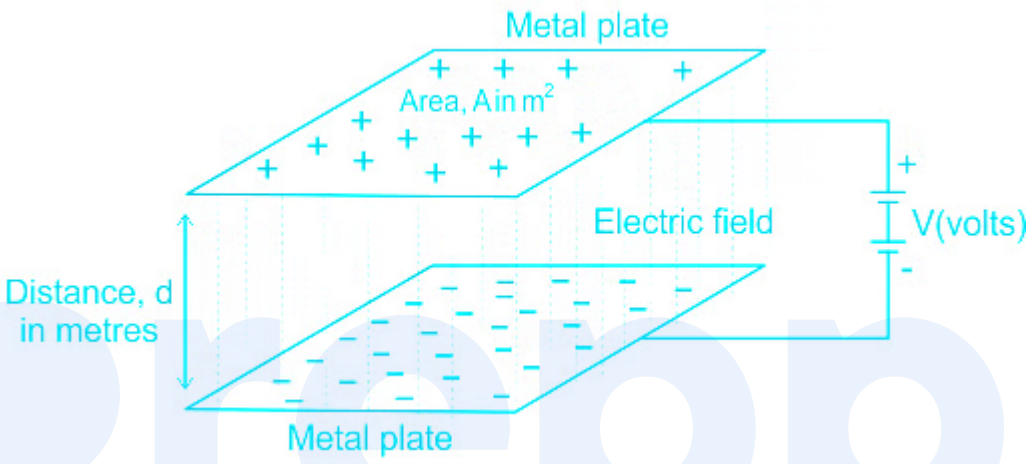
CONCEPT:

- Capacitor: A capacitor is a device that stores electrical energy in an electric field.
- It is a passive electronic component with two terminals.
- The effect of a capacitor is known as capacitance .
- Capacitance: The capacitance is the capacity of the capacitor to storecharge in it. Two conductors are separated by an insinuator (dielectric)

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and when an electricfield is applied , electricalenergy is stored in it as a charge .

- The capacitance of a capacitor (C): The capacitance of a conductor is the ratio of charge (Q) to it by a rise in its potential (V) , i.e.
- C = Q/V
- The unit of capacitance is the farad , (symbol F).
- Farad is a largeunit so generally, we usingμF .



EXPLANATION :

- From the above, it is clear that a **capacitor (condenser)** is used in an electrical circuit to store an electric charge. Therefore option 3 is correct.

NOTE:

- An electrometer is an electrical instrument for measuring electric charge or electrical potential difference.

Transformer:

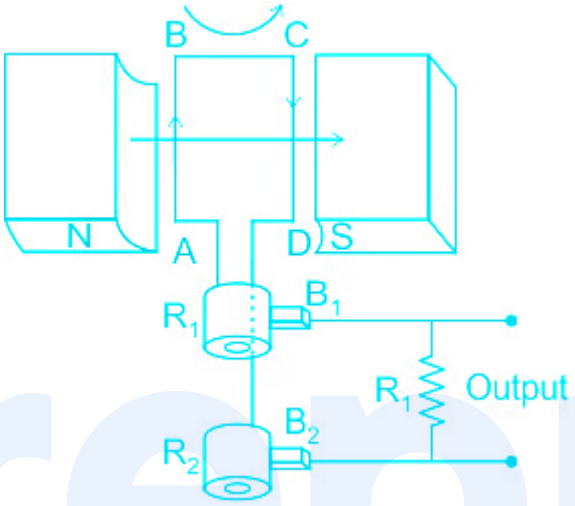
- An electrical device that is used to transfer electrical energy from one electrical circuit to another is called a transformer .
  - The transformer which increases the potential is called a step-up transformer .
  - The transformer which decreases the potential is called a step-down transformer .

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32. **Answer: c**

Explanation:

CONCEPT:



- An e lectric generator is a device that is used to convert mechanical energy into electric energy .
- It is also known as a dynamo .
- An electric generator works on the Electromagnetic Induction Principle.
- The Principle of Electromagnetic Induction states that when a conductor connected with a changing flux , it will i nduce an emf across it .
- The value of induced emf across the conductor depends on the rate of change of flux connected with the conducto r.

EXPLANATION :

- In the **computer** ,**electric fan** , and **refrigerator** , there is an **electric motor** that converts **electrical energy into mechanical energy** and performs their respective work. Therefore option 1 is correct.
- The system which converts the sound wave into the electrical signals such that the sound can be transmitted over a long distance is called as a telephone . Therefore option 2 is correct.
- A **carbon microphone** is a transducer that converts **electric signals to sound** , based on varying electric resistance of carbon granules due to varying

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pressure on them. Therefore option 3 is incorrect.

- An e lectric generator**or dynamo** is a device that is used to convert mechanical energy into electric energy . Therefore option 4 is correct.

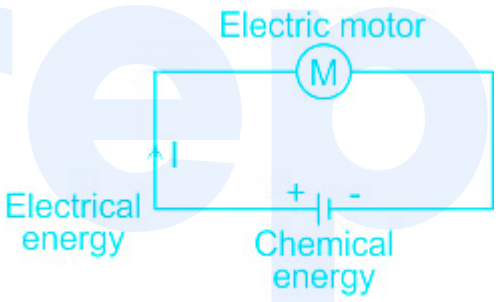
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33. Answer: c

Explanation:

CONCEPT:

- Electric motor : The device in which electrical energy is converted into mechanical energy is called an electric motor.
- An electrical motor is connected to the battery as shown below:



- From this, we can say that first, the battery will convert chemical energy to electrical energy as soon as the circuit is turned on and this electrical energy will be converted into mechanical energy by an electrical motor.

EXPLANATION:

- Dynamo is a device that is used to convert mechanical energy into electric energy . Therefore option 1 is incorrect.
- A transformer is used to convert low voltage (or high current) to high voltage (or low current) and high voltage to low voltage . Therefore option 2 is incorrect.
- From the above, it is clear that the device in which **electrical energy is converted into mechanical energy** is called an **electric motor** . Therefore option 3 is correct.

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- The coils of wire that are wound around any ferromagnetic material (iron cored) or wound around a hollow tube that increase their inductive value are called inductors . Therefore option 4 is incorrect.

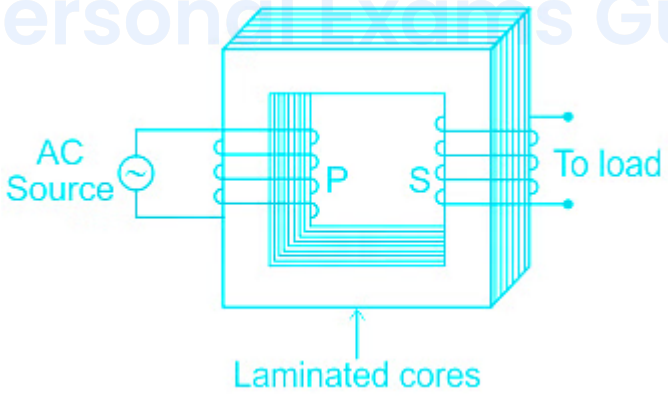
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34. Answer: c

Explanation:

CONCEPT:

- A Transformer is used to convert low voltage (or high current) to high voltage (or low current) and high voltage to low voltage .
- It works on the principle of **electromagnetic induction** .
- The **primary coil** has **Np turns** and the other coil, called the **secondary coil** , has **Ns turns** .
- Generally, the **primary coil works the input coil** and the **secondary coil** works as the **output coil of the transformer** .
- When an AC voltage is applied to the primary coil, the resulting current produces an alternating magnetic flux that links the secondary coil and induces an emf in it. The value of this emf depends on the number of turns in the secondary.



- In a transformer, the voltage in secondary is calculated by

$\frac{N_s}{N_p} = \frac{V_s}{V_p}$

Where, N p and N s are the numbers of turns in the primary and secondary coils

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respectively, and V p and V s are the rms voltages across the primary and secondary respectively.

- In a transformer, the load is connected to the secondary coil while the primary coil of a transformer is connected to an AC source.

EXPLANATION:

- Since the transformer converts the **higher voltage to lower voltage** and **vice versa** , So we can say that it can be used to obtain suitable voltage . Therefore option 3 is correct.
- Also, the transformer works with on principle of electromagnetic induction, It can be used only to obtain suitable AC voltage, not DC voltage.

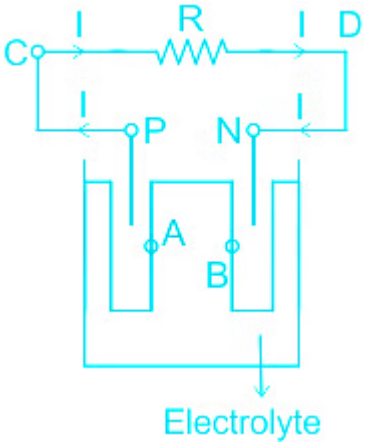
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35. Answer: c

Explanation:

CONCEPT:

- **Battery** : The combination of cells that are used to produce electricity is called a battery.
  - The **cells** are made of plates and hence **battery** is made of many plates.
- The battery has **internal resistance** .



- **Internal resistance** : The resistance offered by the electrolyte to the flow of ions is known as the internal resistance .

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- It is represented by the letter r.
- A cell is said to be ideal if it has zero internal resistance .

EXPLANATION:

- The **12 battery has generally 7, 9, 11, and 17 plates** . So option 3 is correct.

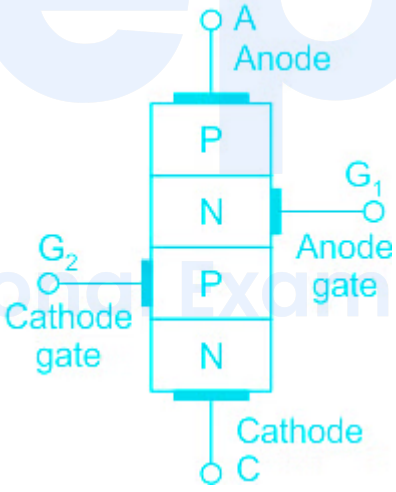
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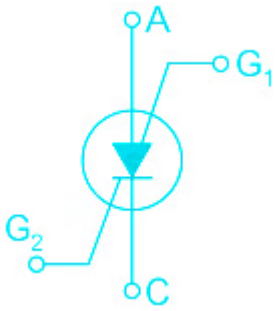
36. Answer: d

Explanation:

CONCEPT :

- The silicon control rectifier (SCR) consists of four layers of semiconductors, which form NPNP or PNPN structures.
- SCR has three P-N junctions labeled J1, J2, and J3, and three terminals.



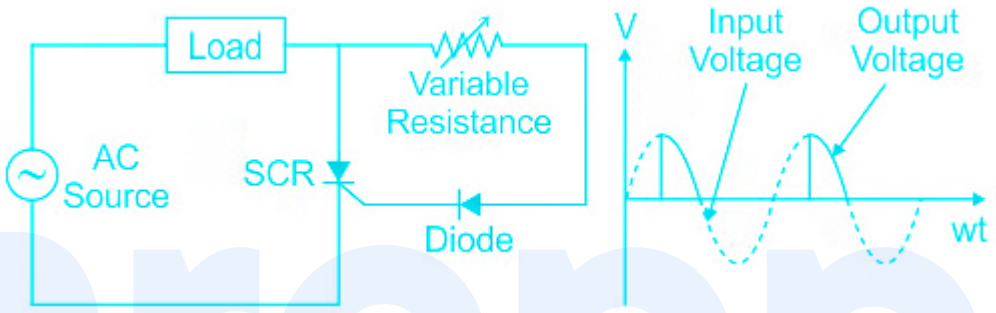


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- The **anode terminal of an SCR** is connected to the **p-type material of a PNPN structure** , and the **cathode terminal** is connected to the **n-type layer** , while the **gate of the SCR** is connected to the **p-type material nearest to the cathode** .

EXPLANATION :

- The SCR usually used in AC circuit s because the **ACpower reverses polarity over the course of the cycle** .



- That means that **d uring the positive half cycle** , **SCR** will become be **forward-biased** , effectively allowing the current pass through it **and** causing it to **turn ON** during one half of each cycle.
- That means that **during a negative half-cycle** , SCR will become be reverse-biased , effectively reducing the anode voltage to zero causing it to turn OFF during another half of each cycle.

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37. Answer: d

Explanation:

Concept :

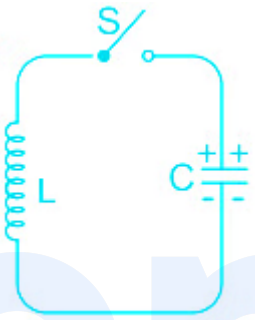
- LC circuit is a resonant electrical circuit with inductor L and capacitor C joined together .
- The circuit acts as an electrical resonator for storing energy , oscillating at the circuit's resonant frequency .
- The charge oscillates with a natural frequency:

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$\omega_o = \frac{1}{\sqrt{LC}} = 2\pi\nu$

Explanation :

- A s eries resonant circuit is used as a voltage amplifier and a parallel resonant circuit is used as a current amplifier .
- A **circuit** that produces electrical oscillations of any desired frequency is known as a circuit or tank circuit . A simple oscillatory circuit consists of a capacitor (C) and an inductance coil (L) .



- This electrical system can produce electrical oscillations of the frequency determined by the values of L and C. Therefore option 4 is correct.

---

38. Answer: a

Explanation:

CONCEPT :

Emf of the cell (E):

- The **potential difference** across the **terminals of a cell** when it is **not supplying any current** is called its **emf** .
- Equation of cell can be written as

⇒ E = V + Ir

Where E = emf of the cell, V = Potential difference, I = current and r = internal resistance

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EXPLANATION :

- When no current is passing through the cell, then I = 0 A, hence

$\Rightarrow$ E = V

As we know **electric potential can be is written** as

$$\Rightarrow E = V = \frac{\text{Work done (W)}}{\text{Charge (q)}}$$

The dimension of work done **(W) = [ML ^{2}T $^{-2}$]**

The dimension of charge **(q) = [IT]**

$\therefore$ The dimension of emf is given by

$$\Rightarrow E = \frac{ML^2T^{-2}}{AT} = [ML^2A^{-1}T^{-3}]$$

⭐ **Important Points**

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Quantity	Unit	Dimension
Pressure	Pascal	[ML -1 T-2]
Stress	Pascal	[ML -1 T-2]
Young Modulus	Pascal	[ML -1 T-2]
Speed	m/s	[LT -1]
Momentum	kg·m/s	[MLT -1]
Potential difference	Volt	[ML 2T -3 A-1]
Torque	Newton meter	[M 1L 2T -2]
Work	Joule	[ML 2T -2]
Energy	Joule	[ML 2T -2]
Weight	Newton	[MLT -2]
Capacitance (C)	Coulomb/volt or Farad	[M -1 L2 T4 A2]
Resistivity or Specific resistance (ρ)	Ohm-meter	[ML 3T -3 A-2]
Electric current (I)	Ampere	[A]

39. **Answer: c**

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Explanation:

CONCEPT :

The intensity of magnetization :

- When a magnetic material is placed in a magnetizing field , it gets magnetized .
- The magnetic momentdeveloped per unit volume of a material when placed in a magnetizing field is called intensity ofmagnetization or simply magnetization . Thus

$I = \frac{m}{V}$

EXPLANATION :

- Mathematically, **magnetic field intensity** can be written as,

$\Rightarrow I = \frac{m}{V}$

- As we know, the **magnetic moment (m) is equal to the current time's area** , therefore,

The dimension of magnetic moment (I) = $[IL^2]$

The dimension of volume (V) = $[L^3]$

∴ The dimension of magnetic field intensity is,

$\Rightarrow I = \frac{[IL^2]}{L^3} = [IL^{-1}]$

⭐ Important Points

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Quantity	Unit	Dimension
Pressure	Pascal	[ML -1 T-2]
Stress	Pascal	[ML -1 T-2]
Young Modulus	Pascal	[ML -1 T-2]
Speed	m/s	[LT -1]
Momentum	kg·m/s	[MLT -1]
Potential difference	Volt	[ML 2T -3 A-1]
Torque	Newton meter	[M 1L 2T -2]
Work	Joule	[ML 2T -2]
Energy	Joule	[ML 2T -2]
Weight	Newton	[MLT -2]
Capacitance (C)	Coulomb/volt or Farad	[M -1 L2 T4 A2]
Resistivity or Specific resistance (ρ)	Ohm-meter	[ML 3T -3 A-2]
Electric current (I)	Ampere	[A]

40. Answer: b

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Explanation:

CONCEPT :

Ammeter:

- An ammeter is an instrument which is used to measure the current flowing through the circuit .
- It has low resistance , ideally zero.
- By connecting ammeter in series , it allows all of the c ircuit current to pass through it and hence measure it.

EXPLANATION :

Given - Reading in the ammeter = 0.6 A and Transforming factor = 150

- The **circuit current** can be calculated as

$\Rightarrow I_{actual}$ = transforming factor × $I_{reading}$

$\Rightarrow$ Iactual = 150 × 0.6 = 90 A

---

41. Answer: a

Explanation:

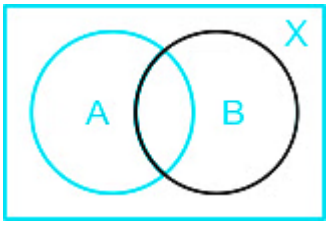
Concept:

Union of the sets:

Union of two given sets is the set that contains those elements that are either in A or in B, or **in both.**

The union of the sets A and B, denoted by A U B

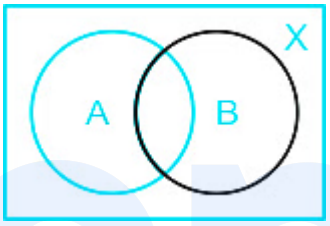
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Intersection of Sets:

The intersection of two given sets is the largest set which contains all the elements that are **common to both the sets.**

The i ntersection of Sets A and B, denoted by $A \cap B$



Formula: $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

Calculation:

Given: $n(A) = 20$, $n(B) = 35$ and $n(A \cup B) = 45$

To Find: $n(A \cap B)$

We know that,

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$\Rightarrow n(A \cap B) = n(A) + n(B) - n(A \cup B)$

$\Rightarrow n(A \cap B) = 20 + 35 - 45$

$\therefore n(A \cap B) = 10$

---

42. Answer: d

Explanation:

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Calculation:

To Find: Value of $\left(\frac{x^4}{x^3}\right)^{3/4}$

$\left(\frac{x^4}{x^3}\right)^{3/4} = \left(\frac{x^3 \times x}{x^3}\right)^{3/4} = (x)^{3/4}$

Hence option 4 is the correct answer.

---

43. Answer: d

Explanation:

Calculation:

Given equations $x^2 + 2x - 35 = 0$

To Find: Roots of the equation

$x^2 + 2x - 35 = 0$

$\Rightarrow x^2 + 7x - 5x - 35 = 0$

$\Rightarrow x(x + 7) - 5(x + 7) = 0$

$\Rightarrow (x - 5)(x + 7) = 0$

So, $(x - 5) = 0$ and $(x + 7) = 0$

$\therefore x = 5$ and -7

---

44. Answer: c

Explanation:

Concept:

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Relationship between arc length (s), radius (r) and angle (θ) made by an arc is given by **s = rθ**

1 rad = 180/π degree

Calculation:

Here, radius r = 10 cm, arc length s = $12\frac{2}{9}$ cm = 110/9

s = rθ

⇒ θ = $\frac{110}{9\times10}$

⇒ θ = 11/9 rad

$= \frac{11}{9} \times \frac{180}{\pi} = \frac{220}{3.14}$

= 70°

Hence, option (3) is correct.

---

45. Answer: d

Explanation:

Concept:

The triangle inequality states that for any triangle, the sum of the lengths of any two sides must be greater than or equal to the length of the remaining side.

If there are 3 sides of triangle namely a, b and c then

a + b > c

b + c > a

c + a > b

Calculation:

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As we know, For any triangle sum of the lengths of any two sides must be greater than or equal to the length of third sides.

Option D: 5, 9, 17

5 + 9 = 14

14 is less than 17

So, triangle can not be formed.

Hence, option (4) is correct.

---

46. Answer: c

Explanation:

Calculation:

To Find: square root of $(3+2\sqrt{2})$

$(3+2\sqrt{2})$

$=1+2+2\sqrt{2}$

$=(1)^2+(\sqrt{2})^2+2\sqrt{2}$

$=(1+\sqrt{2})^2$ ($\because a^2+b^2+2ab=(a+b)^2$)

Now, square root of $(3+2\sqrt{2})$ = $\sqrt{(1+\sqrt{2})^2}=(1+\sqrt{2})$

---

47. Answer: b

Explanation:

Calculation:

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In order to hear 12 rings there will be 11 intervals

So for one ring time will be 33/11 = 3 sec

Now, for 6 there will be 5 intervals

So, time required = 3 × 5 = 15 sec

Hence, option (2) is correct.

---

48. Answer: a

Explanation:

Concept:

To find value of k, for which the system of equation has no solution, solve the equation algebrically.

Calculations:

Given system of equation

x - y = 5 ....(1)

kx - 4y = 1....(2)

To find value of k, for which the system of equation has no solution, solve the equation algebrically, we get

Multiply equation (1) by 4

4x - 4y = 20 ....(3)

subtract it from equation (2), we get

(4 - k) x = 19

Hence, the system has no solution if 4 - k = 0

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⇒ k = 4

Hence, for k = 4, there is no solution to the equations

---

49. Answer: d

Explanation:

Concept:

If two triangles ABC and DEF are similar, ∠A = ∠D, ∠B = ∠E and ∠C = ∠F

Calculation:

Since triangle ABC and DEF are similar



∴∠A = ∠D, ∠B = ∠E and ∠C = ∠F

In △ABC,

∠A + ∠B + ∠C =180

∠A + ∠E + ∠C =180 (∵∠B = ∠E)

47 + 83 + ∠C = 180

⇒ ∠C = 180 - 130

⇒∠C = 50

Hence, option (4) is correct.

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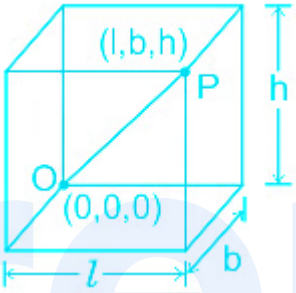
50. Answer: c

Explanation:

Calculation:

Given: length l = 30 ft, breadth b = 24 ft and height h = 18 ft

Longest rod that can be placed in a room is nothing but its diagonal.



Length of diagonal of a cuboid = $\sqrt{(l^2 + b^2 + h^2)}$
Length of longest rod = $\sqrt{(30^2 + 24^2 + 18^2)}$ ft
= $\sqrt{(900 + 576 + 324)}$ ft
= $\sqrt{1800}$ ft
= 42.66 ft
Thus the length of the longest rod is 42.66 ft

Hence, option (3) is correct.

---

51. Answer: d

Explanation:

Concept:

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

Calculation:

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Given: $\tan\theta = \frac{4}{3}$

To Find: Value of $\left(\frac{2\sin\theta - 3\cos\theta}{2\sin\theta + 3\cos\theta}\right)$

$\left(\frac{2\sin\theta - 3\cos\theta}{2\sin\theta + 3\cos\theta}\right)$

Taking cos θ common from numerator and denominator, we get

$= \left(\frac{\frac{2\sin\theta}{\cos\theta} - 3}{\frac{2\sin\theta}{\cos\theta} + 3}\right)$

$= \left(\frac{2\tan\theta - 3}{2\tan\theta + 3}\right)\left(\because \tan\theta = \frac{\sin\theta}{\cos\theta}\right)$

$= \left(\frac{\frac{2\times 4}{3} - 3}{\frac{2\times 4}{3} + 3}\right) = \left(\frac{\frac{8-9}{3}}{\frac{8+9}{3}}\right) = \frac{-1}{17}$

---

52. Answer: b

Explanation:

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Concept:

Formula:

$1 - \sin^2\theta = \cos^2\theta$

$(a + b)(a - b) = a^2 - b^2$

Calculation:

Given: $\frac{\cos\theta}{1-\sin\theta} + \frac{\cos\theta}{1+\sin\theta} = 4$

To Find: θ

$\frac{\cos\theta}{1-\sin\theta} + \frac{\cos\theta}{1+\sin\theta} = 4$

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$$\Rightarrow \frac{\cos\theta(1+\sin\theta)+\cos\theta(1-\sin\theta)}{(1-\sin\theta)(1+\sin\theta)} = 4$$

$$\Rightarrow \frac{\cos\theta+\cos\theta\sin\theta+\cos\theta-\cos\theta\sin\theta}{(1-\sin^2\theta)} = 4$$

$(\because (a + b)(a - b) = a^2 - b^2)$

$$\Rightarrow \frac{2\cos\theta}{\cos^2\theta} = 4 \ldots.(\because 1 - \sin^2\theta = \cos^2\theta)$$

$$\Rightarrow \frac{2}{\cos\theta} = 4$$

$$\Rightarrow \cos\theta = \frac{1}{2}$$

$$\therefore \theta = \frac{\pi}{3}$$

---

53. Answer: c

Explanation:

Concept:

$(a + b)(a - b) = a^2 - b^2$

$\sin^2\theta + \cos^2\theta = 1$

Calculation:

$(1 + \cot\theta - \text{cosec}\,\theta)(1 + \tan\theta + \sec\theta)$

$$= \left(1+\frac{\cos\theta}{\sin\theta}-\frac{1}{\sin\theta}\right)\left(1+\frac{\sin\theta}{\cos\theta}+\frac{1}{\cos\theta}\right) = \left(\frac{\sin\theta+\cos\theta-1}{\sin\theta}\right)\left(\frac{\cos\theta+\sin\theta+1}{\cos\theta}\right) = \frac{(\sin\theta+\cos\theta)^2-1^2}{\sin\theta\cos\theta}$$

$$= \frac{\sin^2\theta+\cos^2\theta+2\sin\theta\cos\theta-1}{\sin\theta\cos\theta}$$

$$= \frac{1+2\sin\theta\cos\theta-1}{\sin\theta\cos\theta} (\because \sin^2\theta+\cos^2\theta = 1)$$

$$= \frac{2\sin\theta\cos\theta}{\sin\theta\cos\theta}$$

$= 2$

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54. **Answer: d**

Explanation:

Concept:

We know that

$\tan\theta = \frac{\sin\theta}{\cos\theta}$

$\cot\theta = \frac{\cos\theta}{\sin\theta}$

$\text{cosec}\,\theta = \frac{1}{\sin\theta}$

$\sin^2\theta = 1 - \cos^2\theta$

Calculations:

Given equations is 3 tan θ + cot θ = cosec θ

$\Rightarrow 3\frac{\sin\theta}{\cos\theta} + \frac{\cos\theta}{\sin\theta} = \frac{1}{\sin\theta}$

$\Rightarrow \frac{3\sin^2\theta + \cos^2\theta}{\sin\theta.\cos\theta} = \frac{1}{\sin\theta}$

$\Rightarrow \frac{3\sin^2\theta + \cos^2\theta}{\cos\theta} = 1$

$\Rightarrow 3\sin^2\theta + \cos^2\theta = \cos\theta$

$\Rightarrow 3(1 - \cos^2\theta) + \cos^2\theta - \cos\theta = 0$

$\Rightarrow 3 - 3\cos^2\theta + \cos^2\theta - \cos\theta = 0$

$\Rightarrow 3 - 2\cos^2\theta - \cos\theta = 0$

$\Rightarrow 2\cos^2\theta + \cos\theta - 3 = 0$

$\Rightarrow 2\cos^2\theta - 2\cos\theta + 3\cos\theta - 3 = 0$

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$\Rightarrow 2\cos\theta(\cos\theta - 1) + 3(\cos\theta - 1) = 0$

$\Rightarrow (2\cos\theta + 3)(\cos\theta - 1) = 0$

$\Rightarrow (2\cos\theta + 3) = 0 \text{ or } (\cos\theta - 1) = 0$

Here, $(2\cos\theta + 3) = 0$ is not possible as the value of cos θ always lies between 0 to 1

$\cos\theta - 1 = 0$

$\cos\theta = 1$

∴ θ = 0°

Hence, the solution of 3 tan θ + cot θ = cosec θ is θ = 0°

---

55. Answer: a

Explanation:

Concept:

1) $\cos^2\theta = 1 - \sin^2\theta$,

2) $\sin^2\theta + \cos^2\theta = 1$

Calculations:

Given:

$2\cos^2\theta + \sin\theta - 2 = 0$

$\Rightarrow 2(1 - \sin^2\theta) + \sin\theta - 2 = 0$

$\Rightarrow -2\sin^2\theta + \sin\theta = 0$

$\Rightarrow 2\sin^2\theta - \sin\theta = 0$ ....(1)

$\sin\theta(2\sin\theta - 1) = 0$

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$\Rightarrow \sin\theta = 0$ or $\sin\theta = 1/2$

$\Rightarrow \theta = 30°$

---

56. Answer: a

Explanation:

Concept:

Follow the following steps to how to find the lowest common multiple (L.C.M.) of polynomials by factorization.

Step. 1) Find the factors of first expression.

Step. 2) Find the factors of second expression.

Step. 3) Find the common factor of the first expression and second expression.

Step. 4) Find the extra factor of the first expression and second expression.

Step. 5) Required LCM = product of common factor and extra factors of first expression and second expression.

Calculations:

Consider, the first expression $x^2 - 2x - 3$

Find the factors of first expression

$\Rightarrow x^2 - 2x - 3 = (x - 3)(x + 1)$

Now, consider, the second expression $x^3 + x^2 + x + 1$

Find the factors of the second expression

$\Rightarrow x^3 + x^2 + x + 1 = x^2(x + 1) + (x + 1)$

$\Rightarrow x^3 + x^2 + x + 1 = (x^2 + 1)(x + 1)$

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The common factors of the two expressions $x^2 - 2x - 3$ and $x^3 + x^2 + x + 1$ is $(x + 1)$

$(x - 3)$ is extra factor in the first expression and $(x^2 + 1)$ are the extra factor in the second expression.

Therefore, the required L.C.M. of $x^2 - 2x - 3$ and $x^3 + x^2 + x + 1$ is $(x + 1)(x - 3)(x^2 + 1)$.

---

57. Answer: c

Explanation:

Concept:

If number of observations (n) is even,

median = $\frac{\text{value of}(\frac{n}{2})\text{th position} + \text{value of}(\frac{n}{2}+1)\text{th position}}{2}$

If number of observations (n) is odd,

median = $\text{value at } (\frac{n+1}{2})\text{th position}$

Calculation:

Here, values of x are not given in ascending order.

Hence, we first arrange the values of x in ascending order and then form the cumulative frequency table. We have the following table

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x	f	cf
4	6	6
5	4	10
6	5	15
7	4	19
8	6	25
9	9	34
10	8	42
	∑f = N= 42	

Since n = 42 is even, the median will be the mean of the values at $\left(\frac{42}{2}\right)$ = 21 st position and 21 + 1 = 22 nd position.

From the above table, both the 21 st and 22 nd values are 8.

Therefore, the median of the above data is 8.

Hence, option (3) is correct.

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58. **Answer: d**

Explanation:

CONCEPT:

Direct Method :

If a variable X takes value x 1, x 2, x 3, ..., x n with corresponding frequencies f 1, f 2, ..., f n respectively then the arithmetic mean of these values is given by: $\bar X = \frac{{\mathop \sum \nolimits_{i = 1}^n \left({{f_i} \cdot {x_i}} \right)}}{N}$ where $N = \;\mathop \sum \limits_{i = 1}^{n\;} {f_i}$

CALCULATION:

Given: Mean of the data is 50

i.e $\bar{X} = 50$

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x	f	f i · x i
10	17	170
30	p	30p
50	32	1600
70	24	1680
90	19	1710
	N = ∑f = 92 + p	∑(f i · x i) = 5160 + 30p

As we know that, $\bar X = \frac{{\mathop \sum \nolimits_{i = 1}^n \left({{f_i} \cdot {x_i}} \right)}}{N}$

By using the table given above we get

$\Rightarrow \bar{X} = \frac{5160+30p}{92+p} = 50$

$\Rightarrow$ 5160 + 30p = 4600 + 50p

$\Rightarrow$ p = 28

Hence, option 4 is the correct answer.

---

59. Answer: d

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Explanation:

Concept:

Ascending Order: Arranging numbers (or other items) from smallest to largest.

Calculation:

Here, $\sqrt{2}, \sqrt[3]{4}$ and $\sqrt[4]{6}$

$\sqrt{2} = 2^{\frac{1}{2}} = 2^{\frac{1}{2}\times\frac{6}{6}} = 2^{\frac{6}{12}} = \sqrt[12]{2^6} = \sqrt[12]{64}$

$\sqrt[3]{4} = 4^{\frac{1}{3}} = 4^{\frac{1}{3}\times\frac{4}{4}} = 4^{\frac{4}{12}} = \sqrt[42]{4^4} = \sqrt[12]{256}$

Similarly, we get $\sqrt[4]{6} = \sqrt[12]{6^3} = \sqrt[12]{216}$

So ascending order: $\sqrt{2}, \sqrt[4]{6}, \sqrt[3]{4}$

Hence, option (4) is correct.

---

60. **Answer: b**

Explanation:

Concept:

Let us consider the standard form of a quadratic equation,

$ax^2 + bx + c = 0$

Let α and β be the two roots of the above quadratic equation.

The sum of the roots of a quadratic equation is given by: $\alpha + \beta = -\frac{b}{a} = -\frac{\text{coefficient of x}}{\text{coefficient of x}^2}$

The product of the roots is given by: $\alpha\beta = \frac{c}{a} = \frac{\text{constant term}}{\text{coefficient of x}^2}$

Calculation:

Given:

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α and β are the roots of the equation $x^2 + px + q = 0$

Sum of roots = $\alpha + \beta = -p$

Product of roots = $\alpha\beta = q$

We know that $(a + b)^2 = a^2 + b^2 + 2ab$

So, $(\alpha + \beta)^2 = \alpha^2 + \beta^2 + 2\alpha\beta$

$\Rightarrow (-p)^2 = \alpha^2 + \beta^2 + 2q$

$\therefore \alpha^2 + \beta^2 = p^2 - 2q$

---

61. **Answer: c**

Explanation:

The correct answer is CaSO 4.1/2 H 2O.

EXPLANATION:

- **Plaster of Paris (POP)** is a quick-setting gypsum plaster consisting of a **fine white powder (calcium sulfate hemihydrate)** , which hardens when moistened and allowed to dry.
- It is also known as the **Plaster of Paris** because for the preparation of POP, the **abundant gypsum was first found near the capital city of France i.e. Paris** .
- The chemical formula of the Plaster of Paris is **CaSO 4.** $\frac{1}{2}$ **H 2O** . Therefore option 3 is correct.
- **Application of Plaster of Paris** is as follows
    1. It is used as a **building material** as a protective coating on walls and ceilings.
    2. It is used as a **moulding and vesting agent for decorative elements** .
    3. It is also used for **aesthetic touch to the construction elements** .
    4. It is also used as **plaster in orthopaedics** and as a **filling material by dentists** , etc.

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⭐ Mistake Points

$$CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O \longrightarrow CaSO_4.2H_2O$$
(Plaster Of Paris) (Gypsum)

\(\begin{array}{*{20}{c}} {CaS{O_{4.}} + \frac{1}{2}{H_2}O + 1\frac{1}{2}{H_2}O}\\ {\left({Plaster\,Of\,Paris} \right)} \end{array} \to \begin{array}{*{20}{c}} {CaS{O_4}.2{H_2}O}\\ {\left({Gypsum} \right)} \end{array}\)

- Gypsum is an ore of Calcium (Ca). The chemical formula of Gypsum is CaSO 4. 2H 2O.
- Gypsum is mainly used as a fertilizer, as the main constituent in plaster, chalk, etc.
- The plaster of Paris on mixing with water produces gypsum.
- Calcium Sulphate Hemihydrate (CaSO 4·1/2 H 2O) on hydration leads to the crystallization of gypsum calcium sulphate dihydrate (CaSO 4·2H 2O).

---

62. **Answer: c**

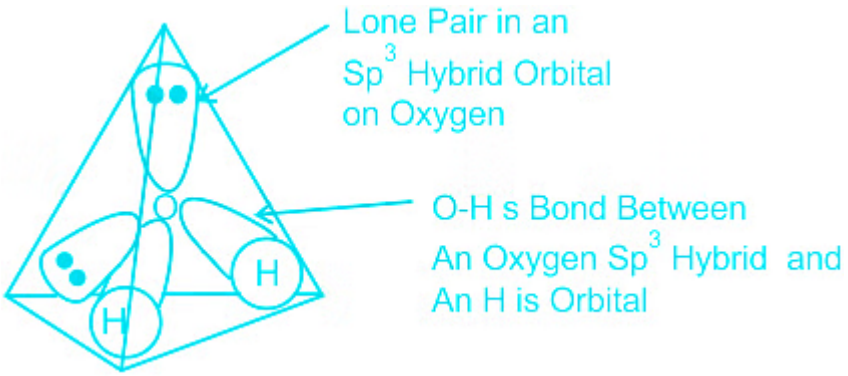
Explanation:

CONCEPT :

- Hybridization:
  - Hybridization is the process of combining two atomic orbitals to form hybrid orbital in a molecule.
- sp Hybridisation:
  - When one ‘s’ orbital and one ‘p’ orbitals of an atom mix to form two new equivalent orbitals.
- sp 2 Hybridisation:
  - When one ‘s’ orbital and two ‘p’ orbitals of an atom mix to form 3 equivalent orbitals.
- sp 3 Hybridisation:
  - When one ‘s’ orbital and three ‘p’ orbitals of an atom mix together to form four new equivalent orbital

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EXPLANATION :



- **Oxygen has six valence electrons** : Two hydrogen will make **2 sigma bonds** and the rest **4 electrons will go in lone pair** . Hence effectively, there are 4 bonds, which gives hybridisation as sp^3. Therefore option 3 is correct.

---

63. **Answer: b**

Explanation:

EXPLANATION :

- Silver Nitrate is used as the **marker during Election** .
- When **silver nitrate is exposed to sunlight** , it breaks down to give **black/brown silver oxides and nitric acid** i.e.,

$\Rightarrow AgNO_3 + H_2O \rightarrow AgO + HNO_3(aq)$

- Silver nitrate decomposes when exposed to the sunlight, so to prevent it from decomposition, **silver nitrate is placed in brown colour bottles** as brown bottle cuts the passage of light through it. Therefore option 2 is correct.

---

64. **Answer: b**

Explanation:

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CONCEPT:

Tollen's reagent:

- It is generally used to distinguish aldehydes from ketones, which consists of Ammonium silver nitrate ions i.e., Ag (NH 3) 2 +

$$\underset{\text{aldehyde}}{R-CHO}+\underbrace{2\ Ag\ (NH_3)_2^{\oplus}+3OH^{\ominus}}_{\text{Tollens reagent}}\xrightarrow{\Delta}\underset{\text{(carboxylate)}}{R-COO^{\oplus}}+2\ Ag\downarrow+4NH_3\uparrow+2H_2O$$

- In this aldehyde is oxidized to carboxylate ion by Tollens' reagent and Ag + ion is reduced to Ag as a silver coating.

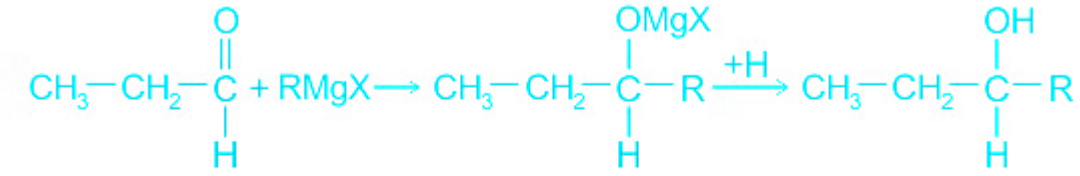
Fehling's solution:

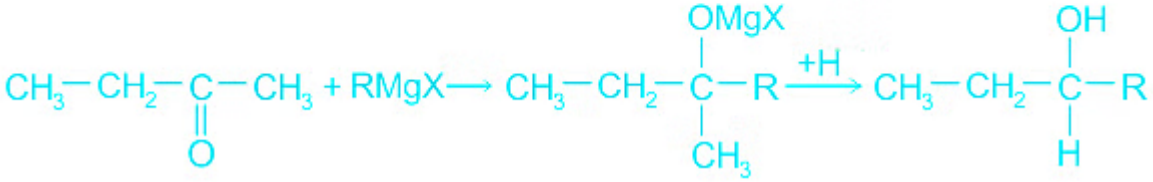
- Just like Tollen's reagent, Fehling's solution is used to distinguish aldehydes from ketones and it is classified into two types Fehling solution A (aqueous copper sulphate) & Fehling solution B (alkaline sodium potassium tartarate i.e., Rochelle salt)
- In this, an aldehyde is oxidized to carboxylate ion by Fehling solution and Cu 2+ ion is reduced to Cu + ion. It may be noted that α-hydroxy ketone also gives this test positive.

$$\underset{\text{(Aldehyde)}}{R-CHO}+\underbrace{2Cu^{2\oplus}+5OH^{\ominus}}_{\text{(Fehling solution)}}\xrightarrow{\text{boil}}\underset{\text{(carboxylate ion) red ppt}}{R-COO^{\ominus}}+Cu_2O\downarrow+3H_2O$$

Grignard's reagent:

- A formula of **Grignard reagent** is given as RMgX where X is a halogen, and R is an alkyl or aryl (based on a benzene ring) group.





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- In the above reaction, **acetaldehyde and acetone** both **reacts with Grignard reagent** to give **alcohols** respective

EXPLANATION:

- From the above, it is clear that **Grignard's reagent reacts with both aldehydes & ketones** . Therefore option 2 is correct.
- Fehling reagent and Schiff's reagent reacts with aldehyde only. Therefore option 1 and 3 is incorrect.

---

65. Answer: d

Explanation:

CONCEPT :

Arrhenius equation:

- Arrhenius equation gives the **dependence of the rate constant of a chemical reaction on the absolute temperature** , a pre-exponential factor, and other constants of the reaction.

$k = e^{\frac{-E_a}{RT}}$

Where k is the rate constant, T is the absolute temperature (in Kelvin), E a is the activation energy for the reaction (in the same units as RT), and R is the universal gas constant.

EXPLANATION :

- From the above, it is clear that **rate constant of a reaction** depends on **temperature** . Therefore option 4 is correct.

---

66. Answer: d

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Explanation:

CONCEPT:

- **Atomic orbitals** : The mathematical functions that describe the wave nature of electrons or electron pairs in an atom are called atomic orbitals.
  - They are used to calculate the probability of finding an electron in a specified region around the nucleus of the atom.
  - An orbital cannot contain more than two electrons, but in a multi-electron atom, the electrons are filled in various orbitals in the order of increasing energy.

EXPLANATION:

- The **atomic orbitals** are the regions of space around the nucleus of an atom where the probability of finding an electron is maximum.
- All the information about the electron in an atom is stored in its orbital wave function ψ .
- Each orbital is **designated by three quantum numbers** labeled as **n,l, and m_l**
  - The **principal quantum number 'n'** is a positive integer with a value of n = 1,2,3.....
  - The principal quantum number determines the size and to large extent the energy of the orbital.
  - **Azimuthal quantum number, 'l'** is also known as orbital angular momentum or subsidiary quantum number. It defines the three-dimensional shape of the orbital.
  - **Magnetic orbital quantum number, 'm_l'** gives information about the spatial orientation of the orbital with respect to a standard set of co-ordinate axis.

---

67. **Answer: a**

Explanation:

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EXPLANATION :

- Valence electrons are the electrons that occupy the **outermost orbitals of an atom** .
- These electrons have a weak attraction towards the atomic nucleus; thus, atoms can easily remove or share these electrons with other atoms.
- The atomic number of Chlorine is 17 .
- The electronic configuration of chlorine is 2, 8, 7 (1s 22s 22p 63s 23p 5) and is distributed in the shells K, L, M respectively.
- From the above electronic configuration of chlorine, it is clear that, in last orbit of Cl, there are **7 electrons** . Therefore option 1 is correct.

---

68. **Answer: b**

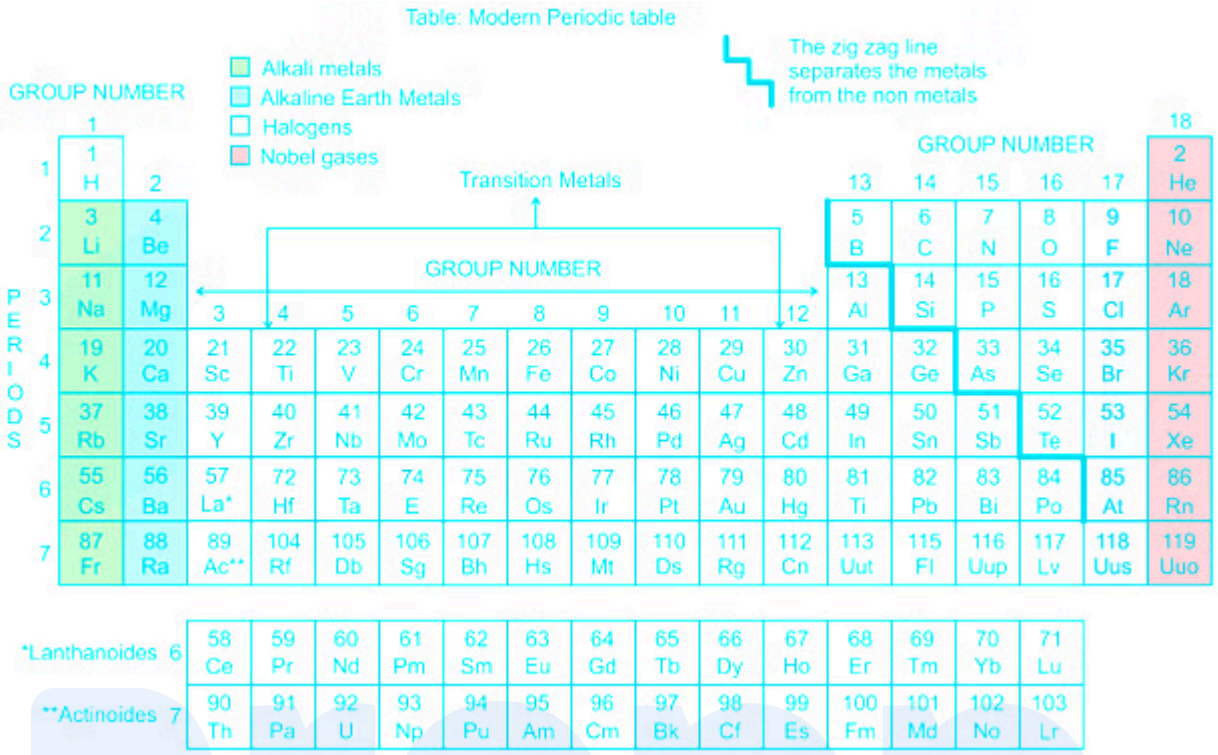
Explanation:

EXPLANATION :

- **Periodic table** is the **tabular arrangement of chemical elements** .
- The Modern Periodic table consists of **18 groups and 7 periods**

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- From the above table, it is clear that the **number of elements in the third period of the Periodic Table** is **8**. Therefore option 2 is correct.

---

69. **Answer: c**

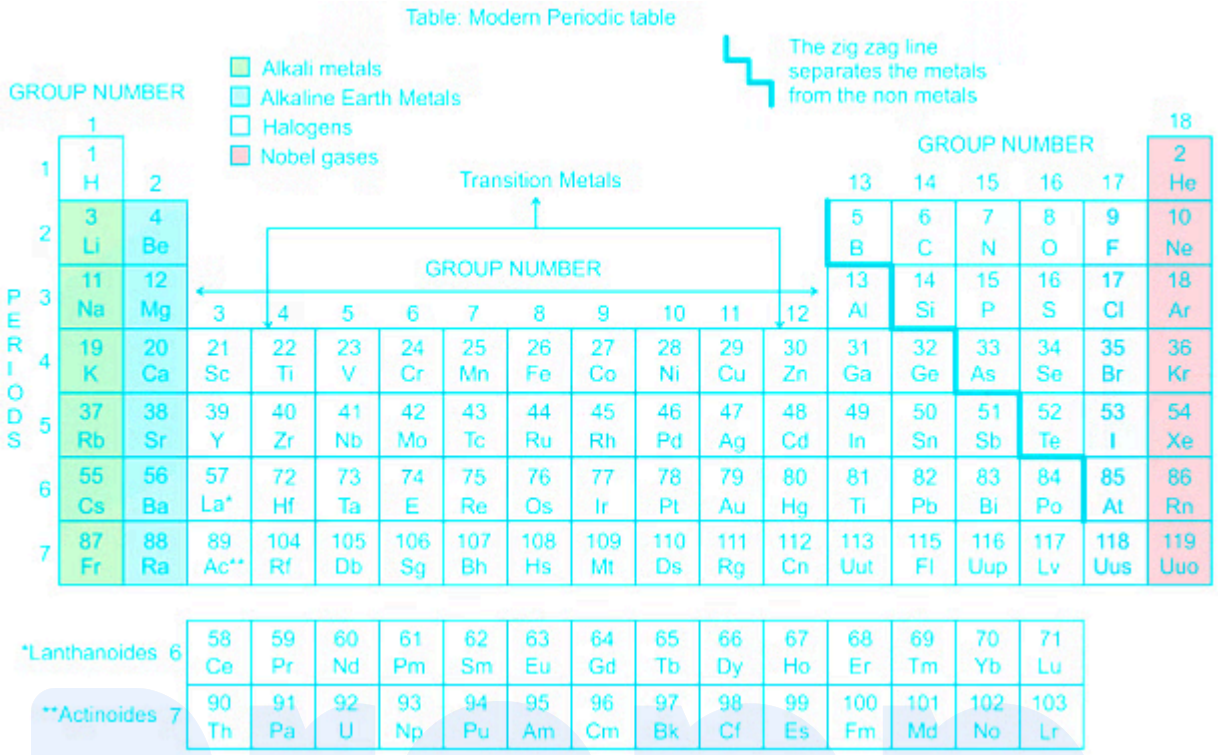
Explanation:

EXPLANATION :

- The periodic table is the tabular arrangement of chemical elements .
- The Modern Periodic table consists of 18 groups and 7 periods

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- As we go up in the periodic table, the **number of shells decreases** and thus **losing electrons becomes difficult** for the atom.
- Hence while moving up a group the **metallic character decreases** . Therefore option 3 is correct.
- As we move from **left to right in a periodic table** the tendency to **gain electrons reduces** . While moving left to right in a period the metallic character reduces.

---

70. Answer: b

Explanation:

The correct answer is **2n 2.**

EXPLANATION :

- The maximum number of electrons present in the orbit can be calculated by using the following formula: 2n 2, where n is the principal quantum number. Therefore option 2 is correct.

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Energy level (principal quantum number)	Shell letter	Capacity of electrons
1	K	2
2	L	8
3	M	18
4	N	32
5	O	50
6	P	72

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71. **Answer: b**

Explanation:

The correct answer is Aluminium

- Bauxite is an ore of Aluminium with chemical formula Al 2O 3.2H 2O. Therefore option 2 is correct.
- It is the primary ore of Aluminium.
- Ore is a naturally occurring mineral or rock from which metal can be extracted.

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Trick: Students were very excited (**Bau xite**) for Alumni (Aluminium) meeting.

Ore of some other important metals:

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Metal	Ores
Aluminium	• Bauxite. • Cryolite. • Corundum, Feldspar.
Iron	• Haematite • Magnetite • Limonite • Siderite
Silver	• Horn Silver • Ruby Silver • Silvenite
Zinc	• Calamine. • Sphalerite. • Zinc blende.
Cobalt	• Smelite. • Cobaltite. • Erythrite.
Magnesium	• Magnesite. • Dolomite. • Carnallite.

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Metal	Ores
Copper	• Malachite. • Cuprite. • Copper pyrites.

72. **Answer: b**

Explanation:

CONCEPT:

- **Iodoform test** : The test which is used to check the presence of carbonyl compounds with the structure R-CO-CH3 or alcohols with the structure R-CH(OH)-CH3 in a given unknown substance is called the iodoform test.

The following **compounds will give a positive iodoform test** :

1. Acetaldehyde
2. Methyl Ketones
3. Ethanol
4. Secondary Alcohols that contain Methyl Groups in Alpha Position

EXPLANATION:

- Acetone, ethyl alcohol, and 2- pentanol will give a positive iodoform test.
- **Diethyl ketone is not any carbonyl or alcohol so it will not give an iodoform test** . Hence option 2 is correct.

---

73. **Answer: d**

Explanation:

The correct answer is Clemmensen's reduction.

CONCEPT :

Wolff-Kishner reduction:

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- The **reduction of aldehydes and ketones to alkanes** by heating them with hydrazine hydrate and a base is known as **Wolff-Kishner reduction** .

Stephen Reaction:

- Preparation of Aldehydes from Nitriles and Esters is done by the Stephen reaction of aldehyde production.
- The reaction was named after Henry Stephen.

Rosenmund reaction:

- The reduction of an acid chloride using hydrogen and a poisoned catalyst to an aldehyde is known as Rosenmund reduction.
- The reaction was named after Karl Wilhelm Rosenmund.

Clemmensen reduction:

- The reduction of **aldehyde or ketone to a hydrocarbon** when they react with **zinc amalgam (Zn/Hg alloy)** in concentrated hydrochloric acid is known as **Clemmensen reduction** .

EXPLANATION :

- From the above, it is clear that the **reduction of ketones by Zn-Hg/HCl** is called **Clemmensen's reduction** . Therefore option 4 is correct.

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---

74. **Answer: a**

Explanation:

CONCEPT :

- **Benedict solution** is a complex mixture of **sodium carbonate** ,**sodium citrate** , and **copper(II) sulfate pentahydrate** .
- Sometimes it is often used in place of Fehling's solution to detect the presence of reducing sugars.

EXPLANATION :

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- Out of all, Sucrose is the one that doesn't give a **'red precipitate' of Cu $_2$O** when heated with **'Benedict's solution** . Therefore option 1 is correct.
- Different types of sugar are **glucose** , Fructose, and **maltose** and convert the **Benedict solution into a red to brick-coloured solution** .

---

75. Answer: b

Explanation:

Concept

Option 2 is correct, i.e. **Stainless steel contains chromium** .

- **Steel (Carbon steel)** is composed of Iron and carbon , which is the main component of stainless steel.
- Stainless steel differs from carbon steel by the amount of chromium present, which is added to make it resistant to rust.
  - Stainless steel, also known as inox steel or inox is a steel alloy of iron, nickel, and a minimum of 10.5% chromium .
- Stainless steel is notable for its corrosion resistance, and it is widely used for food handling and cutlery among many other applications.

NOTE:

- An alloy is a substance made by melting two or more elements together, at least one of the metal.

Name of the alloy	Made up of
Brass	Copper and Zinc
Bronze	Copper and Tin
Stainless steel	Iron, chromium, Nickle, Carbon
German Silver	Copper, Zinc, and Nickle
Nickel Steel	Iron and Nickel

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76. **Answer: d**

Explanation:

CONCEPT:

- Polarizing capacity/polarizing power : The ability of a cation to distort an anion is called the polarization power of that cation.
  - Fajan's rules of polarization : According to this rule, the more the size of an anion and more easily will it be polarized and hence the compound will be more non-polar.
    - And **Less the size of cation more will be it's polarizing power.**

EXPLANATION:

- The size of Li^+ is the smallest in size among all the given options. So according to Fajan's rule, **Li^+ will have the strongest polarizing capacity.** Hence option 4 is correct.

77. **Answer: a**

Explanation:

CONCEPT:

- **Hydrogen peroxide** (H_2O_2) is a chemical compound with the formula H_2O_2.
  - In its pure form, it is a colorless liquid, slightly more viscous than water. Hydrogen peroxide is the simplest peroxide. It is used as an oxidizer, bleaching agent, and disinfectant.
- **Strength of a solution** : The amount of solute or concentration of solute present in a container in which solute and solution are present is called the strength of a solution.

CALCULATION:

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- 10 Volume of H 2O 2 means that the 1L of H 2O 2 will give 10L of oxygen at standard temperature and pressure (STP).

2 H 2O 2 (l) -----→ O 2(g) + H 2O (l)

Here 2 mole of H 2O 2 will have mass = 2 × (2 + 2 × 16) = 68 gm

Thus 22.7 l of O_2 is produced from 68 gm of H 2O 2

So 10 l of O_2 will be produced from (68 × 10)/22.7 = 30 gm of H 2O 2

Strength of 10 V of H 2O 2 = (30 × 10)/100 = 3 %

Hence option 1 is correct.

---

78. Answer: a

Explanation:

CONCEPT:

- **Lewis acid** : A substance that can accept an electron pair is called a Lewis acid.
  - According to the Lewis Theory , an acid is an electron pair acceptor , while electron-pair donors are termed as the **lewis base** .
  - Example of Lewis acid: AlCl3, FeCl3, and BF3.

EXPLANATION:

- In order to get a stable octet configuration, Boron needs 2 electrons. So it can accept a pair of electrons from NH_3 through a reaction. That's why **BF_3 is a lewis acid** . Hence option 1 is correct.
- **Boron (B)** is not an acid, it is just an element.
- **PH_3 and CO** can't accept a pair of electrons.

---

79. Answer: b

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Explanation:

CONCEPT:

- **Electron affinity** : The electron affinity of an element is defined as the ease with which it can accept an electron.
    - Chlorine the group 17th element has the highest electron affinity, also called as halogen represented by X.
- **Electron affinity** increases going through left to right across a period.
- **Electron affinity** decreases going down the group.

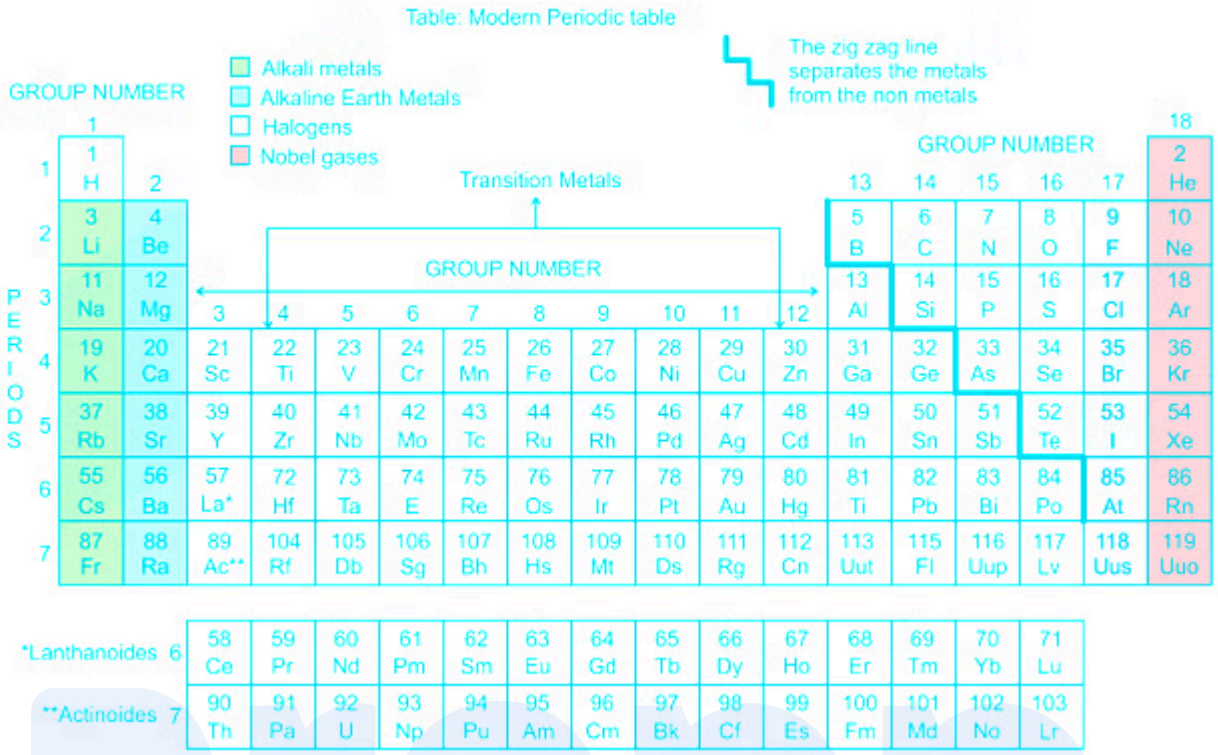
Electron Affinity= 1/ Atomic size

EXPLANATION:

- Although Fluorine has the highest electronegativity, Chlorine has the highest electron affinity and this is because of the considerable repulsion in the tightly packed 2p subshell of Fluorine.
- As the size increase, the electron affinity decreases. So the size of Bromine is less than that of Iodine so the affinity of Br > I.
- Thus the correct order is **Chlorine (Cl) > Fluorine (F) > Bromine (Br) > Iodine (I).** So option 2 is correct.

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80. **Answer: d**

Explanation:

CONCEPT:

- **Inter halogen** : The molecule that contains two or more different halogen atoms and no atoms of elements from any other group is called interhalogen.
- **Halogen** : The group of six elements in the periodic table. Previously it was only five but Tennessee (Ts) added recently.
    - The **halogen elements** are fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At), and Tennessee (Ts).

EXPLANATION:

- (CN) 2 is n **ot an interhalogen** molecule because it doesn't contain any halogen atom.
- KI is also **not an interhalogen** molecule because it has K which is not a halogen atom.

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- Br 2**not an interhalogen** because it is not made of halogen atoms.
- **ICl is an interhalogen molecule** because it contains two atoms and they are halogens (I and Cl). So option 4 is correct.

---

81. Answer: b

Explanation:

The correct answer is **option 2) i.e. revived**

⭐ Key Points

- Let's look at the meaning of the **underlined word and the option** -
- **Resuscitated:** To bring someone or something back to life or wake someone or something
- **Revived** :To come or bring something back to life, health, existence, or use

Here we find that Resuscitated and **Revived**are words with similar meanings.

- Let's look at the meaning of other given options-
  - **Soothed** :To make someone feel calm or less worried
  - **Rescued:** To help someone or something out of a dangerous, harmful, or unpleasant situation
  - **Cured:** To make someone with an illness healthy again

---

82. Answer: a

Explanation:

The correct answer is **option 1) i.e. unsophisticated.**

⭐ Key Points

- Let's look at the meaning of the underlined word and the option -

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- Rustic: Of, relating to, or living in the country, as distinguished from towns or cities; rural; simple, artless, or unsophisticated
- **Unsophisticated:**not complicated, not educated, or without a good understanding of culture

Here we find that Rustic and Unsophisticated are words with similar meanings.

- Let's look at the meaning of other given options-
  - **strange:** unusual or surprising; difficult to understand or explain.
  - **old-fashioned:** I n or according to styles or types no longer current; not modern.
  - **unconventional :**N ot based on or conforming to what is generally done or believed.

---

83. Answer: c

Explanation:

The correct answer is **option3) i.e. outbreak.**

⭐ Key Points

- Let's look at the meaning of the underlined word and the option -
- Onset: The beginning of something, especially something unpleasant.
- Outbreak: A time when something suddenly begins, especially a disease or something else dangerous or unpleasant

Here we find that Onset and Outbreak are words with similar meanings.

- Let's look at the meaning of other given options-
  - **Assault :**T he crime of physically attacking someone
  - **Attack:**To try to hurt or defeat using violence
  - **Onslaught:** A fierce or destructive attack

---

84. Answer: b

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Explanation:

The correct answer is **option2) i.e. deceitful**

⭐ Key Points

- Let's look at the meaning of the underlined word and the option -
- Shifty: Someone who looks shifty gives the impression of being dishonest
- **Deceitful:**G uilty of or involving deceit; deceiving or misleading others.

Here we find that Shifty and Deceitful are words with similar meanings.

- Let's look at the meaning of other given options-
  - **wily:**s killed at gaining an advantage, especially deceitfully.
  - **slippery:**A person who is slippery is someone you feel you cannot trust
  - **crafty:**clever, especially in a dishonest or secret way

---

85. Answer: a

Explanation:

The correct answer is **option 1) i.e. rich.**

⭐ Key Points

- Let's look at the meaning of the underlined word and the option -
- Opulent: Rich in appearance; showing great wealth
- Rich: Having a great deal of money or assets; wealthy.

Here we find that **opulent** and **Rich**are words with similar meanings.

- Let's look at the meaning of other given options-
  - **Hard-working**: Tending to work with energy and commitment; diligent.
  - **Comfortable :** Affording or enjoying contentment and security
  - **Obscure:**Not known to many people

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86. **Answer: a**

Explanation:

The correct answer is option 1) i.e. buried.

⭐ Key Points

- It is a **phrase** 'The good is buried with bones"
- Its **meaning** is that the **bad things people do remain alive even after their death.**
- **No other words** from the options **make** the sentence **meaningful.**
- So the correct word is **'buried'.**

The completed sentence is: The good is buried with the bones.

---

87. **Answer: a**

Explanation:

The correct answer is option 1) i.e. love.

⭐ Key Points

- Let's consider the **usage of the words** given in options when **used with 'marriage':**

love	a marriage which is solely driven by the couple
bigamous	entering into a marriage with one person while still legally married to another
polygamous	the practice of marrying multiple spouses
conventional	Based on what is generally done

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- Thus the **correct answer** is **'love'**

The corrected sentence is: Dowry is no longer permitted by law even in love marriages.

---

88. Answer: c

Explanation:

The correct answer is**option 3) i.e. wise.**

⭐ **Key Points**

- Let's consider the **usage** of the **words** given in the options:

sober	not affected by alcohol
drunk	affected by alcohol to the extent of losing control of one's behaviour
wise	having great wisdom
boring	not interesting

⭐ **Important Points**

- The sentence contains **'as _____as'** . It shows that **simile** is to be used.
- **Judge** is thought to be a **wise** person.
- so **wise** is the correct answer.

The completed sentence is: When he left after the cocktail party, he was as wise as a judge.

---

89. Answer: d

Explanation:

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The correct answer is**option 4) i.e. ground.**

⭐ **Key Points**

- Let's **consider** the **usage** of all the **words given** in the **options:**

bail	The temporary release of an accused person awaiting trial, sometimes on a condition od lodging a sum of money as a guarantee for his appearance in the court
parole	The temporary or permanent release of a person before the expiry of the sentence on the promise of a good behaviour
guarantee	A formal assurance that a certain condition will be fulfilled
ground	The basis of release of some person before the expiry of his sentence.

⭐ **Important Points**

- The sentence contains **'of good behaviour'** . So the **ground** is the correct answer.
- If we give the answer as **'parole'** it will be a **repetition** of the things.

The completed sentence is: The prisoner was released on the ground of good behaviour.

---

90. **Answer: d**

Explanation:

The correct answer is **option 4) i.e. biography.**

⭐ **Key Points**

- Let's **consider** the **meanings** of all the **words given** in **options:**

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novel	A fictitious prose narrative of book-length
essay	A short piece of writing on a particular subject
autobiography	An account of a person's life written by himself
biography	An account of a person's life written by somebody else

⭐ Important Points

- In this sentence **life story of 'Boswell'** is **written** by **' Samuel Johnson'.** So it is a **biography.**

The completed sentence is:"Boswell Life" of Samuel Johnson is considered to be the greatest biography ever written.

---

91. Answer: c

Explanation:

The correct answer is Nadir Shah.

- Nadir Shah took away the peacock throne built by Shahjahan, from India.
- **Nader Shah, the Ruler of Iran** , stole the valuable jewels bound to him **during the invasion of 1739.**

⭐ Key Points

- A famous jewelled throne that was the seat of the Mughal Emperors of India was the Peacock Throne.
- It was commissioned by Emperor Shah Jahan in the early 17th century and was housed in the Diwan-i-Khas (Hall of Private Audiences) in the Delhi Red Fort.
- In 1783, Delhi was captured by Sikh Sardars **Baghel Singh, Jassa Singh Ahluwalia** and **Jassa Singh Ramgarhia** and hoisted the Nishan Sahib at the Red Fort.
- In defiance of the persecution of the Sikhs, he came to the throne on horseback, and he was pulled into the Golden Temple, Amritsar. In the **Ramgarhia Bunga** ,

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where it is still there. It was named after a peacock as two peacocks at the rear are seen dancing.

⭐ Important Points

- **Nader Shah** was one of the most powerful Iranian rulers in Iranian history, reigning from 1736 to 1747 as Shah of Iran (Persia) during an uprising when he was assassinated.
- **The Peacock Throne** was inaugurated on 22 March 1635, the official seventh anniversary of the accession of Shah Jahan, in a glorious ceremony.
- His son Aurangzeb, who had the royal name of Alamgir, ascended the Peacock Throne after Shah Jahan's death.

---

92. **Answer: c**

Explanation:

The correct answer is **Cholas**.

⭐ Key Points

- **The reign of Cholas** is regarded as the **'golden age' of south India** .
- **The golden age of Tamil culture** , characterised by the significance of literature, was the **Imperial Chola period** .
- In the Chola records, several works, including **Rajarajesvara Natakam, Viranukkaviyam and Kannivana Puranam,** are cited.

⭐ Important Points

- **The Chola dynasty** was Southern India's Tamil Thalassocratic monarchy, one of the longest-ruling dynasties in the history of the world.
- In inscriptions from the 3rd century BCE left by Ashoka, of the Maurya Kingdom, the earliest dateable references to the Chola are.
- As one among the Three Tamil Kings of Tamil Nadu, that is together with the Chera and Pandya, the Chola dynasty continued to rule over various regions until the 13th century CE.

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- Despite these ancient beginnings, in **the mid-9th century CE** , the time when it is reasonable to talk of a "Chola Kingdom" only starts with the mediaeval Cholas.

---

93. Answer: c

Explanation:

The correct answer is**the Arctic**.

- **The Arctic Ocean is the smallest ocean basin in the world ,**with a gross area of **14 million square kilometres (5.4 million square miles)** .
- It is **1.5 times the size of the United States** , with a gross area of around 14 million square kilometres (5.4 million square miles).
- The Arctic Ocean is, perhaps the most remote and least explored of all the main ocean basins of the World.
- Owing to year-round ice cover, the **deepest areas of the Arctic Ocean** (5,441 metres; 17,850 feet), known as the Canada Basin, are especially remote and unexplored.

⭐ Important Points

- The Arctic Ocean is the smallest of the five main oceans in the world and the sha llowest. It is also regarded as the coldest of all oceans.
- **The International Hydrographic Organisation (IHO)** acknowledges it as an ocean, although it is called the Arctic Mediterranean Sea by some oceanographers.
- In the centre of the Northern Hemisphere, the Arctic Ocean contains the North Pole area, which stretches south to around 60° N.
- Eurasia and North America circle the Arctic Ocean, and the boundaries meet topographic features; on the Pacific side, the Bering Strait, and on the Atlantic side, the Greenland Scotland Range.

---

94. Answer: c

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Explanation:

The correct answer is **Ionosphere**.

- **Ionosphere zone of the atmosphere makes radio transmission possible**.
- The ionosphere will mirror radio waves directed down to the Earth in the sky because of **the ability of ionised atmospheric gases to refract high-frequency (HF, or shortwave) radio waves** .

⭐ Key Points

- Beyond the horizon, radio waves aimed at an angle into the sky will return to Earth.
- The returned radio waves will again reflect into the sky from the surface of the Earth, causing repeated hops to reach wider ranges.
- This contact approach is unpredictable and inconsistent, depending on the time of day or night, the seasons, temperature, and the 11-year sunspot period, with reception over a given route.
- It was commonly used for transoceanic telephone and telegraph operation, and corporate and diplomatic correspondence throughout the **first half of the 20th century.**

⭐ Additional Information

- **The ionosphere is the ionised part of the upper atmosphere of the Earth** , from an altitude of about 60 km to 1,000 km, an area containing the thermosphere and portions of the mesosphere and exosphere.
- Solar radiation ionises the ionosphere. It plays a significant role in the energy of the atmosphere and forms the magnetosphere's inner side.
- The ionosphere is a shell surrounding the earth with electrons and electrically charged atoms and gases, extending from around 50 km to over 1,000 km in height. It occurs largely because of the Sun's ultraviolet radiation.

---

95. Answer: d

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Explanation:

The correct answer is **Sulphur**.

- **Vulcanization** is a procedure commonly used for products **that are rubbery or elastomeric** .
- **The primary substance used for vulcanizing rubber is Sulphur**.
- After a very large mechanically imposed deformation, these structures forcefully retract to their essentially initial shape.
- Vulcanization can be described as a procedure that increases the retractile force and decreases the amount of permanent deformation that remains after the deforming force has been extracted.
- Thus, vulcanization increases elasticity while plasticity is reduced. It is normally achieved by the creation of a crosslinked molecular network.

⭐ **Important Points**

- **Vulcanization by the action of heat and pressure** is a method of chemical cross-linking of rubber molecules with organic/inorganic substances.
- The chemically cross-linked rubber is known as vulcanizate.
- The introduction of crosslinks may be comparatively few in number into the rubber matrix, but they are sufficient to prevent the entire molecules from flowing unregulated past neighbouring ones.

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96. Answer: b

Explanation:

The Correct Answer is **Wind and water**.

- **Soil erosion, where the soil particles are removed and moved to another site-is a method of moving soil by water or wind**.
- This is a natural cycle that has taken place for aeons of time. For moving **soil materials, water, wind, ice, and gravity are involved.**

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- **Reduced crop production capacity** , lower surface water quality and degraded drainage networks could indicate the loss of soil from farmland. Soil erosion may also cause sinkholes.

⭐ Important Points

- There were three processes involved in erosion: detachment (from the ground), transport (via water or wind), and deposition.
- The deposition is often found in areas where the soil, such as streams, lakes, reservoirs, or deltas, is not desired. And, of importance is that the topsoil is always the most fertile and that the subsoil is less active as it erodes away.
- **Two major forces trigger water erosion are:**
  - Raindrop effects
  - Flowing water

---

97. **Answer: c**

Explanation:

The Correct Answer is S Jayshankar.

- Since 31 May 2019, Subrahmanyam Jaishankar has been the new Minister of External Affairs of the Government of India.

⭐ Important Points

- Subrahmanyam Jaishankar is the first former Foreign Secretary to lead the **Cabinet-level Ministry of External Affairs** .
  - He was elected by the **Bharatiya Janata Party** to the Rajya Sabha of **Gujarat State** as a Member of Parliament on 5 July 2019.
  - He succeeded **Sushma Swaraj in his first tenure as Minister of External Affairs** in the government of Narendra Modi.

⭐ Additional Information

- **Subrahmanyam Jaishankar** entered the Indian Foreign Service in 1977 and worked in various positions in India and abroad throughout his diplomatic

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career spanning over 38 years, including as Ambassador to the Czech Republic (2001-04), China (2009-2013) and the USA (2014-2015).
- In negotiating the Indo-US civilian nuclear deal, he played a key role.

---

98. Answer: b

Explanation:

The Correct Answer is **Telangana**.

⭐ **Key Points**

- **Telangana** is bordered by the **states of Maharashtra to the north, Chhattisgarh to the east, Karnataka to the west, and Andhra Pradesh to the east and south** .
- There are nine states that have a sea-line running through their frontiers,
  - **Gujarat** , Maharashtra, Goa, Karnataka, Kerala, Andhra Pradesh, Tamil Nadu, **Odisha** and **West Bengal** .

⭐ **Important Points**

- Telangana is a state in India that is located on the high Deccan Plateau on the south-central stretch of the Indian peninsula.
- With a geographical area of 112,077 km ^{2}(43,273 sq mi) and 35,193,978 residents as per the 2011 census, it is the eleventh-largest state and the **twelfth most populous state in India** .
- Several major Hindustani powers, such as the Cholas, Chalukyas, Mauryans, Satavahanas, Kakatiyas, Delhi Sultanate, Bahmani Sultanate, Golconda Sultanate, governed Telangana.
- The area was dominated by the Mughals of India during the 16th and 17th centuries.
- The area is renowned for the community of the Ganga-Jamuni Tehzeeb.
- Telangana was ruled by the Nizam of Hyderabad during the 18th Century and the British Raj.
- On 2 June 2014, as the newly established state with Hyderabad as its capital, the city was divided from the northwestern portion of Andhra Pradesh.

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Warangal, Nizamabad, Khammam and Karimnagar are his other major towns.

---

99. **Answer: c**

Explanation:

The Correct Answer is **Sprinter**.

- **Hima Das is an Assam State Indian Sprinter**.
- With a timing of **50.79 sec** , she holds the current Indian national record in 400 metres that she clocked at the 2018 Asian Games in Jakarta, Indonesia.
- In a track event at the IAAF World U20 Championships, she was the **first Indian competitor to win a gold medal** .

⭐ **Additional Information**

- **Hima Das** competed in the **400 metres and the 4,400 metres relay at the 2018 Commonwealth Games in Gold Coast, Australia,** in April 2018.
- At the 2018 **World U-20 Championships** in Tampere, Finland, she won the 400 m final on 12 July 2018, clocking 51.46 seconds and becoming the first Indian sprinter to win a gold medal in an international track event.
- **In October 2019** , she was qualified for the World Athletics Championships to be held in Doha.
- **On 25 September 2018** , she awarded with Arjuna Award by the President of India.

---

100. **Answer: a**

Explanation:

The Correct Answer is **Veer Chakra**.

- **Vir Chakra, India's third-highest wartime gallantry medal, was awarded to Wing Commander Abhinandan Varthaman**, who shot down an enemy jet

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during an aerial war with Pakistan in February and was held captive for three days.
- On the eve of Independence Day celebrations (August 2019), the defence ministry declared the military awards.

⭐ Additional Information

- **Wing Commander Abhinandan Varthaman** is an Indian Air Force fighter pilot who was held hostage for 60 hours in Pakistan during the 2019 India-Pakistan standoff after his aircraft was shot down in an aerial dogfight.
- **On 28 February 2019** , facing a legal effort to thwart it, Pakistan agreed to release him as a "gesture of goodwill" and on 1 March 2019, he returned to India at Wagah.
- He was flying a **MiG-21** as part of a sortie on 27 February 2019, which was scrambled by Pakistani aircraft to intercept an intrusion into Jammu and Kashmir.

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