Answers

1. **Answer: c**

Explanation:

Concept:

Newton's Third Law of motion

- Newton's third law of motion states that to every action there is always an equal and opposite reaction.
- If body A exerts a force F on another body B, then B exerts a force -F on A.
- Force always comes in pairs.

Explanation:

- A man is at rest in the middle of a horizontal plane of perfectly smooth ice then,
- He can move himself to the shore by making use of **Newton's third law motion.**
- He exerts a force on the ice in opposite direction, then from **Newton's third law** the ice also exerts force on the man.

⭐ Additional Information

Newton's First Law of motion

- Everybody continues to be in its state of rest or of uniform motion in a straight line unless compelled by some external force to act otherwise.
- In other words, "If the net external force on a body is zero, its acceleration is zero "
- The first law of motion is sometimes also known as the law of inertia.

Newton's Second Law

- Newton's second law of motion states that " the rate of a momentum of a body is directly proportional to the applied force and takes in the direction in which the force acts"
- $F = k\frac{dP}{dt}$
- where k is proportionality constant and equal to 1

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- P = MV. where, M = mass and V = velocity.

---

2. **Answer: b**

Explanation:

Explanation:

- The sound waves of frequency greater than 20 kHz are called **ultrasonic waves** .
- **Infrasonic waves** are sub-audible acoustic waves that typically lie below the human hearing threshold (usually between 0.1 to 10 Hz, sometimes going up to 20 Hz). While these waves cannot be “heard” by humans.
- The human ear can easily detect frequencies between 20 Hz and 20 kHz.
- Hence sound waves with frequencies ranging from 20 Hz to 20 kHz is known are as **audible sounds** .
- **Compared to audible sound waves, ultrasound waves have a higher frequency.**

---

3. **Answer: c**

Explanation:

Concept:

- An echo is a repetition of sound produced by the reflection of sound waves from a wall, mountain, or another obstructing surface.
- We can hear the original sound and the reflected sound (echo) separately only if there is a time interval of at least 0.1 seconds between them.
- Speed of sound = 344 m/s (at 20° C)
- $Speed(s) = \frac{Distance(d)}{Time(t)}$ --- (1)

Calculation:

For minimum distance to hear an echo, t = 0.1 s, speed of sound, s = 344 m/s

Now from eq 1

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Distance = 344 × 0.1 = **34.4 m**

Thus, the distance traveled by sound in 0.1 s is 34.4 meters.

But this distance is traveled by sound from the source of sound to the reflecting surface and then coming back to the source.

So, the distance between the source and the reflecting surface is halved of 34.4 m

d' = 17.2 m

---

4. Answer: b

Explanation:

Explanation:

- The process of transferring charge from a charged object to the earth with the help of the low-resistance wire is called **earthing.**
- The electrical earthing is done by connecting the non-current carrying part of the equipment or neutral of the supply system to the ground.
- Earthing is provided in buildings to protect us from electrical shocks due to any leakage of electrical current.
- Types of Electrical Earthing
  - **Neutral Earthing** - In neutral earthing, the neutral of the system is directly connected to the earth by the help of the GI wire.
  - The neutral earthing is also called the system earthing.
  - **Equipment Earthing** - Such type of earthing is provided to the electrical equipment
  - . The non-current carrying part of the equipment like its metallic frame is connected to the earth by the help of the conducting wire.

⭐ Additional Information

- **Lightning** is an electrical discharge caused by imbalances between storm clouds and the ground, or within the clouds themselves. Most lightning occurs within the clouds.

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5. **Answer: b**

Explanation:

Explanation:

- Electric potential difference is also known as voltage.
- **The electric potential difference is the work done per unit charge to move a unit charge from one point to another in an electric field or circuit.**
- The SI unit of potential difference is Volt (V)

⭐ Additional Information

- **Current** is the flow of electrical charge carriers like electrons.
- Current flows from negative to positive points.
- The SI unit for measuring electric current is the ampere (A).
- There are two types of electric current, namely alternating and direct current.
- **Electric Power** - Electric power is the rate at which electrical energy is transferred by an electric circuit.
- The SI unit of Power is the Watt or One Joule per second.
- **Resistance** is a measure of the opposition to current flow in an electrical circuit.
- Resistance is measured in ohms, symbolized by the Greek letter omega (Ω)

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6. **Answer: b**

Explanation:

Explanation:

- A superconductor is a material that offers zero resistance to electric current under a certain critical temperature and remains in a superconductive state.
- **At low temperatures, lead behaves as a Superconductor**
- Lead exhibit superconducting phase transitions at low temperatures of 7.2 Kelvin.

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- The temperature below which certain material behaves like a superconductor is termed transition temperature or critical temperature
- At this temperature (known as critical temperature), the electrical resistivity of lead drops to zero.

⭐ Additional Information

- The conductor is a material or device that conducts or transmits heat or electricity
- A semiconductor is a material product usually comprised of silicon or germanium, which conducts electricity more than an insulator, but less than a pure conductor.
- The insulator is a substance or device which does not conduct electricity or heat.

---

7. **Answer: a**

Explanation:

Concept:

- Resistance is the property of the substance to resist the flow of electric current through it.
- The unit of resistance is Ohm.
- **The resistance (R) of a metallic wire is directly proportional to its length (L) and inversely proportional to its area of cross-section (A)** .
- $R = \rho\frac{L}{A}$
- The **resistivity (ρ)** of a material is a fundamental property, and it shows how strongly the material opposes the electric current.

Explanation:

The resistance of a metallic wire is directly proportional to its length and inversely proportional to its area of cross-section.

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8. **Answer: b**

Explanation:

Concept:

There are two types of generators – DC generators and AC generators. Both DC and AC generators convert mechanical power to electrical power.

- A generator operates on the principle of electromagnetic induction.
- Faraday's laws of electromagnetic induction whenever the flux of magnetic field through the area bounded by a closed conducting loop changes, an emf is produced in the loop.
- A direct current (DC) generator is a type of electrical machine used to transform mechanical energy into DC electricity.
- AC Generator is a machine that converts mechanical energy into alternating electrical energy i.e., alternating current and alternating emf is known as an AC generator.

The major difference between AC and DC generators. are -

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AC generator	DC generators
It generates AC electric power	It produces DC electric power
Electrical current reverses direction periodically.	Electrical current flows only in one direction.
AC generator does not have commutators.	**DC generators have commutators** due to which the current flow only in one direction.
It has slip - rings.	It has split-ring commutators
AC generators are very efficient	DC generators are less efficient.

---

9. **Answer: c**

Explanation:

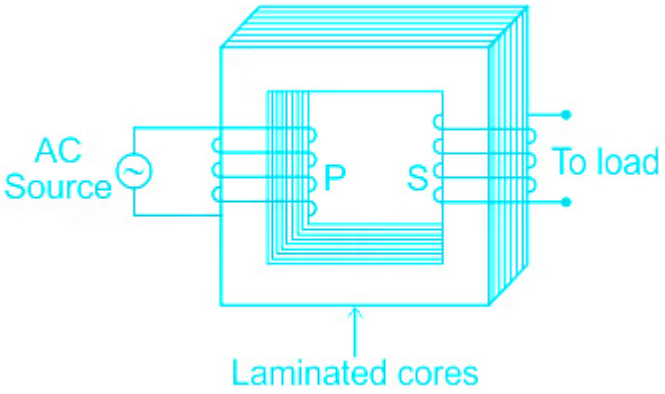
Concept:

- When the two coils are arranged in such a way that a change of current in one coil causes an emf to be induced in the other, the coils are said to have mutual inductance.
- The mutual inductance is denoted letter M and measured in Henry.
- The **transformer is a device that raises or lowers the voltage in AC circuits through mutual induction** and consists of two coil wounds on the same core.

Explanation:

Working Principle of Transformer

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- According to the principle of mutual inductance, when an alternating voltage is applied to the primary winding of the transformer, an alternating flux ϕ_m which is called as the mutual flux is produced in the core.
- This alternating flux links both the windings magnetically and induces EMFs E_1 in the primary winding and E_2 in the secondary winding of the transformer according to Faraday's law of electromagnetic induction.
- A transformer works on the principle of Mutual induction.
- The EMF (E_1) is called as primary EMF and the EMF (E_2) is known as secondary EMF and being given as,
- $E_1 = -N_1 \frac{d\phi_m}{dt}$ --- (1)
- $E_2 = -N_2 \frac{d\phi_m}{dt}$ ---(2)
- From equation 1 and 2
- $\frac{E_2}{E_1} = \frac{N_2}{N_1}$
- From the above expression, it can be seen that the magnitude of EMFs E_1 and E_2 depend upon the number of turns in the primary and secondary windings of the transformer respectively
- **If $N_2 > N_1$, then $E_2 > E_1$, thus the transformer will be a step-up transformer.**
- **And if $N_2 < N_1$, then $E_2 < E_1$, thus the transformer will be a step-down transformer.**

The transformer changes low voltage alternating current to high voltage alternating current and vice-versa

---

10. **Answer: c**

Explanation:

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Explanation:

- The SI unit is an international system of units used in technical and scientific research to minimize confusion with measuring units.
- The symbol of SI unit of inductance is H
- **It stands for Henry**
- One henry is the value of self-inductance in a closed circuit or coil in which one volt is produced by a variation of the inducing current of one ampere per second.
- It is named after Joseph Henry, an American scientist who discovered electromagnetic induction.

⭐ Additional Information

- Hertz is the SI unit of frequency.
- The number of complete waves produces in 1 second, is called Hertz.
- The halogens are a group in the periodic table consisting of chemically related elements: fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At), and Tennessee (Ts).

---

11. **Answer: c**

Explanation:

Concept:

- Faraday's laws of electromagnetic induction whenever the flux of magnetic field through the area bounded by a closed conducting loop changes, an emf is produced in the loop.
- The emf is given by $\xi = -\frac{\delta\phi}{\delta t}$
- The law described by equation 1 is called Faraday's law of electromagnetic induction
- The flux may be changed in a number of ways-
  - One can change the magnitude of the magnetic field B at the site of the loop,
  - the area of the loop or,

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- the angle between the area-vector dS and the magnetic field B

Explanation:

The emf so produced drives an electric current through the coil. If the resistance of the coil is R, the current is

$i = \frac{\xi}{R} = -\frac{1\delta\phi}{R\delta t}$

So, we can say that the phenomena of electromagnetic induction are induced current in a coil due to relative motion between a magnet and the coil.

---

12. Answer: d

Explanation:

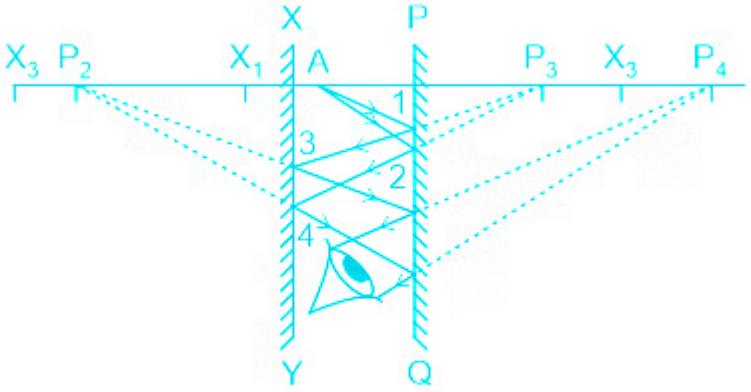
Concept:

- The number of images formed by two plane mirrors inclined at an angle of θ is given by $n = \frac{360}{\theta} - 1$
- If n is in decimal, then only the integral part is taken.

Explanation:

The angle between two parallel plane mirrors is 0°

So no of image, $n = \frac{360}{0} - 1 = \infty$



Formation of image in parallel mirrors facing each other

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So, if the point light source is placed between two parallel plane mirrors, then the number of images formed will be infinite.

---

13. **Answer: b**

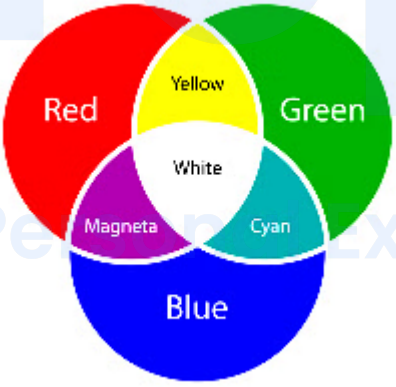
Explanation:

Concept:

- There are three primary colours, red, green and blue.
- Two primary colours combined will create a secondary colour.
- Two systems of colour mixing

1. Additive colour mixing
2. Subtractive colour mixing

When we mix the colours then we get the following colour -



- When Red and Green are mixed then Y ellow colour is formed.

---

14. **Answer: a**

Explanation:

Explanation:

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- Accommodation of the human eye is the process of adjusting the lens to focus on objects at various distances, thereby allowing clear vision
- **Far-sightedness,** also known as long-sightedness, **hypermetropia** , or hyperopia, is a condition of the eye where distant objects are seen clearly but near objects appear blurred.
- This issue can be overcome with the help of a **converging lens** .
- **Nearsightedness** is an eye condition in which you can see nearby objects clearly, but faraway objects appear fuzzy or blurry. It's also called **myopia**
- This issue can be overcome with the help of a **diverging lens** .
- **Presbyopia** is an age-related eye condition in which the ability to focus on nearby objects reduces.
- **Bifocal lenses** are lenses with lines separating two different prescriptions.
- There is a presence of a distance lens at the top and the lower part has a lens that can be used to view the objects placed nearby.

Bifocal lenses are used by people suffering from both **myopia and hypermetropia or presbyopia** .

---

15. **Answer: c**

Explanation:

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Explanation:

The **dual nature of light** describes that light has dual nature. It behaves as both particle nature (Energy particle of Planck) and waves nature i.e., electromagnetic waves.

- **De-Broglie equation states wave nature.**
- When subatomic particles (electron, proton, etc.) behave like a wave then the wavelength is called **de Broglie** wavelength
- $\lambda = \frac{h}{p}$
- p = mv
- λ = de Broglie wavelength, h = Planck constant, p = momentum of the subatomic particles, m = mass of subatomic particles, v = velocity of

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subatomic particles

- **Quantum Nature of Light**
- According to the quantum theory of light, "light is propagated in the bundles of small energy, each bundle is called photon which possesses energy".
- $E = h\nu = hc/\lambda$
- where ν is frequency, λ is the wavelength of light, h is Planck's constant, and c is the speed of light.

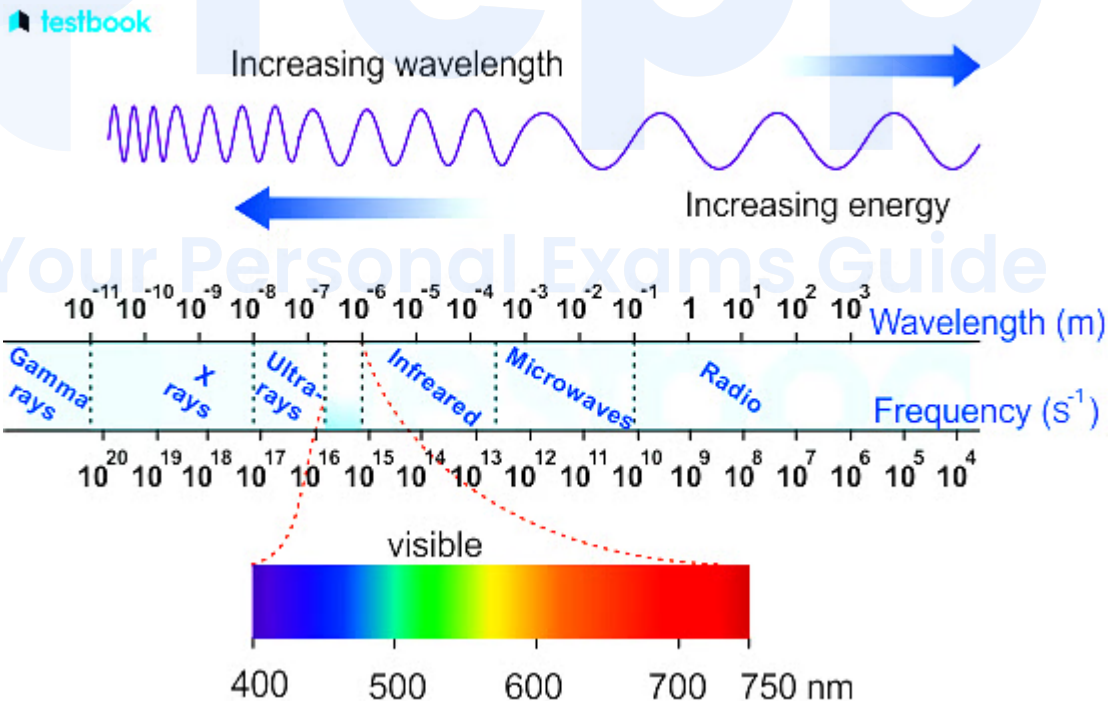
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16. Answer: d

Explanation:

Concept:

- The spectrum is a continuous range of electromagnetic radiation waves.
- It ranges from the longest **radio** waves to the shortest **X-rays and gamma rays.**



Explanation:

- X-rays have the smallest wavelength in the above options.
- Most X- rays have a wavelength ranging from 0.01 to 10 nm

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- They are powerful waves of electromagnetic energy.

⭐ Additional Information

Properties of X-ray

- X-Rays are pure energy having no mass and they transfer energy from one place to another in the form of photons.
- They travel in straight lines with the velocity of light.
- They are used to capture human skeleton defects.
- They are capable of traveling in a vacuum.
- X-rays are not affected by electromagnetic field.

---

17. Answer: c

Explanation:

Concept:

The **dual nature of light** describes that light has dual nature. It behaves as both particle nature (Energy particle of Planck) and waves nature i.e., electromagnetic waves.

De-Broglie equation states wave nature.

- When subatomic particles (electron, proton, etc.) behave like a wave then the wavelength is called de Broglie wavelength
- $\lambda = hp$
- $p = mv$
- λ = de Broglie wavelength, h = Planck constant, p = momentum of the subatomic particles, m = mass of subatomic particles, v = velocity of subatomic particles

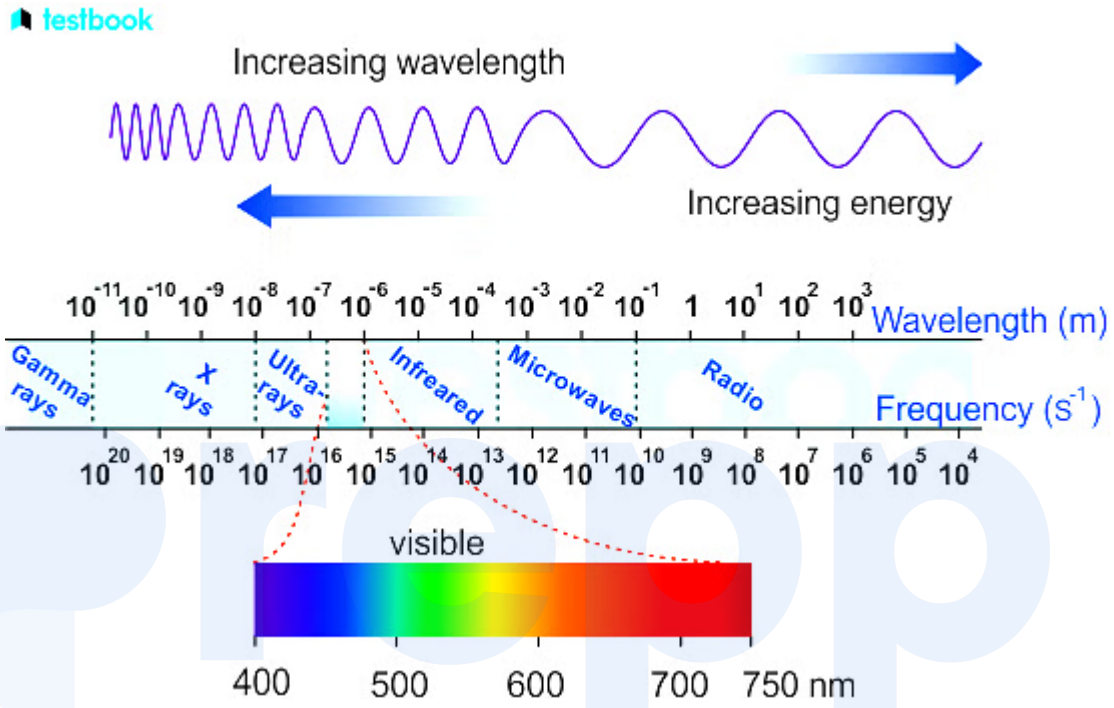
Quantum nature of light

- According to the quantum theory of light, "light is propagated in the bundles of small energy, each bundle is called photon which possesses energy".

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- $E = h\nu = \frac{hc}{\lambda}$
- where ν is frequency, λ is the wavelength of the wave, h is Planck's constant, and c is the speed of light

Frequency and wavelength of radiation or wave (diagram 1)



<u>Explanation:</u>

- A photon of X-ray has an energy of 1 keV. A photon of visible radiation has an energy of 3 eV. So, both photons have different energies. So **option 2 is correct**
- **The speeds of both the photons in a vacuum are the same and are equal to the speed of light.** So, **option 3 is in not correct.**

From diagram 1

- The frequency of X-ray photons is higher than the frequency of visible radiation photons. So, **option 4 is correct**
- The wavelength of an X-ray photon is less than the wavelength of a visible radiation photon. So, **option 1 is correct**

---

18. Answer: c

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Explanation:

Concept:

- **A solar cell is a P-N junction device that converts solar energy into electrical energy.**
- **Solar Cell works on the principle of the photovoltaic effect** . The photovoltaic effect is the process of generation of EMF due to the absorption of ionizing radiation from sunlight.
- In solar cells, various types of semiconductor materials are used such as **GaAs, CdSe** , etc but the most common semiconductor material used is silicon.
- About 90% of solar cells are composed of silicon.
- When two pieces of semiconductor material (silicon) containing N-type and P-type impurities are connected by some means then a P-N junction is created.
- The light energy is converted into electrical energy from the solar cells.

⭐ Additional Information

- The **lighting emitting diode** is a p-n junction diode. It is a specially doped diode made up of a special type of semiconductor. When the light emits in the forward biased, then it is called a light-emitting diode.
- A **laser diode** is a semiconductor that uses a p-n junction for producing coherent radiation with the same frequency and phase which is either in the visible or infrared spectrum.
- A **transistor** is a semiconductor device that allows a weak signal to be transferred from a low-resistance circuit to a high-resistance circuit.

---

19. **Answer: d**

Explanation:

Concept and Explanation:

- **Radio Wave Propagation** deals with the behavior of radio waves when the waves travel from one end to another.

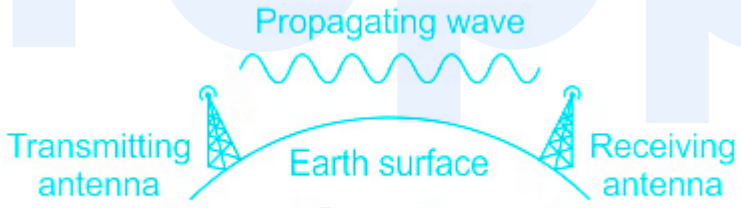
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- In order for electromagnetic (radio) waves to travel, a transmitting antenna and a receiving antenna is required.
- The path or mode in which the radio waves follow or can travel is termed radio wave propagation.
- There are three (3) modes of radio wave propagation as follows.

1. **Ground wave or surface wave propagation**
2. **Space wave and line of sight (LOS) propagation**
3. **Skywave propagation**

Ground wave propagation

- It is a mode of propagation in which the electromagnetic wave follows the curvature or contour of the earth.
- The antennas used for propagation are placed vertically (i.e. the electric (E) component orientation is vertical) and the frequency used for transmission are low frequency or medium frequency (< 2Mhz), Transmission distance: 100 to 1000 km



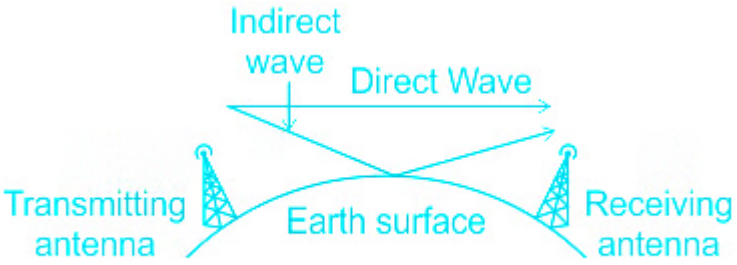
Ground Wave Propagation

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Space Wave Propagation:

- It is also called direct wave propagation and offers line-of-sight communication.
- Here the signal from the transmitting antenna propagates in a straight line toward the receiving antenna.
- It neither follows the earth's curvature nor undergoes refraction by the ionospheric layer of the atmosphere rather propagates horizontally from one end to another
- The waves travel in a straight or direct path and the frequency used for such propagation is greater than 30Mhz.

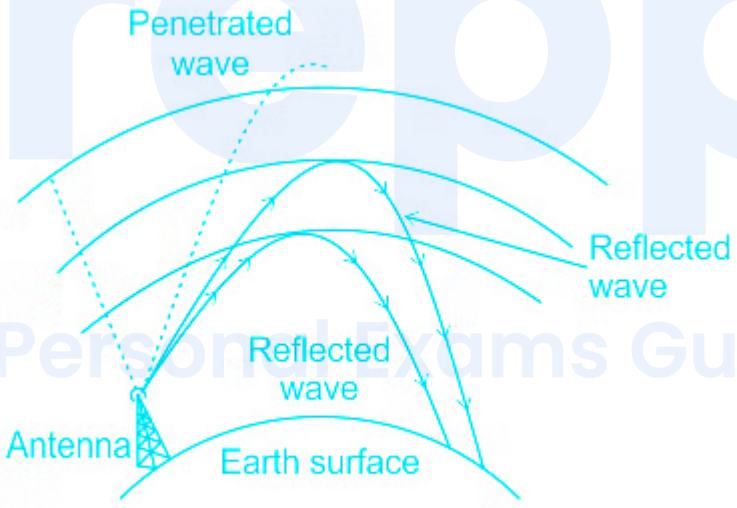
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Sky Wave Propagation

Sky Wave Propagation:

- This type of wave propagation makes use of the upper atmospheric layer i.e., the ionosphere to transmit the radio waves
- Frequency range: 3MHz to 30 MHz.
- The electromagnetic waves transmitted from one end of the earth's surface reach the other end when TIR takes place at the ionospheric layer of the atmosphere.



Sky Wave Propagation

---

20. **Answer: b**

Explanation:

Explanation:

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- Artificial satellites are human-built objects orbiting the Earth and other planets in the Solar System.
- Aryabhatta was India's first satellite launched on 19 April 1975,
- **Radio waves are used for communication in artificial satellites.**

Applications of Artificial Satellites

- Telecommunication: The satellites are used for telecommunication purposes through telephone, television, mobile phones, internet services, etc.
- Monitoring: This is used to secure important information about geological and meteorological areas even agriculture monitoring
- It also helps in identifying the exact location of an airplane, a ship, a person, and an object.

⭐ Additional Information

- Infrared waves are used by remote control, thermal imaging cameras
- Ultraviolet wave is used to disinfect surfaces
- Amplitude Modulation is used to carry commercial signals

---

21. Answer: b

Explanation:

Concept:

- A semiconductor is a material product usually comprised of silicon or germanium, which conducts electricity more than an insulator, but less than a pure conductor.
- In semiconductors, the conduction band and the valence band are separated by a relatively small energy gap.
- For germanium, this gap is 0.67eV
- For silicon, this gap is 1.1 eV.
- Arsenic has five valence electrons. Thus, it is known as a pentavalent element.
- There are two types of semiconductors

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1. **P-type of semiconductor** - p -type is formed by doping of trivalent impurity atoms. p-type semiconductor the majority charge carrier is a hole.
2. **N-type of semiconductor** - n-type is formed by doping of pentavalent impurity atoms. **n-type semiconductor the majority charge carrier is the electron.**

Explanation:

- The outermost shell of arsenic has five electrons and silicon has four electrons.
- When silicon is doped with arsenic, then the four electrons of arsenic bond with four electrons of silicon.
- The bond they form is a covalent bond.
- One electron is still free which is responsible for the conduction.
- The energy of this extra electron is much higher than the valence electrons locked in a covalent bond.
- Such impurities, which donate electrons for conduction, are called donor impurities.
- As the number of negative charge carriers is much larger than the number of positive charge carriers, thus these semiconductors are called **n-type semiconductor.**

---

22. **Answer: a**

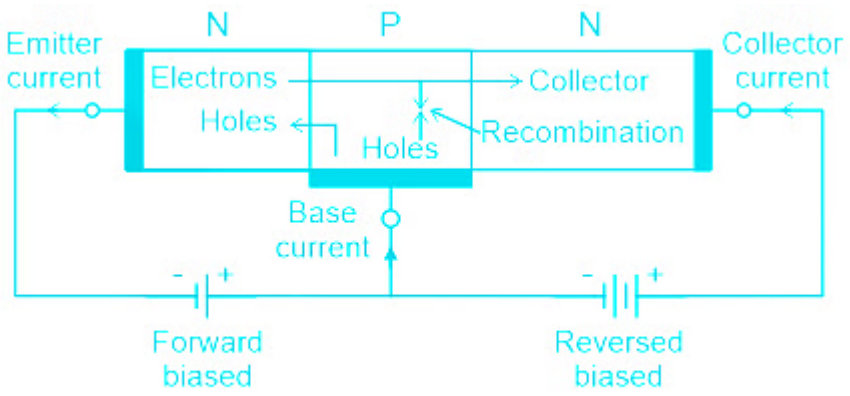
Explanation:

Concept:

Transistor

- A transistor is a type of semiconductor device that can be used to both conduct and insulate electric current or voltage.
- A transistor basically acts as a switch and an amplifier.
- In simple words, we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals.
- Parts of transistor: Emitter, collector and base

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Working of Transistor

- In a transistor, the Doping level is emitter>base>collector .
- To activate a transistor, biasing is essential.
- Transistor Biasing is**the process of setting a transistor's DC operating voltage or current conditions to the correct level so that any AC input signal can be amplified correctly by the transistor.**
- **The channel width in a junction field effect transistor is controlled by the By two back-biased p-n junctions.**

⭐ **Additional Information**

P-N junction diode:

- A P-N junction is an interface or a boundary between two semiconductor material types, namely the p-type and the n-type, inside a semiconductor.
- A P-N junction diode is a two-terminal semiconductor device that is used for allowing electric current in one direction.



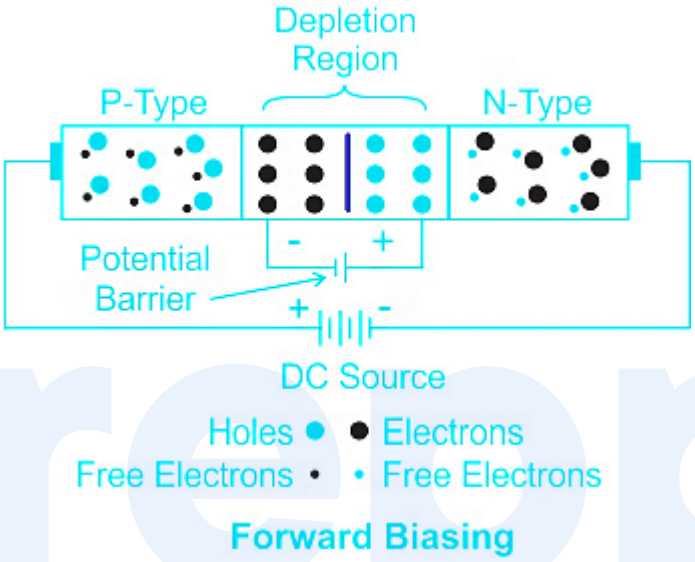
There are two operating regions in the P-N junction diode:

1. P-type
2. N-type

There are three biasing conditions for the P-N junction diode, and this is based on the voltage applied :

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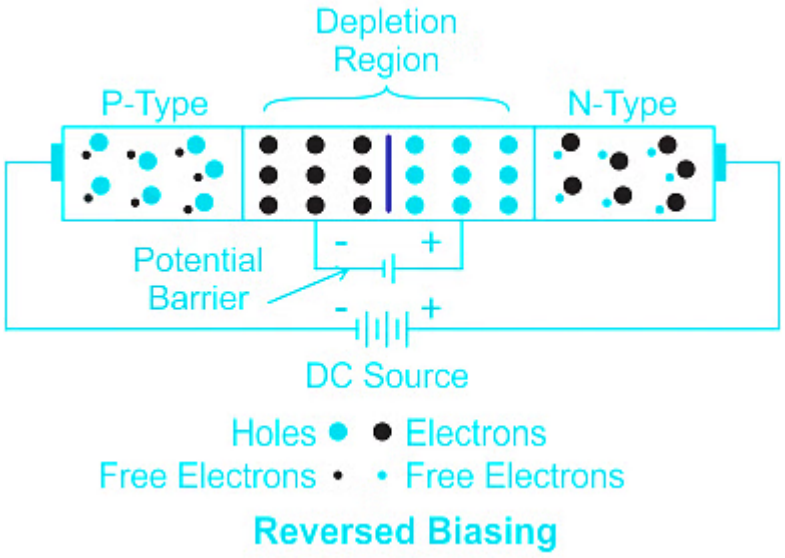
- Zero bias: No external voltage is applied to the P-N junction diode.
- Forward bias:
    - The positive terminal of the voltage potential is connected to the p-type while the negative terminal is connected to the n-type.
    - During forward bias, the width of the depletion region decreases, and the barrier height is reduced.



Reverse bias:

- The negative terminal of the voltage potential is connected to the p-type and the positive is connected to the n-type.
- During reverse bias, the width of the depletion region increases, and the barrier height increases.

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23. **Answer: b**

Explanation:

Concept:

- A **junction transistor** is formed by sandwiching a thin layer of a p-type semiconductor between two layers of n-type semiconductors or by sandwiching a thin layer of an n-type semiconductor between two layers of p-type semiconductors
- The **Bipolar junction transistor** is a solid-state device and, in these transistors, the current flow in two terminals are emitter and collector, and the flow of current is controlled by the third terminal is the base terminal.
- In NPN, it includes two N-regions separated by one P-region
- In PNP, it includes two P-regions and separates with one N-region

Explanation:

- For an NPN bipolar transistor, the base is a p-type semiconductor and the emitter, and collector are n-type semiconductors
- The flow of current controlled by the third terminal is the base terminal
- P-type semiconductor the majority charge carrier is a hole
- So, the mainstream of current in the base region is the **diffusion of holes** .

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24. Answer: c

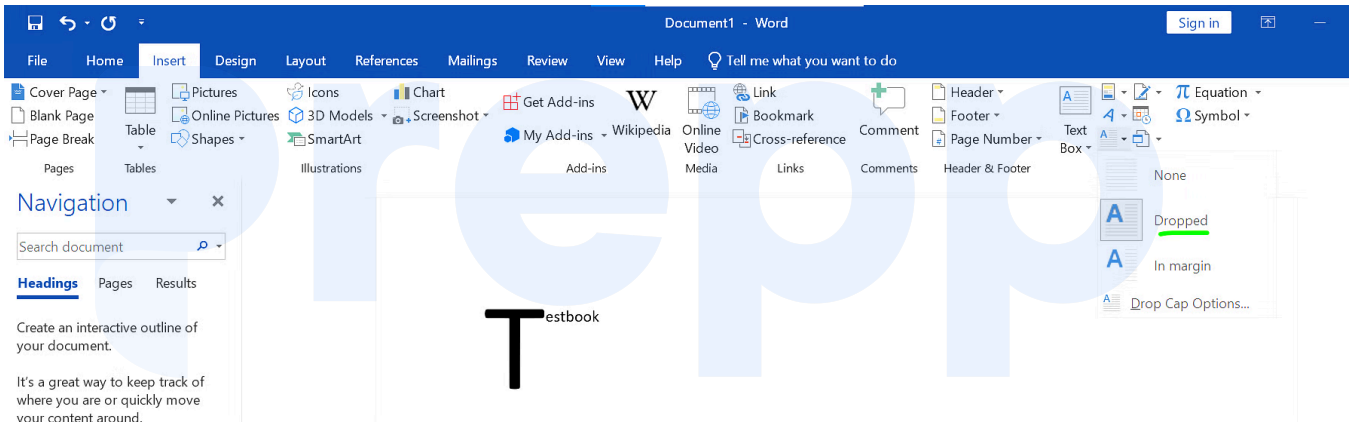
Explanation:

The correct option is (3)

Drop cap

Concept:-

In MS Word Drop cap provides the option of increasing the size of a first letter of a text.



Three choices are available when one of the two is chosen:

- Choose a typeface to use for the drop cap. This selection won't alter the font used in the paragraph.
- Determines the dimensions of the drop cap. The drop cap character gets more significant the more lines you drop.
- Positions the drop cap with relation to the text of the paragraph.

⭐ **Key Points**

- Drop caps are a unique feature offered by MS Word. A drop cap is a huge capital letter with the width of two or more lines of conventional text that appears at the start of a text block or a paragraph.
- Footnotes are notes listed at the page's bottom and numbered in your text.

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- Every footnote has a matching footnote indication, which is placed in the superscript text as a number, lowercase letter, asterisk, or other sign.
- You can align text to the left, right, center, or to a decimal character using tab stops. Additionally, you can automatically add special characters like dashes, dots, or lines before a tab. For each text box in a publication, you can establish a new tab stop.

---

25. Answer: d

Explanation:

Concept and Explanation:

- Modulation is a technique used for the encoding of information from a message source in a way that is suitable for transmission.
- The process by which data/information is converted into electrical/digital signals for transferring that signal over a medium is called modulation.
- The process of extracting information/data from the transmitted signal is called demodulation
- A Modem is a device that performs both modulation and demodulation processes.
- Modulation is divided into two types.
    1. Analog Modulation - Analog modulation deals with an analog signal.
    2. Digital modulation - Digital modulation is the process of encoding a digital information signal into the amplitude, phase, or frequency of the transmitted signal.
- Analog modulation is further divided into three types.
    1. Amplitude modulation - Amplitude modulation is a type of analog modulation in which the amplitude of the high-frequency carrier signal is changing with respect to the instantaneous amplitude of the modulating signal.
    2. Frequency modulation - the frequency of the carrier signal varies with respect to the instantaneous amplitude of the modulating (message) signal.

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3. Phase modulation - The process in which the phase of the carrier signal varies with the instantaneous amplitude of the modulating (message) signal is called phase modulation,

- Pulse modulation is a type of modulation in which the signal is transmitted in the form of pulses.

---

26. Answer: a

Explanation:

The correct option is (1)

UNIX

Concept:-

Operating systems include Microsoft Windows, Apple's macOS, Ubuntu, Linux, **Unix** , and others. An operating system, which runs on every computer, is essentially a critical piece of low-level system software.

⭐ Key Points

- **An operating system** is a type of system software that controls the use of computer hardware and software resources and offers general program functions.
- **UNIX** was frequently used for Internet servers, workstations, and mainframe computers in the late 20th century.
- Simpleness, portability (ability to run on a variety of platforms), multitasking and multiuser capabilities, a sizable software library, and a hierarchical file system were among **UNIX's** key strengths.

⭐ Additional Information

JAVA:- Sun Microsystems first launched Java, a well-known high-level, class-based object-oriented programming language, in 1995.

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ORACLE: - The software and services provided by Oracle, a company in the computer industry, include Java.

MS Office:- Applications like Word, Excel, PowerPoint, Access, OneNote, Outlook, and Publisher make up the majority of it. With a selection of specifically designed apps, Microsoft Office was largely developed to automate the manual office job.

---

27. Answer: d

Explanation:

The correct option is (4)

Penta number system

Concept:-

There are four number systems in reference to computers:

- Binary number system(base-2)
- Decimal number system (base-10)
- Octal number system (base-8)
- Hexadecimal number system (base-16)

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⭐ **Key Points**

- Only the "on" and "off" states of a switch may be understood by a computer. The numbers 1 and 0 stand for these two states. Binary numerals are created by fusing the integers 1 and 0. These figures depict a variety of statistics.
- The base-10 number system, arguably the most widely used number system, is referred to as decimal. Ten single-digit digits make up the decimal number system: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.
- The base value of the hexadecimal number system, a sort of number system, is 16. Additionally, it can occasionally be spoken as "hex." There are only 16 symbols used to represent hexadecimal integers. A, B, C, D, E, and F are the following values or symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

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- An octal number system is one that has the number "eight" as its fundamental unit. It uses digits 0 through 7.

---

28. Answer: a

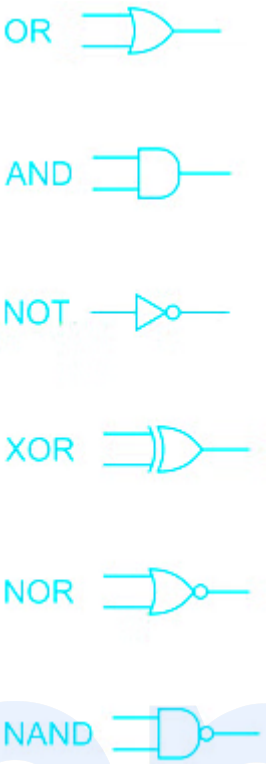
Explanation:

<u>Explanation:</u>

- A logic gate is an electronic circuit that evaluates a particular logical function.
- The circuit has one or more input terminals and an output terminal.
- A **universal gate** is a logic gate that can implement any Boolean function without the need to use any other type of logic gate.
- **The NOR gate and NAND gate are universal gates** .
- The function X = NOT (A AND B) of two logical variables A and B is called the NAND function
  - It is written as $X = \overline{A.B}$
- The function X = NOT (A OR B) of two logical variables A and B is called the NOR function
  - It is written as $X = \overline{A + B}$
- Where A and B are the input, and X is the output.

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29. **Answer: c**

Explanation:

Concept:

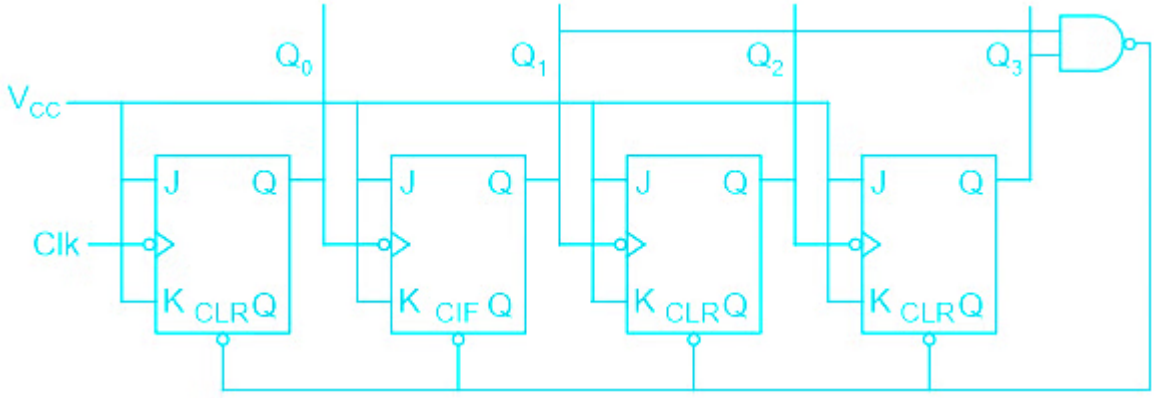
Counter device:

- In digital logic and computing, a counter is **a device which stores (and sometimes displays) the number of times a particular event or process has occurred, often in relationship to a clock**.
- The most common type is a sequential digital logic circuit with an input line called the clock and multiple output lines.
- **Counters are of two types:** Asynchronous or ripple counters and Synchronous counters.

Construction of Counter:

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- A counter circuit is usually constructed of **several flip-flops connected in a cascade**.



- Counters are a very widely used component in digital circuits, and are manufactured as separate integrated circuits and also incorporated as parts of larger integrated circuits.

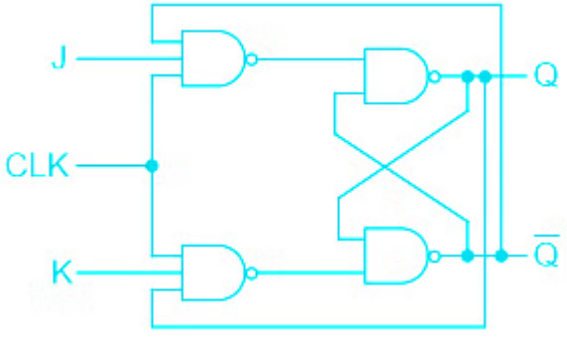
Explanation:

A counter circuit is usually constructed of several flip-flops connected in a cascade .

⭐ **Additional Information**

Flip-flops

- It is **a device which stores a single bit (binary digit) of data**; one of its two states represents a "one" and the other represents a "zero".
- Such data storage can be used for storage of state, and such a circuit is described as sequential logic in electronics.



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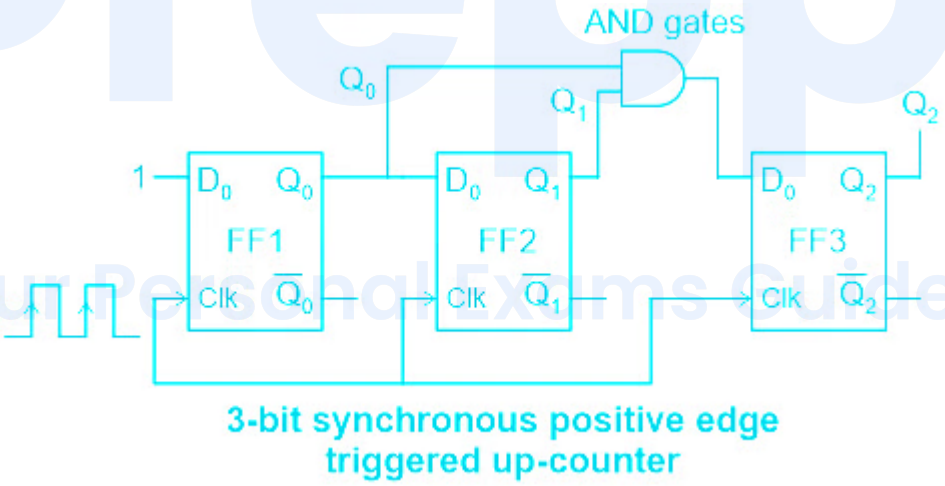
30. **Answer: b**

Explanation:

Concept:

Counter device:

- In digital logic and computing, a counter is **a device which stores (and sometimes displays) the number of times a particular event or process has occurred, often in relationship to a clock**.
- The most common type is a sequential digital logic circuit with an input line called the clock and multiple output lines.
- **Counters are of two types:**
  1. **Asynchronous or ripple counters**
  2. **Synchronous counters**



3-bit synchronous positive edge triggered up-counter

Explanation:

In digital logic and computing, a counter is a device which stores (and sometimes displays) the number of times a particular event or process has occurred.

---

31. **Answer: c**

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Explanation:

Explanation:

- **Modulation** is a technique used for the encoding of information from a message source in a way that is suitable for transmission.
- The process by which data/information is converted into electrical/digital signals for transferring that signal over a medium is called modulation.
- The process of super-imposing information onto a carrier wave is called modulation

⭐ Additional Information

- The process of extracting information/data from the transmitted signal is called **demodulation**
- A Modem is a device that performs both modulation and demodulation processes.
- **Communication** is the exchanging of information by speaking, writing, or using some other medium
- **Transmission** is actually the process of sending and propagating analog or signals of digital information.

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32. **Answer: d**

Explanation:

Explanation:

- **Modulation** is a technique used for the encoding of information from a message source in a way that is suitable for transmission.
- The process by which data/information is converted into electrical/digital signals for transferring that signal over a medium is called modulation.
- **The process of superimposing modulated wave (low frequency) onto a carrier wave (high frequency) to travel long distances is called modulation**
- The reasons why modulation is required in communication systems

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- To increase the signal strength - **Its strength needs to be increased to travel long distances.**
- Signals within the frequency of 20 Hz to 20 kHz frequency cannot travel large distances.
- Modulation is required to increase the message signal's frequency and enhance its strength so that it properly reaches the receiver.
- Modulation **prevents the interference of message signals from other signals** . By using a carrier signal of high frequency,
- **To transmit electrical signals over an antenna through free space.**

---

33. Answer: c

Explanation:

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Explanation:

- Modulation is a technique used for the encoding of information from a message source in a way that is suitable for transmission.
- The process by which data/information is converted into electrical/digital signals for transferring that signal over a medium is called modulation.
- The process of extracting information/data from the transmitted signal is called demodulation
- **A Modem is a device that performs both modulation and demodulation processes.**

⭐ Additional Information

- A multiplexer (MUX) is a combinational logic circuit designed to switch one of several inputs to a single common output line.
- A serial port is an interface that allows a PC to transmit or receive data one bit at a time.

---

34. Answer: b

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Explanation:

Concept:

- Modulation is a technique used for the encoding of information from a message source in a way that is suitable for transmission.
- The process by which data/information is converted into electrical/digital signals for transferring that signal over a medium is called modulation.
- The process of super-imposing information onto a carrier wave is called modulation
- Modulation percentage = $\frac{V_m}{V_c} \times 100$ --- (1)
- Where, V_m= modulation signal, V_c= carrier signal

Calculation:

Given, modulation signal V_m= 8 V, carrier signal V_c= 12 V

From equation 1

Modulation percentage = $\frac{8}{12} \times 100$ = 66.67 ≈ **67%**

---

35. **Answer: c**

Explanation:

The correct option is (3)

Bullets and Numbering

Concept:-

The MS Word numbering and bullet features to add to the creation of lists in documents.

⭐ Key Points

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- To organize, arrange, and emphasize text, Word users can create and operate with lists.
- You can select to create numbered or bulleted lists, display the bullets as symbols, or use a variety of numbering schemes.
- As you type or after you've completed typing, you can construct a list. When you click the Numbering or Bullets button on the Formatting toolbar, a new number or bullet will instantly appear, allowing you to create a list as you type.

⭐ Additional Information

Scaling:- Scaling is the process of changing or adjusting an object's size in computer graphics. You can use scaling to make an object bigger or smaller.

Word wrap:- a word processing function that automatically moves a word from the end of one line of text to the start of the next when there isn't enough room for it.

Word Art:- You can add text styles from the WordArt library to your publications to add ornamental elements like shaded or mirrored (reflected) text. To add unique text effects to your document, use WordArt.

---

36. **Answer: d**

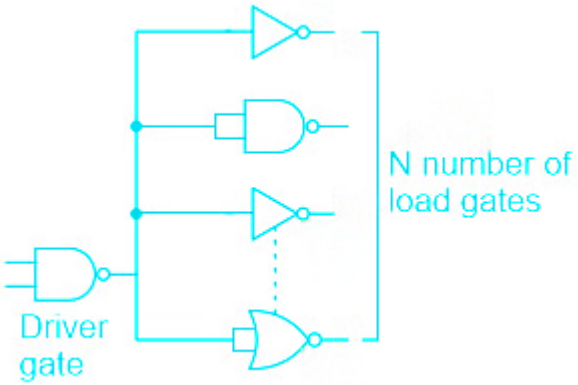
Explanation:

Concept:

Fan-out:

- In digital circuitry, fan-out is a measure of the maximum number of digital inputs that the output of a single logic gate can feed without disrupting the circuitry's operations.
- Most transistor-to-transistor logic (TTL) gates can support up to 10 other digital gates or devices.
- **Thus, a typical TTL gate has a fan-out of 10.**

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- In contrast, complementary metal oxide semiconductor (CMOS) gates can support over 50 connected devices, giving them a fan-out rate of greater than 50.
- Hence, CMOS has maximum fan-out.
- Standard TTL has a minimum value of fan-out.

⭐ **Additional Information**

Typical characteristics of IC logic families

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IC logic family	Fan-out	Power dissipation (mW)	Propagation delay (ns)	Noise margin (V)
Standard TTL	10	10	10	0.4
Schotiky TTL	10	22	3	0.4
Low-power schottky TTL	20	2	10	0.4
ECL	25	25	2	0.2
CMOS	50	0.1	25	3

37. **Answer: c**

Explanation:

Concept:

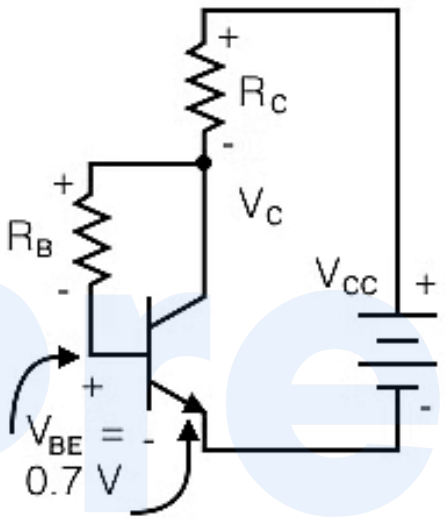
Transistor biasing:

- To active an transistor, biasing is essential.
- Transistor Biasing is**the process of setting a transistors DC operating voltage or current conditions to the correct level so that any AC input signal can be amplified correctly by the transistor.**
- The channel width in a junction field effect transistor be controlled by the By two back-biased p-n junctions.

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Type of transistor biasing:

- Collector feedback bias
  - If the emitter current were to increase, the voltage drop across RC increases, decreasing VC, decreasing IB fed back to the base.
  - This, in turn, decreases the emitter current, correcting the original increase.



$$I_C = \beta I_B \qquad I_C \approx I_E \qquad I_E \approx \beta I_B$$

$$V_{CC} - I_C R_C - I_B R_B - V_{BE} = 0$$

$$V_{CC} - I_E R_C - (I_E/\beta) R_B - V_{BE} = 0$$

$$V_{CC} - V_{BE} = I_E R_C + (I_E/\beta) R_B$$

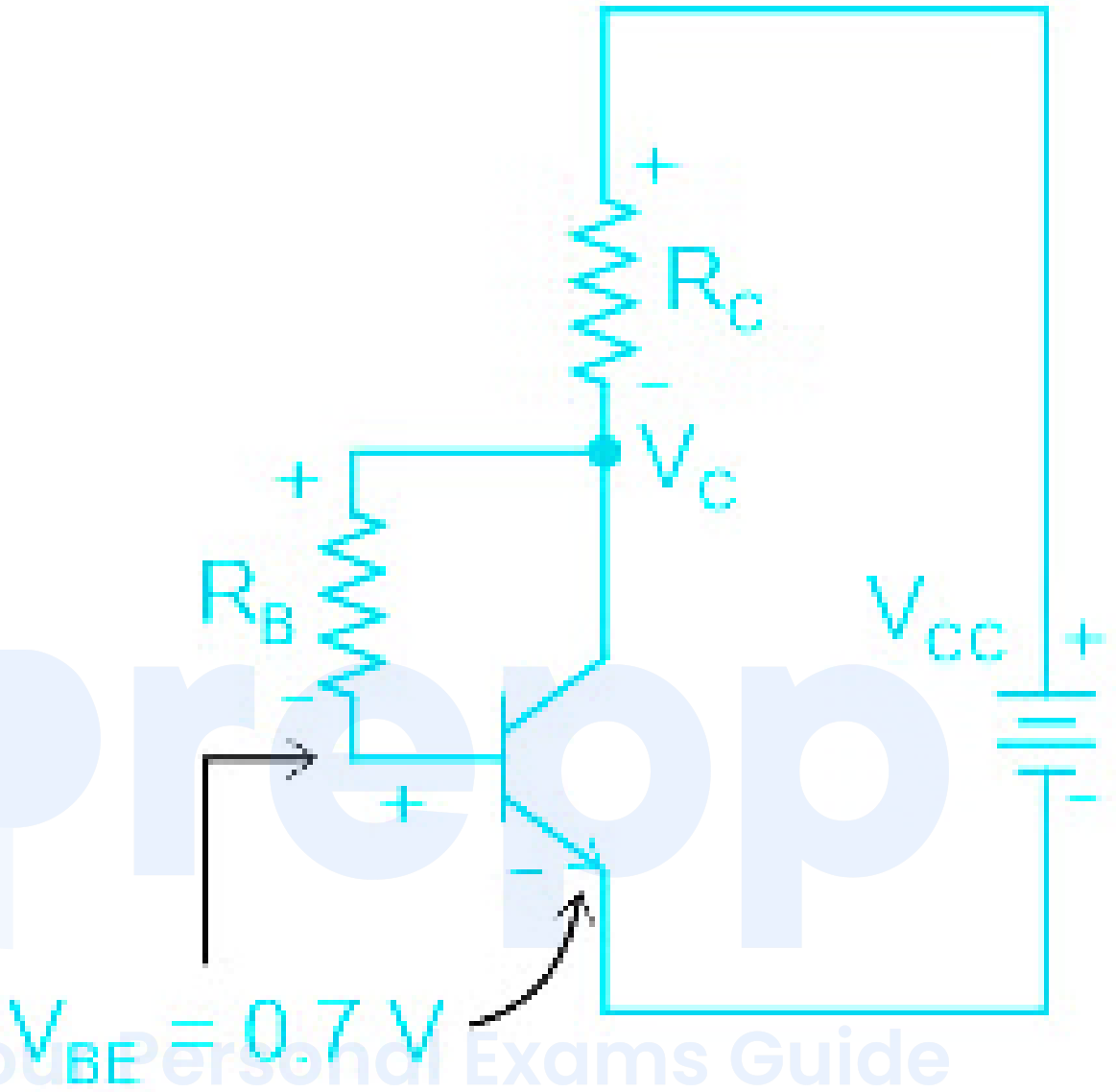
$$V_{CC} - V_{BE} = I_E((R_B/\beta) + R_C)$$

$$I_E = \frac{V_{CC} - V_{BE}}{R_B/\beta + R_C}$$

$$R_B = \beta\left[\frac{V_{CC} - V_{BE}}{I_E} - R_C\right]$$

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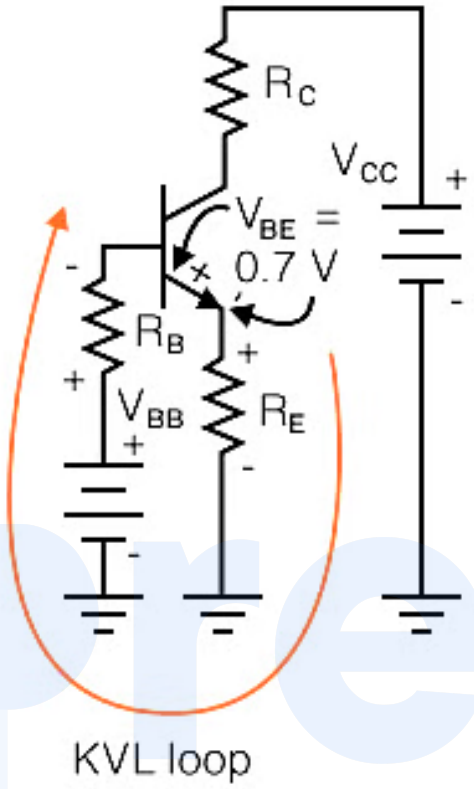
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- **Emitter biased:**
  - Inserting a resistor RE in the emitter circuit as in figure below causes **degeneration al so known as negative feedback.**
  - This opposes a change in emitter current IE due to temperature changes, resistor tolerances, beta variation, or power supply tolerance.

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$$V_{BB} - I_B R_B - V_{BE} - I_E R_E = 0$$

$$I_E = (\beta + 1) I_B \approx \beta I_B$$

$$V_{BB} - (I_E/\beta) R_B - V_{BE} - I_E R_E = 0$$

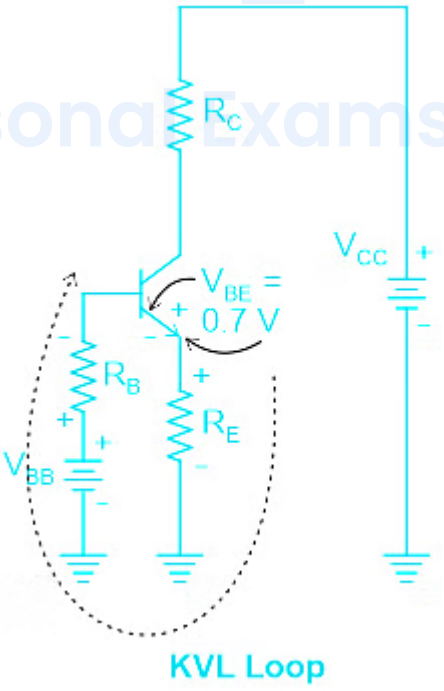
$$V_{BB} - V_{BE} = I_E((R_B/\beta) + R_E)$$

$$I_E = \frac{V_{BB} - V_{BE}}{R_B/\beta + R_E}$$

$$R_B/\beta + R_E = \frac{V_{BB} - V_{BE}}{I_E}$$

$$R_B = \beta \left[\frac{V_{BB} - V_{BE}}{I_E} - R_E \right]$$

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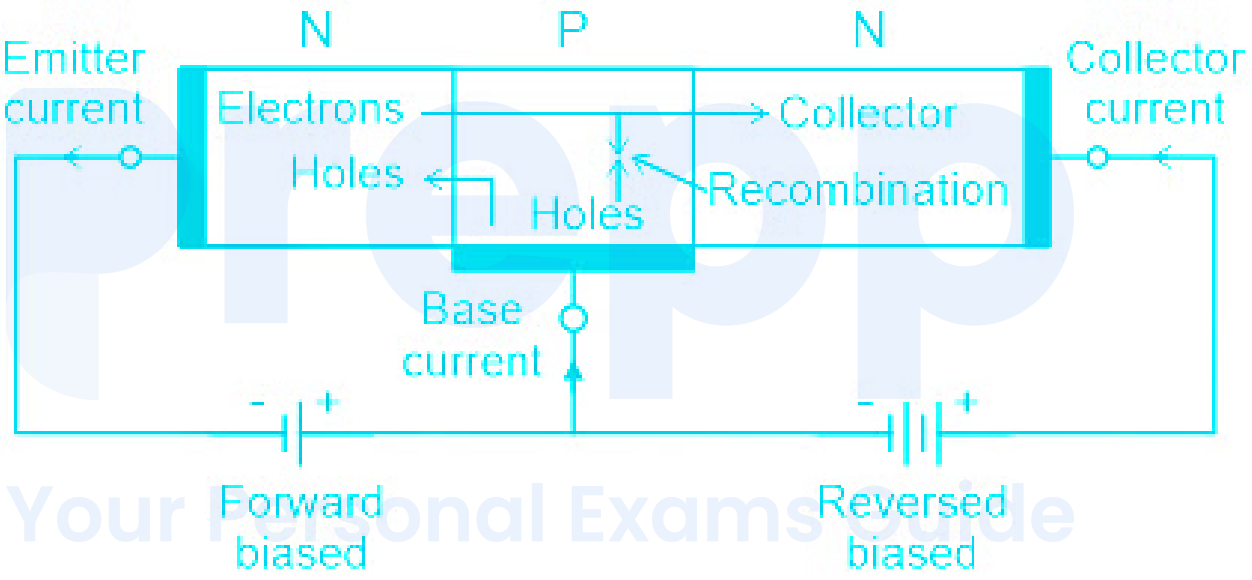
Explanation:

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Which type of transistor baising is shown in the given figure is collector feedback bias.

⭐ Additional Information

Transistor

- A transistor is a type of a semiconductor device that can be used to both conduct and insulate electric current or voltage.
- A transistor basically acts as a switch and an amplifier.
- In simple words, we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals.
- Parts of transistor: Emitter, collector and base
- 

Working of Transistor
- In transistor, Doping level is emitter>base>collector .

---

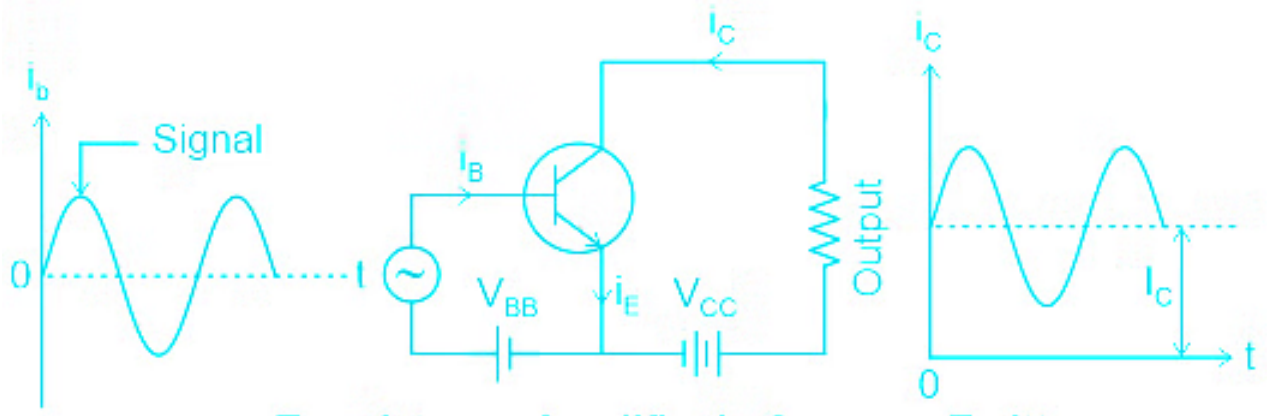
38. **Answer: b**

Explanation:

Concept:

Transistor Amplifier:

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- A transistor acts as an amplifier by **raising the strength of a weak signal.**
- The DC bias voltage applied to the emitter-base junction, makes it remain in **forward biased condition.**
- This forward bias is maintained regardless of the polarity of the signal.
- 

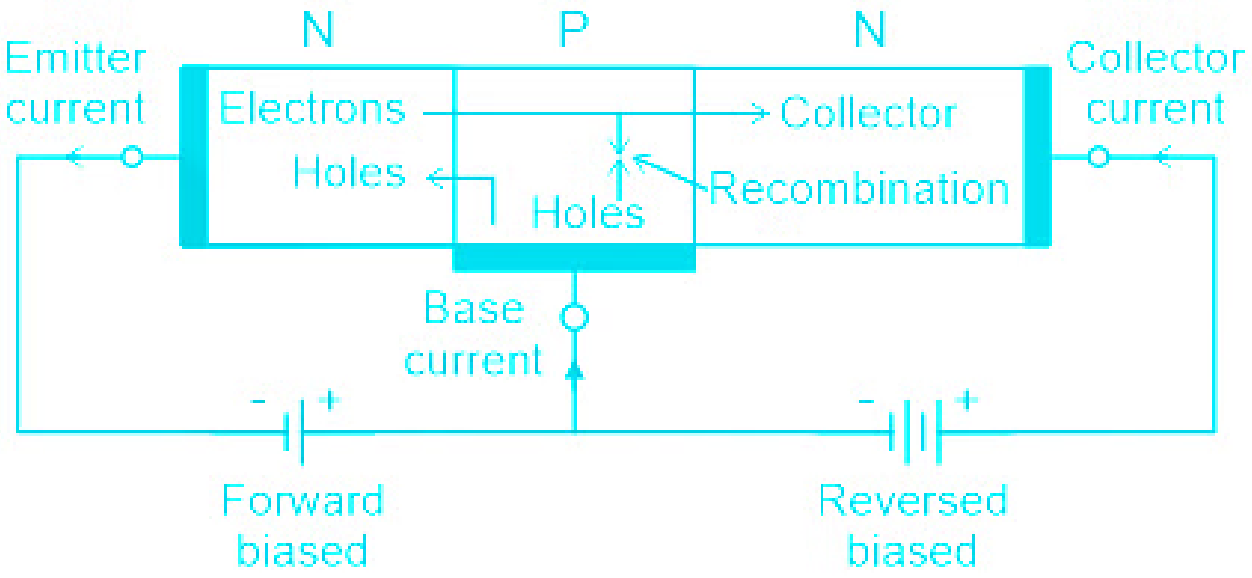
Transistor as Amplifier in Common Emitter
- The low resistance in the input circuit, lets any small change in the input signal result in an appreciable change in the output. The emitter current caused by the input signal contributes to the collector current, which then flows through the load resistor R L , resulting in a large voltage drop across it.
- Thus a small input voltage results in a large output voltage, which shows that the transistor works as an amplifier.
- **A transistor amplifier has high output impedance because the collector has reversed biased.**

⭐ Additional Information

Transistor

- A transistor is a type of semiconductor device that can be used to both conduct and insulate electric current or voltage.
- A transistor basically acts as a switch and an amplifier.
- In simple words, we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals.
- Parts of transistor: Emitter, collector, and base

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- 

Working of Transistor
- In transistor, Doping level is **emitter>base>collector**.

---

39. **Answer: c**

Explanation:

The correct option is (3)

Understanding

<u>Concept:-</u>

A computer can do input, processing, and control, but because it lacks a brain, it cannot perform understanding.

⭐ <u>Key Points</u>

- It receives information or data from one end, stores it for processing, and then outputs the outcome from the processing on the other end.
- Computer input refers to the data it receives at one end, and computer output refers to the output it produces after processing the data.
- Any goal-oriented activity requiring, utilizing, or producing computing hardware is referred to as computing.

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- data processing, often known as computer data manipulation.
- Data processing can be described as the use of computers to carry out specific operations on data.
- An output device enables the computer to convey data in a format that is understandable to humans, such as the sound played through a speaker.

---

40. Answer: d

Explanation:

The correct option is (4)

IBM-370

Concept:-

The first supercomputer in the world is IBM-370.

⭐ **Key Points**

- As the System/360's replacements, the IBM System/370 line of 32-bit mainframe computers maintains backward compatibility.
- All versions of the System/370 were third-generation computers since they made use of IBM's Monolithic System Technology (MST) monolithic integrated circuits.
- When compared to a general-purpose computer, a supercomputer performs at a high level. Instead of million instructions per second, a supercomputer's performance is measured in floating-point operations per second (FLOPS) (MIPS).

⭐ **Additional Information**

TIANHE-2:- The No. 1 supercomputer in the world, Tianhe-2, was created by China's National University of Defense Technology.

CRAY-1:- Cray Research developed, produced, and sold the Cray-1 supercomputer. The first Cray-1 system, announced in 1975, was set up at Los Alamos National

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Laboratory in 1976. The Cray-1 eventually sold over 100 units, making it one of the most profitable supercomputers ever.

PARAM:- The Param 8000 is the first supercomputer in India. It is a collection of gigaflop supercomputers created in 1991 by Vijay P. Bhakta, who is credited with being the "architect of India's push in supercomputing."

---

41. Answer: a

Explanation:

Concept: -

There are four quantum numbers that describe the possible positions of an electron in an atom.

- The principal quantum number determines the size and to large extent the energy of the orbital. Size of the orbital increases with an increase of the principal quantum number 'n'. In other words, the electron will be located away from the nucleus. Also, the energy of the orbital will increase with an increase of n.
- Azimuthal quantum number , 'l' is also known as orbital angular momentum or subsidiary quantum number . It defines the three-dimensional shape of the orbital. For a given value of n, l can have n values ranging from 0 to n – 1 , that is, for a given value of n, the possible value of l are: l = 0, 1, 2, ... (n - 1)
- Magnetic orbital quantum number ml gives information about the spatial orientation of the orbital with respect to the standard set of the coordinate axis. It can be any integer between -l and +l i.e. 2l + 1 values of m l are possible.
- The spin quantum number (s): An electron can spin either in the clockwise direction or in the anticlockwise direction, therefore, for any particular value of the magnetic quantum number, the spin quantum number can have two values, i.e., +1/2 and –1/2

Explanation: -

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Spin quantum number: The spin quantum number describes the angular momentum and direction of the spin of an electron in the orbital.

- Each orbital can will hold two electrons . The two electrons will have +1/2 and -1/2 spin.
- The electrons tend to fill the orbitals before they pair up.
- Hence, the first electron filled in the orbital will have a spin of +1/2. The electrons start pairing up once all the orbitals are half-filled by one electron each.
- The second electron to fill the orbital will have a spin of -1/2.

Conclusion: -

The possible values of the spin quantum number are two, i.e. +1/2 and -1/2.

The correct answer is 1.

---

42. **Answer: c**

Explanation:

Concept: -

Atomic number

- It plays a very important role in the placement of elements in the modern periodic table .
- It represents the number of protons and hence the number of electrons in an atom.
- The number of electrons in an atom governs its chemical behavior.
- The study of elements has revealed their applicability in different forms.
- The number of protons present in the nucleus of an atom is called the atomic number. It is generally represented by Z.
- It has been established that the charge of a proton is equal to but opposite to that of an electron.
- Since an atom is electrically neutral and neutrons carry no electrical charge, the number of electrons and protons in a neutral atom is the same.

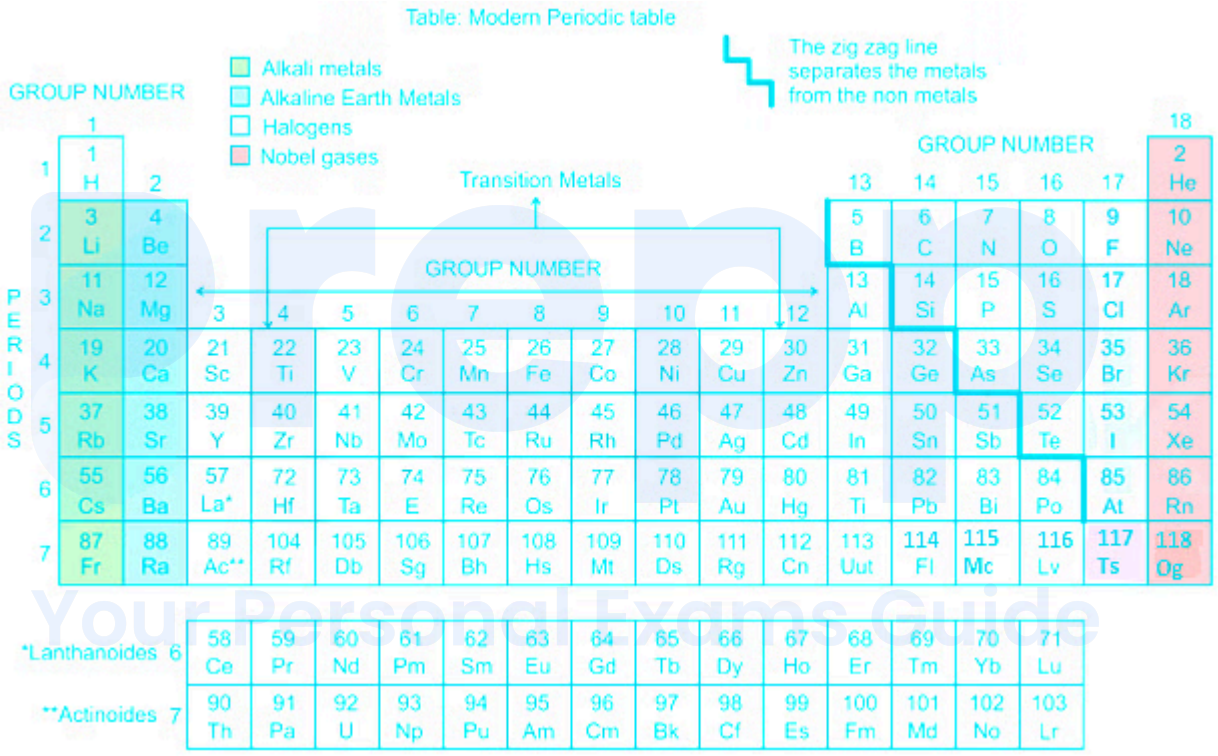
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- This implies that the atomic number is equal to the number of protons or the number of electrons in an atom.
- **As we know that elements tend to lose or gain electrons during many chemical reactions, and the number of protons is conventionally used to represent the atomic number of an element.**
- Hydrogen has an atomic number of one as it has only one proton in its atom.

Explanation: -

Let's Look at the periodic table: -



So, the atomic number of Aluminum, silicon, chlorine, and Magnesium is 13, 14, 17, and 12 respectively.

Conclusion: -

The Atomic Nuber of Phosphorous is 15. So, the atomic number of Cl will be more than Phosphorous.

Hence, the correct option is (3), Chlorine.

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43. **Answer: c**

Explanation:

Concept:-

- Rust is basically iron oxide.
- It is of reddish-brown color.
- During rusting of iron, the red-brown powder is formed.
- During rusting, iron and oxygen react in the presence of water or air moisture.
- Hydrous iron oxide and iron oxide hydroxide are present in the rust.
- Generally, refined iron goes through corrosion.
- **Rust is an iron oxide, usually red oxide formed by the redox reaction of iron and oxygen in the presence of water or air moisture. Rust consists of hydrated iron oxides Fe 2O .**
- An entire iron can be converted into rust with time.
- **During rusting in iron, Red-brown powder is coated on the iron.**

Explanation: -

The chemical reaction is :

There is an anodic dissolution or oxidation of iron going into aqueous (water) solution:

$2Fe \rightarrow 2Fe^{2+} + 4e^-$

Cathodic reduction of oxygen that is dissolved into the water also occurs:

$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

The iron ion and the hydroxide ion react to form iron hydroxide:

$2Fe^{2+} + 4OH^- \rightarrow 2Fe(OH)_2$

The iron oxide reacts with oxygen to yield red rust , **$Fe_2O_3.H_2O$.**

Conclusion: -

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As the Iron oxidation state is changing from 0 to +3 hence, it is an oxidation reaction.

So, the correct option is (3).

⭐ Additional Information

- Many other metals are corroded but rusting of these metals is not called rust.
- The most familiar form of rust is the reddish coating that forms flakes on iron and steel (Fe 2O 3), but rust also comes in other colors, including yellow, brown, orange, and green. The different colors reflect various chemical compositions of rust.
- Galvanization is used to prevent the rusting of iron.
- In galvanization:-
  - a layer of zinc is coated on iron.
- Special weathering steel alloys can be used, in which rusting takes place slowly.

---

44. Answer: a

Explanation:

Concept:

- Rust is an iron oxide, a typically reddish-brown oxide generated when **iron** and **oxygen** react catalytically in the presence of water or air moisture.
- Rust is made up of hydrous iron(III) oxides and iron(III) oxide-hydroxide.
- Rust is created via a **redox interaction** between oxygen and iron in a water-rich environment, such as high-moisture air.
- There are a number of methods to prevent rusting -
  1. **Electroplating**
  2. **Galvanization**
  3. **Coating with paint and grease**
  4. **Lubrication**

Explanation:

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- Iron when exposed to moist air for a long time acquires a coating of a brown flaky substance called **rust** .
- The **rusting of iron can be prevented by** painting, oiling, greasing, **galvanizing** , chrome plating, anodizing or making alloys.
- **Galvanization is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc.**
- The galvanized article is protected against rusting even if the zinc coating is broken.

∴ In galvanization, iron is coated with zinc.

---

45. Answer: b

Explanation:

Concept: -

Mixtures are of two types: -

Homogenous Mixtures: -

- Those mixtures in which the substances are completely mixed together and are indistinguishable from one another are called homogeneous mixtures .
- A homogeneous mixture is a mixture in which the composition is uniform throughout the mixture .
- Many homogeneous mixtures are commonly referred to as solutions.
- Some examples of homogeneous mixtures (or solutions) are Sugar solution, Salt solution, Copper sulfate solution, Seawater, Alcohol and water mixture, Petrol and oil mixture, Soda water, etc.

Heterogeneous mixture:

- A heterogeneous mixture is a mixture with a non-uniform composition that contains components in different phases .
- The composition varies f rom one region to another with at least two phases that remain separate from each other, with clearly identifiable properties.

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- Heterogeneous mixtures contain particles that retain their chemical properties when they are mixed and can be distinguished after they are mixed.
- The components of heterogeneous mixtures can be separated by the filtration of chemical procedures .
- The two types of heterogeneous mixtures are suspensions and colloids .
- Sugar and sand form a heterogeneous mixture . If you look closely, you can identify tiny sugar crystals and particles of sand.
- Ice cubes in cola form a heterogeneous mixture.

Explanation: -

A Solution is having a uniform distribution of solutes in the solvent medium.

Thus, solutions are homogenous in concentration.

Hence, the correct option is (2).

---

46. **Answer: c**

Explanation:

Concept: -

Chemical change a change in which one or more new substances are formed is a chemical change.

- A chemical change occurs when the substance's composition is changed .
- When bonds are broken and new ones are formed a chemical change occurs.
- Examples of Chemical change are the bursting of a firecracker, the germination of seeds, and coal formation from buried trees.

Physical changes only change the appearance of a substance.

- Physical changes are limited to changes that result in a difference in the display without changing the composition.

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- The boiling of water is an example of Physical change .

Explanation: -

Ripening of fruit. burning of coal, and curling of curd all are non-reversible changes that involve a change in the chemical composition of a substance and hence are Chemical Changes.

Whereas, evaporated water can be recovered back by condensation, and water's chemical composition in both the liquid phase and vapor phase are the same.

Hence, evaporation is a physical change and not a chemical change.

So, the correct option is (3).

---

47. **Answer: a**

Explanation:

Explanation: -

Rectified spirit:

- Rectified spirit is the highly concentrated form of ethanol that contains 95% ethanol and 5% water by weight.
- Rectified spirit is highly concentrated ethanol that has been purified by means of repeated distillation in a process called rectification.
- Rectified spirit is a colourless, clear liquid with a pleasant alcoholic odour.

Denatured alcohol:

- Denatured alcohol is also known as methylated spirits .
- Denatured alcohol is used as a solvent as well as a fuel source for alcohol burners and camping stoves.

Absolute alcohol:

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- Absolute alcohol is defined as a liquid containing alcohol at least 99 percent pure alcohol by weight.
- Even a small amount of pure ethanol (also known as absolute alcohol) can be lethal.
- It is also used as a substitute fuel for gasoline in combustion engines.

Power alcohol:

- Power alcohol is made up of 80% petrol, 20% ethanol, and a small amount of benzene. It is used to generate electricity.

Diluted Alcohol: -

- The ethanol solution with other liquids mixed in it can be referred to as diluted alcohol regardless of concentration.

Thus, 95% ethanol is called Rectified spirit.

The correct answer is Rectified spirit, option 1.

---

48. Answer: a

Explanation:

Explanation: -

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Compound	Formula	**Suffix**	Use
Ketone	CnH_2nO	**-one**	• Ketone is acetone which is an excellent solvent for a number of plastics and synthetic fibers. • Chemical peeling and for acne treatments. • nail paint remover, • Production of textiles, varnishes, plastics, paint remover, paraffin wax, etc.
Carboxylic acid	R–COOH, with R referring to the alkyl group	**-oic acid**	• Used in the production of polymers, biopolymers, coatings, adhesives, and pharmaceutical drugs. • They also can be used as solvents, food additives, antimicrobials, and flavorings.
Aldehyde	A functional group with the structure -CHO	**-al**	• Used in tanning, preserving, and embalming and as a germicide, fungicide, and insecticide for plants and vegetables. • Production of certain polymeric materials like Bakelite.
Alcohol	C 2H 6O, or can be written as C 2H 5OH or CH 3CH 2OH	-ol	• Alcoholic Drinks. • Industrial methylated spirits. • Use of ethanol as a fuel. • Ethanol as a solvent. • Methanol as a fuel.

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			• Methanol as an industrial feedstock.

The compound with the -al suffix is Propanal.

Hence, **the correct option is (1).**

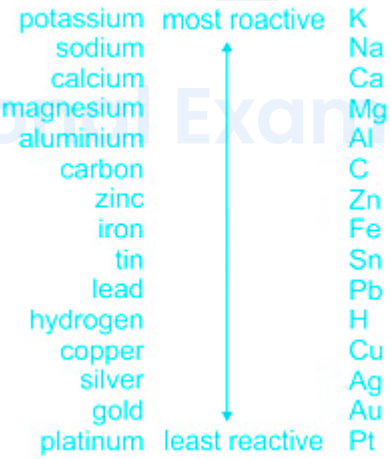
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49. Answer: c

Explanation:

Concept: -

- The electrochemical series defines the order of metals according to their reactivity .
- It moves downwards with decreasing rate of reactivity .
- Hence, the topmost metal shows the highest reactivity and the lowermost metal shows the least reactivity.
- The electrochemical series is also called the activity series



DISPLACEMENT REACTIONS -

- A displacement reaction is a type of reaction that occurs when an atom or a set of atoms in a molecule is replaced by another atom.
- The displacement of one by another is only possible when the one displacing is more reactive than the one being displaced.

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Explanation: -

Looking at the electrochemical series it is clear that, zinc is more reactive than Tin.

Zinc can react with the acids present in the food and will make it contaminated.

That's why Zinc is not used to manufacture food packaging cans

Hence, the correct option is (3).

---

50. Answer: c

Explanation:

Concept: -

Lead-storage battery:

The battery uses spongy lead and lead peroxide for the conversion of chemical energy into electrical power, such type of battery is called a lead-acid battery. The lead-acid battery is most commonly used in power stations and substations because it has higher cell voltage and lower cost. It is a reversible battery.

The active elements of lead-acid are

- Lead peroxide (PbO_2) : It forms the positive active material; The PbO_2 is dark chocolate brown in color
- Spongy lead : It forms the negative active material; It is grey in color.
- Dilute Sulfuric Acid (H_2SO_4) – It is used as an electrolyte; It contains 31% of sulfuric acid

Charging reaction:

$PbO_2 + H_2SO_4 + Pb \rightarrow PbSO_4 + 2H_2O + PbSO_4$ + Electrical energy

Discharging reaction:

$PbSO_4 + 2H_2O + PbSO_4$ + Electrical energy $\rightarrow PbO_2 + H_2SO_4 + Pb$

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Reaction at the negative plate:

$Pb + H_2SO_4 \rightarrow PbSO_4 + 2H^+ + 2e$

Reaction at the positive plate:

$PbO + H_2SO_4 + 3H^+ + 2e \rightarrow 2PbSO_4 + 2H_2O$

Hence the negative electrode in a lead-acid battery is Lead (Pb).

Explanation: -

So, The active elements of lead acid are

- Lead peroxide (PbO_2) : It forms the positive active material; The PbO_2 is dark chocolate brown in color
- Spongy lead : It forms the negative active material; It is grey in color.
- Dilute Sulfuric Acid (H_2SO_4) – It is used as an electrolyte; It contains 31% of sulfuric acid

Hence, the acid used in lead-storage batteries is the Sulphuric acid option, (3).

---

51. Answer: a

Explanation:

Explanation: -

Copper metal when exposed to air turns green in colour due to corrosion.

- When the copper vessel is exposed to air in the rainy season, the metal reacts with gases and moisture and atmospheric gases to form a mixture of copper carbonate and copper hydroxide.
- This gives a green colour to the surface of copper metal.

The reaction is:

$2Cu + H_2O + CO_2 + O_2 \rightarrow Cu(OH)_2 + CuCO_3$

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- Copper objects lose their shine and form a green coating of basic copper carbonate.
- The copper object will form a green layer on its surface when it is exposed to air for a long time.
- Copper corrodes by oxidation which reacts with oxygen in the air to form copper oxide.
- Copper oxide then combines with carbon dioxide to make copper carbonate , which gives it a green colour.
- Copper reacts with moist carbon dioxide in the air and slowly loses its shiny brown surface and gains a green coat.

On exposure to moist air, copper gains a green coat on its surface due to the formation of copper carbonate.

Hence, the correct option is (1).

⭐ Additional Information

- Silver articles become black after some time when exposed to air.
- Silver articles react with sulphur in the air to form a coating of silver sulphide .

---

52. **Answer: b**

Explanation:

Concept: -

- Ethylene is a natural plant hormone that helps in the ripening of fruits.
- It is considered the aging hormone of plants and can also cause a plant to die.
- Ethylene, unlike the rest of the plant hormones, is the only gaseous hormone.
- Ethylene is produced in all higher plants and is produced from methionine in essentially all tissues.

Explanation: -

Green fruits can be ripened by providing ethylene artificially.

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Usually, fruits are wrapped in paper with calcium carbide, and water is sprinkled over them.

In reaction with water, calcium carbide produces ethylene gas.

Hence, the correct option is (2).

---

53. Answer: d

Explanation:

Explanation: -

- Nettle stings or bee-sting have methanoic acid commonly called formic acid (HCOOH).
- The leaves and young stems of this herbaceous plant are fitted with stinging hairs tipped with formic acid and other irritants.
- If touched, these needle-like hairs inject the stinging acid into the skin, triggering a burning, tingling sensation and an itchy rash.

So, the bee sting contains methanoic acid that causes pain and irritation.

The correct an swer is **Methanoic Acid, option 4.**

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⭐ Additional Information

- Tartaric Acid:
  - It is a white crystalline organic acid found in many fruits including grapes, tamarind, apricots, avocados, and banana.
    It naturally develops in the process of winemaking.
    It is mostly used with baking soda as a flavoring agent to enhance foods.
- Ethanoic Acid:
  - Chemical formula:- CH 3COOH.
  - IUPAC name:- Ethanoic acid
  - Anhydrous Acetic acid is called Glacial Acetic acid.
  - Its crystals are obtained at a temperature slightly lower than 16.7°C.
- Citric acid :

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- The fruits containing citric acid are termed citrus fruits. eg: lemon, orange, grapefruit, etc.
- These are sour in taste and are a good source of Vitamin C , thus helping in preventing the disease caused by the deficiency of Vitamin C, i.e., Scurvy .

---

54. Answer: a

Explanation:

Explanation: -

Aqua regia is a yellow-orange or sometimes red color fuming liquid.

Aqua regia is made by combining concentrated nitric acid (HNO 3) with concentrated hydrochloric acid (HCl) in a ratio of 1:3.

It must be made fresh because it decomposes quickly.

Uses:

- It is used for the manufacture of chloroauric acid.
- It can dissolve noble metals such as gold and platinum but not all metals.
  - Hence the G oldsmiths use Aqua regia to dissolve the lustreless outer surface of Gold and Platinum and bring back the lustrous inner surface.
- It is used as an electrolyte in the Wohlwill process to refine gold of the highest quality.

Hence, **the correct answer is conc. HNO3 and conc. HCl. i.e. option (1).**

---

55. Answer: b

Explanation:

Explanation: -

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CaCO 3 is the chemical formula of Calcium carbonate.

- Limestone is a carbonate sedimentary rock composed primarily of calcium carbonate (CaCO 3).
- Limestone is the raw material used in the process of manufacturing cement.
- Limestone released carbon dioxide gas while heating.
- Limestone is used as:
- Building material.
- Essential component cement industry.
- Aggregate for the base of roads.
- Filler in products such as toothpaste or paints.

CaO is the chemical formula of Calcium oxide.

- Calcium oxide is the most abundant in ordinary Portland Cement.
- Calcium oxide is used for the dehydration of gases.

CaSO 4is the chemical formula of Calcium Sulphate.

- It is used as a plaster of Paris.

MgSO 4 is the chemical formula of Magnesium Sulphate.

The correct answer is CaCO 3, Option (2).

---

56. Answer: a

Explanation:

Concept: -

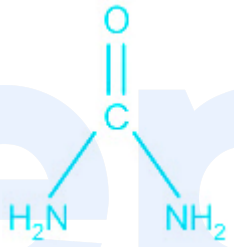
Urea

- It is a nitrogenous compound formed in the liver.
- Urea consists of carbon, nitrogen, oxygen, and hydrogen. Hence, Option 4 is correct.
- It has a chemical formula of CH4N2O.

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- It is also known as Carbamide or Ureophil.
- This compound is the end product of protein metabolism.
- It is a waste product and has no physiological function.
- It dissolves in blood and the kidney excretes it in urine.
- This organic compound has two NH2 groups connected by a functional group carbonyl.
- Urea dissolves in water and is non-toxic.
- It is colorless and has no smell.
- It is widely used as an important raw material in industries and commonly used in fertilizers.

Image of Urea Formula:



Explanation: -

Urea is synthesized as follows:

$2NH_3(g) + CO_2(g) \rightarrow H_2O\text{-}CO_2^- NH_4^+(s) \rightarrow H_2N\text{-}CO\text{-}NH_2 + H_2O$

ammonium carbonate **urea**

Hence, the correct answer is option 1, carbon dioxide.

---

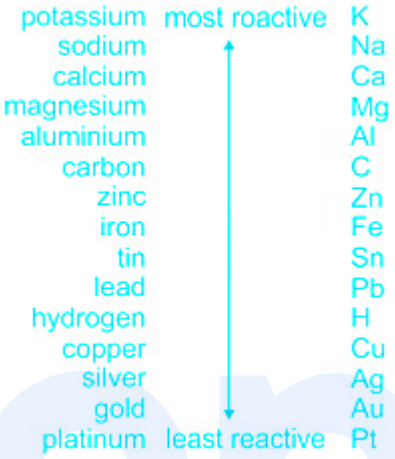
57. Answer: d

Explanation:

Concept: -

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- The electrochemical series defines the order of metals according to their reactivity .
- It moves downwards with decreasing rate of reactivity .
- Hence, the topmost metal shows the highest reactivity and the lowermost metal shows the least reactivity.
- The electrochemical series is also called the activity series



Explanation: -

Among the given options Potassium is having the highest position in the electrochemical series.

So, Potassium is the most reactive.

Hence, the correct option is (4).

---

58. Answer: d

Explanation:

Explanation: -

- Graphene is an allotrope of carbon consisting of a single layer of atoms arranged in a two-dimensional honeycomb lattice.
- The name is a portmanteau of "graphite" and the suffix -ene, reflecting the fact that the graphite allotrope of carbon consists of stacked graphene layers.

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- Graphene is a two-dimensional material and has good electrical conduction.
- It is one of the thinnest but strongest materials tested so far.
- Graphene is a carbon material that is one atom thick. Its thin composition and high conductivity mean that it is used in applications ranging from miniaturized electronics to biomedical devices.
- The term allotrope refers to one or more forms of a chemical element that occurs in the same physical state. The different forms arise from the different ways, atoms may be bonded together.
- There are many allotropes of carbon.
- These include diamond, graphite, graphene, carbon nanotubes, fullerenes, and carbon nanobuds.
- Graphene is the strongest material known to mankind.

Hence, **the correct option is (4).**

---

59. Answer: d

Explanation:

Explanation: -

Nitrous Oxide

- Nitrous oxide is a chemical compound N_2O.
- It is a naturally occurring gas that is colorless and non-flammable.
- It is called laughing gas because of its exhilarating effect of inhaling.
- The main source of Nitrous oxide includes soils under natural vegetation, Oceans, and Tundra.
- It is also used as an anesthetic and analgesic

Hence, the correct option is (4).

---

60. Answer: c

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Explanation:

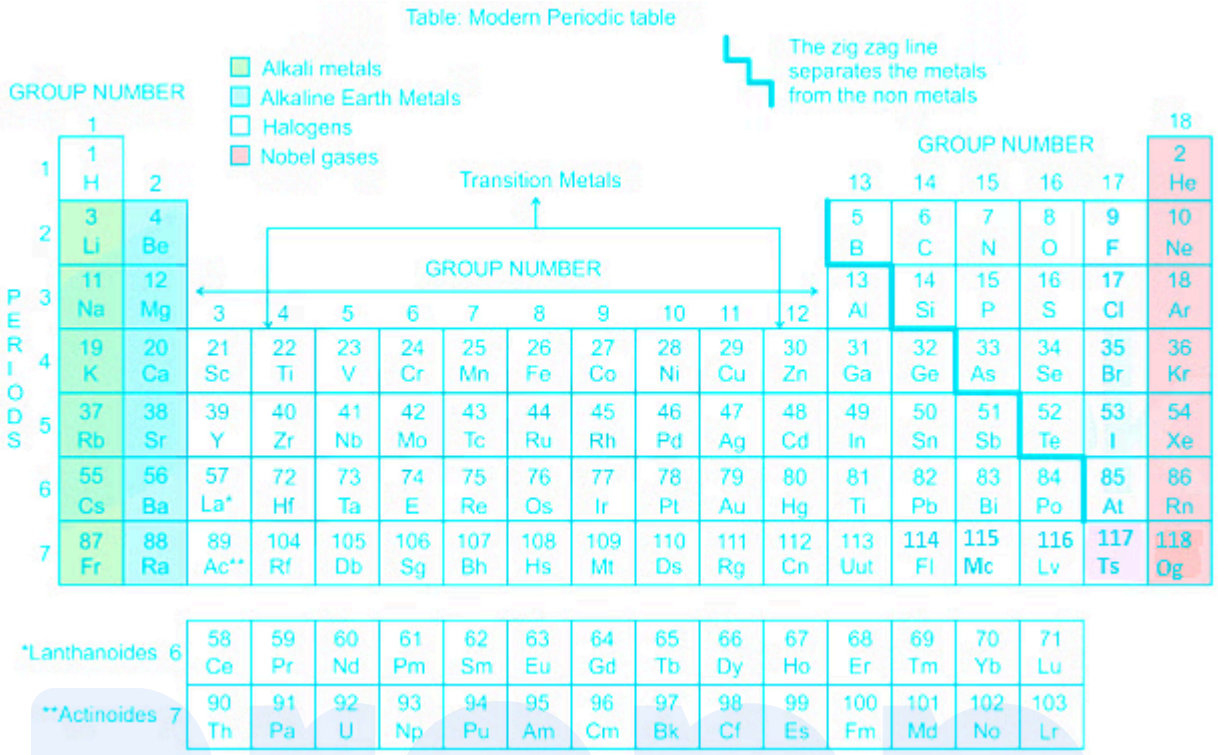
Concept: -

- Modern Periodic Table has 18 Groups and 7 Periods.
- It has 118 Elements.
- Each of the tables has a vertical row called a group. Elements in groups have similar chemical and physical properties because they have the same number of outer electrons.
- Each of the tables has horizontal rows called periods. During a period, a gradual change in chemical properties occurs from one element to another.
- The elements are arranged in the modern periodic table on the basis of Mosely's law, which states that the physical and chemical properties of elements are the periodic function of their atomic number.
- The Structure of it is like a bird Grid.
- The Modern Periodic table is used to organize all the known elements.
- Advantages of Modern Periodic Table:-
    - It is easier to remember the properties of an element if its position in the periodic table is known.
    - It made the study of Chemistry Systematic and Easy.

Modern Periodic Table:-

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Explanation: -

A period in the periodic table represents the principal quantum number.

As Principal quantum numbers stay the same moving left to right in the rows of the periodic table.

So, the shell remains same i n a periodic table, while moving from left to right in a period.

Hence, the correct answer is a shell, option 3.

---

61. Answer: c

Explanation:

Concept-

the n th term of an AP is given by $a_n = a + (n-1)d$

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Calculation-

The first two-digit number divisible by 3 is 12 and the last number is 99.

Thus 12, 15, 18,....96, 99 form an AP with **'n'** terms.

Here a = 12, d = 3 a_n = 99 Then,

a + (n - 1)d = 99

12 + (n - 1)3 = 99

n - 1 = 29

n = 30

The first two-digit number divisible by 5 is 10 and the last number is 95

Thus 10, 15, 20,....90, 95 form an AP with 'm' terms.

Here a =10, d = 5 a m = 95 Then,

a + (m - 1)d = 95

10 + (m - 1)5 = 95

m - 1 = 17

m = 18

Now the series of terms divisible commonly by 3 and 5 will be

15, 30, 45,.....90 form an AP with **'s'** terms

Here a = 15, d = 15 and a s = 90

a + (s -1)d = 90

15 + (s - 1)15 = 90

s - 1 = 5

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s = 6

∴ no of terms divisible by 3 and 5 will be 30 + 18 - 6 = 42

---

62. **Answer: b**

Explanation:

Concept-

1. The **divisibility rule of 15** says If the number is divisible by both 3 and 5 then it is divisible by 15.
2. The **divisibility rule of 5** if the number unit digit contains 0 or 5 then it is divisible by 5.
3. The **divisibility rule of 3** says that the sum of the digits of a number must be divisible by 3.

Calculation-

As all the option's unit digit is 5, all must be divisible by 5.

Now the sum of the digits of a number of all options will be

1,65,485 = 29 which is not divisible by 3

3,06,045 = 18 which is divisible by 3

2,12,695 = 25 which is not divisible by 3

2,95,145 = 26 which is not divisible by 3

Only 3,06,045 is divisible by 3 and 5

∴ 3,06,045 is divisible by 15.

---

63. **Answer: d**

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Explanation:

Concept-

Calculation-

Given, cos 27° = x

⇒ cos (90° - 63°) = x

⇒ sin 63° = x

Now, $cos\theta = \sqrt{1 - sin^2\theta}$

$cos63^\circ = \sqrt{1 - sin^2 63^\circ}$

$cos63^\circ = \sqrt{1 - x^2}$

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

⇒ $tan\ 63^\circ = \frac{sin\ 63^\circ}{cos\ 63^\circ}$

⇒ $tan\ 63^\circ = \frac{x}{\sqrt{1-x^2}}$

∴ the value of tan 63° is:- $\frac{x}{\sqrt{1-x^2}}$

---

64. Answer: d

Explanation:

Calculation-

$\sqrt{\frac{1-\cos\theta}{1+\cos\theta}} \times \sqrt{\frac{\text{cosec}\,\theta-\cot\theta}{\text{cosec}\,\theta+\cot\theta}} = \frac{1-r}{1+r}$

⇒ $\sqrt{\frac{1-\cos\theta}{1+\cos\theta}} \times \sqrt{\frac{\frac{1}{\sin\theta}-\frac{\cos\theta}{\sin\theta}}{\frac{1}{\sin\theta}+\frac{\cos\theta}{\sin\theta}}} = \frac{1-r}{1+r}$

⇒ $\sqrt{\frac{1-\cos\theta}{1+\cos\theta}} \times \sqrt{\frac{\frac{1-\cos\theta}{\sin\theta}}{\frac{1+\cos\theta}{\sin\theta}}} = \frac{1-r}{1+r}$

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$\Rightarrow \frac{1-\cos\theta}{1+\cos\theta} = \frac{1-r}{1+r}$

on comparing both sides we get

$\Rightarrow$ r = cos θ

∴ the value of r is cos θ

---

65. Answer: b

Explanation:

Concept-

Area of rhombus = $\frac{1}{2}$ × product of its diagonals

Calculation-

Area of rhombus = $\frac{1}{2}$ × 4 × 12

Area = 24 cm^2

∴ The area of a rhombus is 24 cm 2

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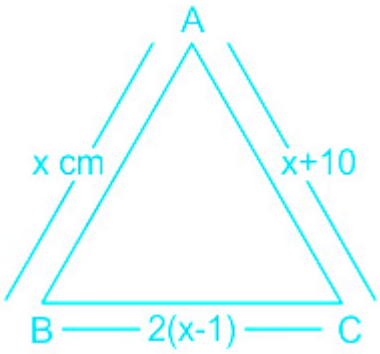
66. Answer: d

Explanation:

Calculation-

In Δ ABC let the length of **AB be x cm** then,

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BC = 2x - 2 and AC = x + 10

The perimeter of Δ ABC = 32 cm

AB + BC + AC = 32

⇒ x + (2x - 2) + (x + 10) = 32

⇒ 4x = 24

⇒ x = 6

Now, Length of side AB = x = 6 cm

Length of side BC = 2x - 2 = 10 cm

Length of side AC = x + 10 = 16 cm

∴ the smallest side is 6 cm.

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67. Answer: c

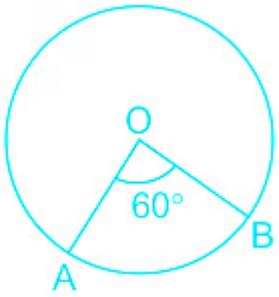
Explanation:

Concept-

1. Circumference of circle = 2πr
2. Area of a sector = $\pi r^2\left(\frac{\theta}{360^\circ}\right)$ where θ = central angle.

Calculation-

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Here Area of sector AOB we needs to find.

Circumference of circle = C

2πr = C

$\Rightarrow \ r = \frac{C}{2\pi}$

Area of sector = $\pi \times \left(\frac{C}{2\pi}\right)^2 \times \left(\frac{60^\circ}{360^\circ}\right)$

Area = $\frac{C^2}{24\pi}$

∴ area of a circle will be $\frac{c^2}{24\pi}$

---

68. Answer: b

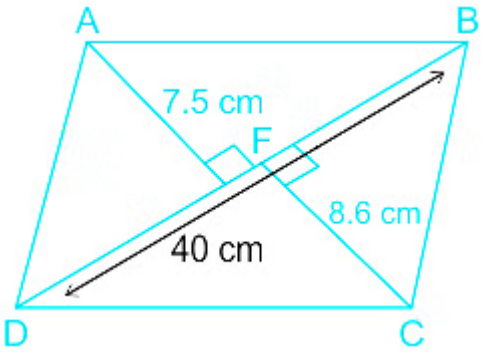
Explanation:

Concept-

Area of quadrilateral = $\frac{1}{2}$ × length of diagonal × [sum of the perpendicular from opposite vertex]

Calculation-

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Area of quadrilateral = $\frac{1}{2}$ × 40 × (7.5 + 8.6)

Area = 322 cm ^{2}

∴ **Area of the quadrilateral will be 322 cm 2**

---

69. **Answer: d**

Explanation:

Given:

∠CPB = 100°

Concept used:

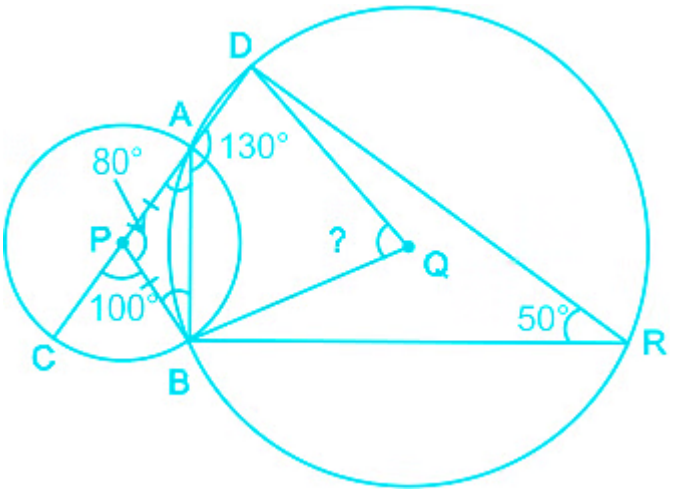
Two angles are said to be supplementary angles if they add up to 180 degrees. Supplementary angles form a straight angle (180 degrees) when they are put together.

The angle subtended by an arc of a circle at its center is twice the angle it subtends anywhere on the circle's circumference.

The opposite angles of a cyclic quadrilateral are supplementary which means that the sum of either pair of opposite angles is equal to 180 degrees.

Calculation:

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In the given figure,

∠CPB = 100°

So, ∠APB = 80° [∵ ∠APB = Supplementary Angle of ∠CPB]

Now, in ΔAPB,

AP = PB = radius of the smaller circle

So, ∠PAB = ∠PBA

∠PAB = [180° - 80°)/2]

⇒ ∠PAB = 50°

Now,

∠DAB = 180° - 50°

⇒ ∠DAB = 130° [∵ ∠DAB = Supplementary Angle of ∠PAB]

As ABRD is a cyclic quadrilateral

So, ∠BRD = 180° - 130° = 50°

Now,

According to the concept,

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∠BQD = 50 × 2 = 100° i.e x

∴ The required value of x is 100°

---

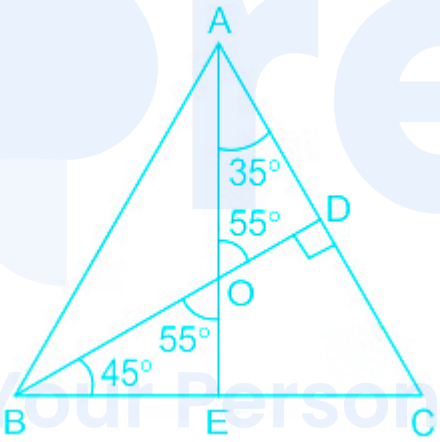
70. Answer: a

Explanation:

Concept-

1. Sum of the angles of a triangle is 180°
2. Vertical opposite angles are equal.

Calculation-



In Δ AOD using the angle sum property

∠DAO + ∠AOD + ∠ ADO = 180°

35° + ∠AOD + 90° = 180°

∠AOD = 55°

Now, ∠AOD = ∠BOE = 55°

In Δ BOE using the angle sum property

∠BOE + ∠OBE + ∠OEB = 180°

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55° + 45° + ∠OEB = 180°

∠OEB = 80°

∴ the measure of angle ∠AEB is 80°

---

71. Answer: a

Explanation:

Calculation-

Let the cost of 1 table be 'x' and 1 chair be 'y'

Than according to the given condition

2x + 4y = 16,000 and x = 6y

Now, 2x + 4y = 16,000

⇒ 2(6y) + 4y = 16,000

⇒ 16y = 16,000

⇒ y = 1,000

∴ cost of 9 chairs will be 9y = 9,000

---

72. Answer: a

Explanation:

Calculation-

$x + \frac{1}{x} = 5$

On squaring both sides we get

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$x^2 + \frac{1}{x^2} + 2 \times x \times \frac{1}{x} = 25$

$\Rightarrow x^2 + \frac{1}{x^2} + 2 = 25$

$\Rightarrow \ x^2 + \frac{1}{x^2} = 23$

$\therefore$ **the value of $x^2 + \frac{1}{x^2}$ is 23.**

---

73. Answer: a

Explanation:

Concept-

1. In grouped data of marks in interval a - b mean marks is given by $\frac{a+b}{2}$
2. $Mean = \frac{Sum\ of\ observation}{Total\ no\ of\ observation}$

Calculation-

Mean marks of all interval classes will be:-

$\frac{9+11}{2}$ = 10

$\frac{11+13}{2}$ = 12

$\frac{13+15}{2}$ = 14

$\frac{15+17}{2}$ = 16

$\frac{17+19}{2}$ = 18

The total marks of all students will be = 10 × 6 + 12 × 5 + 14 × 2 + 16 × 2 + 18 × 5

= 60 + 60 + 28 + 32 + 90

= 270

Total no of students = 6 + 5 + 2 + 2 + 5 = 20

Mean marks per student = $\frac{270}{20}$

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Mean = 13.5

∴ The mean marks per student are 13.5

---

74. Answer: d

Explanation:

Calculation-

$5x - 3 < 3x + 1$

$\Rightarrow 2x < 4$

$\Rightarrow x < 2.$

Solution of $5x - 3 < 3x + 1$ is $x < 2$.

---

75. Answer: a

Explanation:

Concept-

In a Diagonal matrix, every element is 0 except the principal diagonal element for ex- $\begin{bmatrix} I & 0 & 0 \\ 0 & I & 0 \\ 0 & 0 & I \end{bmatrix}$

In the unit matrix, all the diagonal elements are 1 and the rest element is 0

A square matrix is a matrix with the same number of rows and columns.

Calculation-

$A = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$

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As matrix A only satisfies the condition of a square matrix having 3 rows and 3 columns.

$\therefore A = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ **is a square matrix.**

---

76. Answer: a

Explanation:

Concept-

Integration by parts formula-:

$\int uv\, dx = u\int v dx - \int (u' \int v dx) dx$

Calculation-

$\int x \log x\, dx$

Taking log x as first function x as second and using by parts formula

$= \log x \int x dx - \int \left(\frac{d}{dx}(\log x)\right)\left(\int x dx\right) dx$

$= \log x \left(\frac{x^2}{2}\right) - \int \frac{1}{x} \times \frac{x^2}{2} dx$

$= \frac{x^2}{2}\log x - \frac{1}{2}\int x dx$

$= \frac{x^2 \log x}{2} - \frac{x^2}{4} + C$

$\therefore \int x \log x\, dx = \frac{x^2 \log x}{2} - \frac{x^2}{4} + C$

---

77. Answer: c

Explanation:

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Concept-

Integrating by parts formula-;

$\int uv\,dx = u\int vdx - \int(u'\int vdx)dx$

Calculation-

$\int x^3 e^{x^2} dx$

Using the substitution method let $x^2 = t$ so that on differentiating w.r.t 't' we get $x\,dx = \frac{1}{2}\,dt$ then, the integral is given by

$\Rightarrow \int \frac{1}{2} te^t\,dt$ using by parts here taking 't' as first function

$\Rightarrow \frac{1}{2}\left[t\int e^t - \int\left(\frac{d(t)}{dt}\int e^t\right)dt\right]$

$\Rightarrow \frac{1}{2}\left[te^t - \int e^t dt\right]$

$\Rightarrow \frac{1}{2}\left(te^t - e^t\right) + C$

On substituting the value of 't'

$\Rightarrow \frac{1}{2}\left(x^2e^{x^2} - e^{x^2}\right) + C$

$\Rightarrow \frac{1}{2}\left(x^2 - 1\right)e^{x^2} + C$

$\therefore \int x^3 e^{x^2} dx = \frac{1}{2}\left(x^2 - 1\right)e^{x^2} + C$

---

78. Answer: c

Explanation:

Calculation-

$\frac{dy}{dx} = e^{x+y} + x^2e^y$

$\Rightarrow \frac{dy}{dx} = e^x e^y + x^2e^y$

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$\Rightarrow \frac{dy}{dx} = (e^x + x^2)e^y$

$\Rightarrow \frac{dy}{e^y} = (e^x + x^2)dx$

$\Rightarrow \int e^{-y}dy = \int (e^x + x^2)dx$

$\Rightarrow -e^{-y} = e^x + \frac{x^3}{3} + C$

$\Rightarrow e^x + e^{-y} + \frac{x^3}{3} = C$

∴ the solution of the differential equation $\frac{dy}{dx} = e^{x+y} + x^2e^y$ is $e^x + e^{-y} + \frac{x^3}{3} = C$

---

79. Answer: a

Explanation:

<u>Concept-</u>

1. **Order** is the highest order derivative involved in differential equation
2. **Degree** is the power of the highest-order derivative.

<u>Calculation-</u>

$\left(\frac{d^3y}{dx^3}\right)^2 = \sqrt{\frac{dy}{dx}}$

On squaring both sides we get

$\Rightarrow \left(\frac{d^3y}{dx^3}\right)^4 = \frac{dy}{dx}$

Here highest order derivative is $\frac{d^3y}{dx^3}$ of Order 3

Power of $\frac{d^3y}{dx^3}$ is 4 so Degree is 4.

∴ The order of the differential equation is 3 and the Degree is 4.

---

80. Answer: c

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Explanation:

Concept-

Product of two numbers = Product of their LCM and HCF

Calculation-

One polynomial is $x^3 - 3x^2 - x + 3$ Let the other will be p(x).

LCM = $x^4 - 10x^2 + 9$ and HCF = $x^2 - 1$

Now,

LCM × HCF = Product of the two polynomials

$(x^4 - 10x^2 + 9) \times (x^2 - 1) = p(x) \times (x^3 - 3x^2 - x + 3)$

$(x^4 - 10x^2 + 9) \times (x^2 - 1) = p(x) \times (x^2(x - 3) - 1(x - 3))$

$(x^4 - 10x^2 + 9) \times (x^2 - 1) = p(x) \times (x - 3) \times (x^2 - 1)$

$x^4 - 9x^2 - x^2 + 9 = p(x) \times (x - 3)$

$x^2(x^2 - 9) - 1(x^2 - 9) = p(x) \times (x - 3)$

$(x^2 - 1)(x^2 - 9) = p(x) \times (x - 3)$

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

$p(x) = x^3 + 3x^2 - x - 3$

∴ the other polynomial is $x^3 + 3x^2 - x - 3$.

---

81. **Answer: c**

Explanation:

The correct answer is Nidhi Chibber.

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⭐ Key Points:

- The **Central Board of Secondary Education (CBSE)** is India's national **secondary school board** , which oversees both public and private institutions.
- Established in **1929** , The Board was a government-sponsored experiment in **interstate integration and cooperation** in secondary education.
- More than **27,000 schools** in India and **240 institutions** in 28 other countries are **affiliated** with the CBSE.
- All CBSE-affiliated institutions use the **NCERT curriculum** , especially in grades 9 through 12.
- Currently serving as chair of the CBSE is IAS **Nidhi Chibber.**

---

82. Answer: c

Explanation:

The correct answer is **Sikandar Lodi.**

⭐ Key Points:

- In 1458, Sikandar Lodi was born to Bahlul Lodi , the first sultan of the Lodi dynasty, and Bibi Ambha , a Hindu goldsmith's daughter.
- After Bahlul Lodi, Sikandar Lodi was the second monarch of the Lodi dynasty and the Sultan of Delhi.
- In his sultanate, Sikandar expanded the areas between the Satluj River and the Bundelkhand region as well as the domains that stretched from the region of Punjab to Bengal.
- He published poems in Persian under the **pseudonym Gulrukhi** .
- He passed away on **November 21st, 1517** , and was laid to rest in **Delhi's Lodi Gardens.**

⭐ Additional Information:

- **Akbar:**
  - From **1556** to **1605** , Akbar, "the third Mughal emperor", ruled.

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    - Under the guidance of a regent named **Bairam Khan,** Akbar succeeded his father, Humayun, and consolidated the Mughal empire's Indian realms.
- **Ibrahim Lodi:**
    - The **final Sultan** of the **Delhi Sultanate** was **Ibrahim** Khan **Lodi** , who succeeded his father Sikandar Khan Lodi in 1517.
    - He served as the **Lodi dynasty's final ruler** .
- **Bahlol Lodi:**
    - **Bahlul Khan Lodi** was the **Pashtun Lodi tribe's chief** .
    - Following the abdication of the last claimant from the previous **Sayyid reign** , he established the Lodi dynasty from the **Delhi Sultanate.**
    - On **April 19, 1451,** Bahlul was **crowned sultan** of the dynasty.

---

83. Answer: a

Explanation:

The correct answer is **Odisha.**

⭐ **Key Points**

- The Kingdom of Utkala was centred in the northern and eastern portions of the modern-day Indian state of Odisha and also included the districts of West Bengal's Bankura, Purulia and Midnapore.
- In the epic Mahabharata, with the names of Utkala, Utpala, and Okkal, this kingdom was mentioned. In India's national anthem, Jana Gana Mana, it is said.
- The kingdoms of Bharata Varsha (Ancient India) were mentioned as the Dasarnas, the Mekalas (a kingdom west of Utkala) and the Utkalas (6:9).
- Utkalas were listed as being associated with the Kauravas in the Kurukshetra War.

⭐ **Additional Information**

- When **Bande Utkala Janani** was performed in **1936** , the year **Odisha** became a separate State, it became legendary.

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- The Odisha Assembly decided to sing Bande Utkala Janani at the conclusion of each session in **1994** .
- There have been numerous discussions about making it the **State song** ever since.
- Thousands of people sung the song on May 30 to support frontline healthcare workers facing the **COVID-19** outbreak in response to a plea from **Chief Minister Naveen Patnaik.**
- The request to give Bande Utkala Janani the status of the State song was approved by the **State Cabinet,** which is presided over by the CM, via video conferencing.

---

84. Answer: c

Explanation:

The correct answer is **Neelam Sanjeev.**

⭐ **Key Points:**

- The sixth President of India, **Neelam Sanjiva Reddy,** was an Indian politician who presided over the country from **1977 to 1982.**
- He began a lengthy political career with the **Indian National Congress Party** in the independence movement and later held several important positions in independent India before becoming the **president** of that country, including **deputy chief minister of Andhra state** and the **first chief minister of United Andhra Pradesh,** two-time speaker of the Lok Sabha, and Union Minister.
- On **August 6, 1977** , the Indian Election Commission held the country's **seventh indirect presidential election.**
- Despite the fact that 37 candidates submitted their nominations, 36 of them were disqualified, resulting in **Neelam Sanjiva Reddy's victory** as one of India's two presidents with no opposition.

⭐ **Additional Information:**

- **B. D. Jatti,** the vice president, assumed the role of acting president on **February 11, 1977** , the day Fakhruddin Ali Ahmed passed away.

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- Within six months of the day the position became vacant, a **presidential election** had to be held.
- The members of the **Lok Sabha (524), Rajya Sabha (232),** and **22 state Legislative Assemblies (3776),** totaling 4532 electors, made up the **Electoral College.**

---

85. Answer: c

Explanation:

The correct answer is**Rs. 100,000.**

⭐ **Key Points:**

- A cash reward of **Rs. 100000** and a **souvenir** are included with the Hridaynath award for lifetime achievement.
- The recipient of the 2018 Hridaynath Award for Lifetime Achievement is **Mohammed Zahur Khayyam Hashmi.**
- The prize was created in 2011 by the Hridayesh Art organisation to honour the composer and performer **Hridaynath Mangeshkar.**
- He is the son of **Deenanath Mangeshkar** and the younger brother of Lata Mangeshkar and Asha Bhosle.

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⭐ **Additional Information:**

- **Hridaynath Mangeshkar is** an Indian composer.
- He is the younger brother of **Lata Mangeshkar and Asha Bhosle** and the only child of musician Deenanath Mangeshkar.
- He is commonly referred to as **Balasaheb** in the cinema and **music industries.**
- In 1955, Hridaynath made his music debut with the Marathi movie **Akash Ganga.**

---

86. Answer: c

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Explanation:

T he correct answer is Assam.

⭐ Key Points:

- In addition to being a national park, **Manas National Park** is also a **biosphere reserve, Project Tiger reserve, a UNESCO Natural World Heritage Site,** and an elephant reserve in the Indian state of **Assam** .
- It shares a boundary with **Bhutan's Royal Manas National Park,** which is located in the Himalayan foothills.
- A few rare and imperiled endemic species found there are the **pygmy hog, golden langur, hispid hare,** and **Assam roofed turtle.**
- It is well known that Manas is home to a sizable herd of **wild water buffalo.**

⭐ Additional Information:

- Manas National Park, which covers 360 km ^{2}, was proclaimed a sanctuary on **October 1, 1928.** (140 sq mi).
- The Manas Bio Reserve was founded in **1973** .
- Prior to the declaration of the sanctuary, the reserved forests were known by the designations **Manas R.F. and North Kamrup R.F.**
- The Raja of Gauripur and the Cooch Behar royal dynasty used it as a **hunting park.**
- In the years between **1951 and 1955,** the area was increased to 391 km ^{2} (151 sq mi).
- **UNESCO** named it a World Heritage Site in **December 1985.**

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---

87. Answer: c

Explanation:

The correct answer is Kapil Dev.

⭐ Key Points:

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- Under the leadership of **Kapil Dev** , India won their first World Cup in **1983** .
- **Tendulkar, Ganguly, Dravid,** and **Kumble** , who are regarded as some of the finest Indian players, all made their debuts in the **1980s** and **1990s.**
- It is believed that **Ganguly's** leadership marked the **beginning of Indian cricket's transformation** into one of the game's dominant forces.
- Ganguly was followed by **MS Dhoni** , whose outstanding leadership helped India win its **second World Cup in 2011.**

⭐ Additional Information:

- The Indian cricket team made its Test debut in **1932** and went on to rank among the top four test teams in each of the years from **2005 to 2008** according to the **ICC rankings.**
- In 1983 and 2011, the group won the **ODI Cricket World Cup.**
- Other notable international triumphs for Team India include the **ICC Champions Trophy** in **2002** and **2013** and the **Twenty20 World Cup** in **2007.**
- European merchant sailors brought cricket to the Indian subcontinent in the **18th century** , and the first cricket club was founded in **1792** .

---

88. **Answer: c**

Explanation:

The correct answer is **Canning.**

⭐ Key Points:

- **Bahadur Shah Zafar** would be the final Mughal ruler, and after his death, none of his progeny would be recognized as kings, according to **Governor-General Canning's** decree from 1856.
- Only **princes** would be used to describe his **offspring** .
- In 1849, **Governor -General Dalhousie** made the announcement that following **Zafar's passing** , his family would be relocated from the Red Fort and given a new home to live in Delhi.
- Around this period, the name of the **Mughal King** was also **erased** from the **coinage** .

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⭐ Additional Information:

- During the **Sepoy Mutiny,** Lord Canning served as the **governor-general of India** in the year **1857.**
- He served as India's **first viceroy.**
- He did away with the **notion** of **lapse** , allowing the Indian princes to choose a **successor** to continue their rule.

---

89. **Answer: a**

Explanation:

The correct answer is **S. Venkataraghavan.**

⭐ Key Points:

- Srinivasaraghavan Venkataraghavan is a former Indian cricketer .
- In **1975** , S. Venkataraghavan **captained** the **Indian cricket team** in the **inaugural World Cup.**
- He captained the Indian cricket team in the **first two ICC Cricket World Cups** and later became an **umpire** on the **elite International Cricket Council Test panel.**
- His Test career was one of the **longest** for amongst other Indian players.
- He also played for **Derbyshire** in English county cricket from the year **1973 to 1975.**
- He has received the civic honour of the Padma Shri.

⭐ Additional Information:

- **Bishan Singh Bedi:**
  - **Bishan Singh Bedi** is a former Indian cricketer best known for his slow **left-arm orthodox bowling.**
  - From **1966** until **1979** , he was a member of India's legendary **spin quartet** in Test cricket.
- **G.R. Vishwanath:**
  - Gundappa Ranganath Viswanath is a former Indian cricketer.

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    - Throughout the **1970s** , Vishwanath was regarded as one of the **best India's batsmen.**
    - Viswanath represented India in Test cricket from **1969 to 1983,** appearing in 91 games and amassing over 6,000 runs.
- **Mansur Ali Khan Pataudi:**
    - **Nawab Mohammad Mansoor Ali Khan Pataudi** was a former Indian cricket captain and batsman.
    - Pataudi was named India's cricket **captain** at the age of 21 and is regarded as **"one of (its) greatest".**
    - Pataudi was also known as the **"greatest fielder in the world"** during his time.

---

90. Answer: d

Explanation:

The correct answer is **4.**

⭐ **Key Points:**

- The model hanging around you is around the size of methane if the **Hayden Sphere** is the size of a **rhinovirus** .
- **One carbon atom** and **four hydrogen atoms** make up the methane molecule (CH_4).
- **Natural gas** primarily consists of methane.
- Methane is the most **basic alkane hydrocarbon** and is typically found in a **gaseous condition.**
- It produces a lot of greenhouse gas.

⭐ **Additional Information:**

- Methane is a substance that has the **chemical formula** CH_4(one carbon atom bonded to four hydrogen atoms).
- It is a **group-14 hydride** and the most fundamental component of **natural gas.**

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- Due to its relative abundance on Earth, methane makes a **good fuel,** but its **gaseous** condition at **standard temperatures** and **pressure** makes its extraction and storage challenging.
- It is shaped as a **tetrahedron** and has four **C-H linkages.**

---

91. Answer: b

Explanation:

The correct answer is "**It is known to us all that there is only one God.**"

⭐ Key Points

- The given sentence is in the **active voice** so we will change it to the **passive voice** .
- There are a few rules to remember when changing a sentence from active to passive voice.
  - The **base form** of the verb in the **active voice** will change to the **past participle** form of the verb in the **passive voice** .
  - In the given sentence, the verb " **know** "(V_1) will change to the past participle form of the verb " **known** "(V_3).
  - The subject pronoun " **we** " in the active voice changes to the object pronoun " **us** " in the passive voice.
  - The sentence in the passive voice begins with an **object** followed by the helping verb, the main verb, and the subject.
  - The given sentence in the passive voice will begin with the **object pronoun "it"** .
- Only **option 2** has the correct passive voice.

Hence, the correct answer is **option 2** .

---

92. Answer: a

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Explanation:

The correct answer is "**Negligible**".

⭐ Key Points

- Let's look at the **meaning** of the given word.
  - **Salient** : most noticeable or important.
- Let's look at the **meaning** of the given options.
  - **Negligible:** so small or unimportant as to be not worth considering; insignificant.
  - **Prominent** : important; famous.
  - **Striking :** attracting attention by reason of being unusual, extreme, or prominent.
  - **Clear:** easy to perceive, understand, or interpret.
- As per the meaning of the given words, " **negligible** " has the opposite meaning of the given word.
  - **Example** :*The number of students who had failed the mid-semester examination was negligible.*

Hence, the correct answer is **option 1** .

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93. Answer: a

Explanation:

The correct answer is "**To make all the decisions** ".

⭐ Key Points

- The meaning of the idiom " Rule the roost." is to be the person who **makes all the decisions in agroup** .
- We use the given idiom to refer to a person who makes all the important decisions in a particular situation.
  - **Example** :*My wife rules the roost in my house.*

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Hence, the correct answer is **option 1** .

---

94. Answer: d

Explanation:

The erroneous segment is "**were much larger.** "

⭐ Key Points

- In the given sentence, the usage of the auxiliary verb " **were** " is incorrect.
- In the given sentence, "The number of" is a quantifier whenever we use "the number of" it means the thing which we are quantifying is fixed and acts as a singular noun/collective noun irrespective of the usage of a plural noun. Hence, we need to use a singular verb. This doesn't happen with the phrase "A number of" we need to use "a plural verb" with it.
- We use the auxiliary verb " **was** " with the singular subject.

The correct sentence is : *The number of visitors at the fair**was**much larger than expected.*

Hence, the correct answer is **option 4** .

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---

95. Answer: d

Explanation:

The erroneous segment is "**of the king's** "

⭐ Key Points

- In the given sentence, the usage of the **possessive form** of the noun " **king's** " is incorrect.
- The given sentence has the **preposition** "**of** " which shows the **possession** .

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- In the given sentence, the preposition "of" links the picture with the king so we don't need to use the possessive form of the noun "king's"
- We need to use the non-possessive form " **king** " in the erroneous segment.

The correct sentence is : *The picture of the **king** is exactly like the king himself.*

Hence, the correct answer is **option 4** .

---

96. Answer: a

Explanation:

The erroneous segment is "**The movie who** ".

⭐ Key Points

- The usage of the relative pronoun " **who** " in the given sentence is incorrect.
- We use the relative pronoun " **who** " to refer to **people** .
- We use the relative pronoun " **that** " to refer to **people** , **animals, or things** .
- The relative pronoun " **that** " is also an **essential clause** as it provides information about the noun in the first clause of the sentence.
- In the given sentence, " **the movie** " is a thing so we need to use the relative pronoun " **that** ". We can also use "which" in the given sentence.

The correct sentence is*The movie **that/which** came out yesterday was really good.*

Hence, the correct answer is **option 1** .

---

97. Answer: b

Explanation:

The erroneous segment is "**with hundred yards** "

⭐ Key Points

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- The usage of the preposition " **with** " in the given sentence is incorrect.
- We use the preposition " **with** " to imply that in the same place or accompanying.
- We need to use the preposition " **within** " to refer to something that is within a particular distance.
- In the given sentence, the statement implies that the school is about a hundred yards from the speaker's house.

The correct answer is : *The school is **within** hundred yards from my house.*

Hence, the correct answer is **option 2** .

---

98. Answer: a

Explanation:

The correct answer is "**She said that she was going to town with her father** ."

⭐ Key Points

- The given sentence is in **direct speech** so it will change to **indirect speech** .
- There are a few rules to remember when changing a sentence from **direct** to **indirect** speech.
  - If the reporting verb is in the **past tense** in direct speech then the tense of the sentence will change in indirect speech.
  - The given sentence is in the **present continuous tense** in direct speech which will change to the **past continuous tense** in indirect speech.
  - The helping verb " **am** " is used for the present tense in the given sentence and will change to " **was** " in indirect speech.
  - The **first person** pronoun " **I**" in direct speech will change to the **third person** pronoun " **she** ".
  - The first-person pronoun " **my** " in direct speech will change to the third-person pronoun " **her** ".
- Only **option 1** has the correct indirect speech.

Hence, the correct answer is **option 1** .

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99. **Answer: c**

Explanation:

The correct answer is **"II and III "**

⭐ Key Points

- The **third** paragraph provides the answer to the **second** question as it explains how the small region's increasing density affects its gravitational field .
- The **final** paragraph provides the answer to the **third** question by stating the end result of the gradually increasing concentration of the small region of gas i.e. t he process continues until the small region of gas finally forms a gravitationally bound object.
- As per the above-mentioned sentences, only**II and III** are answered in the passage.

Hence, the correct answer is **option 3** .

100. **Answer: c**

Explanation:

The correct answer is "**depict the successive stages of a phenomenon** "

⭐ Key Points

- The theme of the given passage is mentioned in the first sentence of the passage which is the **formation of the stars** and the reason for the phenomenon that is **gravitational instability** .
- The **second** paragraph of the passage mentions a hypothetical scenario to explain the formation of the stars and the phenomenon of gravitational instability.

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- The third paragraph explains how the small region's increasing density affects its gravitational field.
- The final paragraph elucidates the end result of the gradually increasing concentration of the small region of gas i.e. the process continues until the small region of gas finally forms a gravitationally bound object.

Hence, the correct answer is **option 3** .

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