

MET – 2025

Sample Paper

Physics

Q. 1 If potential $V = -5x + 3y + \sqrt{15}z$, then electric field $E(x, y, z)$ is:

Option 1:

10 unit

Option 2:

8 unit

Option 3:

7 unit

Option 4:

5 unit

Solution:

As we learn

Relation between field and potential -

$$E = \frac{-dv}{dr}$$

- wherein

$\frac{dv}{dr}$ is Potential gradient.

$$\vec{E} = -gradV$$

$$\vec{E} = - \left[\frac{\partial V}{\partial x} \hat{i} + \frac{\partial V}{\partial y} \hat{j} + \frac{\partial V}{\partial z} \hat{k} \right]$$

$$\vec{E} = - \left[5\hat{i} + 3\hat{j} + \sqrt{15}\hat{k} \right] = \sqrt{25 + 9 + 15} = \sqrt{49} = 7unit$$

Q. 2 An electron (mass= 9.0×10^{-31} kg and charge = 1.6×10^{-19} coulomb) is moving in a circular orbit in a magnetic field $2\pi \times 10^{-4} \text{wb/m}^2$ its time period of revolution is -

Option 1:

$$5.6 \times 10^{-6} \text{ sec}$$

Option 2:

$$5.6 \times 10^{-8} \text{ sec}$$

Option 3:

$$8.3 \times 10^{-6} \text{ sec}$$

Option 4:

$$8.3 \times 10^{-8} \text{ sec}$$

Correct Answer:

$$5.6 \times 10^{-8} \text{ sec}$$

Solution:

As we learn

Time period of charged particle -

$$T = \frac{2\pi m}{qB}$$

- wherein

independent of speed of particle

$$T = \frac{2\pi m}{qB} = \frac{2\pi \times 9.0 \times 10^{-31}}{1.6 \times 10^{-19} \times 2\pi \times 10^{-4}}$$

$$T \frac{9 \times 10^{-31}}{1.6 \times 10^{-23}} = 5.6 \times 10^{-8} \text{ sec}$$

Correct option is 2

Q. 3 Arrange the following electromagnetic radiations per quantum in the order of increasing energy :

- A : Blue light B : Yellow light
C : X-ray D : Radiowave.

Option 1:

D, B, A, C

Option 2:

A, B, D, C

Option 3:

C, A, B, D

Option 4:

B, A, D, C

Correct Answer:

D, B, A, C

Solution:

As we learnt in

Balmer series -

$$\frac{1}{\lambda} = R \left(\frac{1}{2^2} - \frac{1}{n^2} \right)$$

(*visible light*)

- wherein

$$n = 3, 4, 5 \text{ --- } \text{---}$$

When electron jump from higher orbital to n=2 energy level

Radio wave < Yellow light < Blue light < X-ray

Correct option is 1.

Q. 4 For a planet escape velocity is $10\sqrt{2} \text{ km/sec}$ then the orbital velocity of the satellite near surface of planet will be equal to -

Option 1:

20 km/sec

Option 2:

15 km/sec

Option 3:

10 km/sec

Option 4:
12 km/sec

Correct Answer:
10 km/sec

Solution:

Relation of escape velocity and orbital velocity -

$$V = \sqrt{\frac{GM}{r}}$$

$$V_e = \sqrt{\frac{2GM}{R}}$$

$V \rightarrow$ Orbital velocity

$V_e \rightarrow$ Escape velocity

- wherein

$$V_{orbital} = \frac{V_e}{\sqrt{2}}$$

$$V_{escape} = \sqrt{2}V_{orbital}$$

Orbital Velocity

$$V_{orbital} = \frac{V_e}{\sqrt{2}}$$

$$V_{Orbital} = \frac{10\sqrt{2}}{\sqrt{2}} = 10 \text{ km/sec}$$

Correct option is 3

Q. 5 The mean value of current is defined by-

Option 1:
average value of current for one complete cycle

Option 2:
average value of current for half cycle.

Option 3:
average value of current for $\frac{1}{4}$ th cycle.

Option 4:

Mean value is always zero

Correct Answer:

average value of current for half cycle.

Solution:

As we have learnt,

Mean or average value $i(av)$ -

The average value of alternating current for one complete cycle is zero.

The average value of ac over half cycle is defined as mean value.

Q. 6 The time difference value of voltage and current in pure inductor circuit is equal to -

Option 1:

T

Option 2:

0

Option 3:

$\frac{T}{3}$

Option 4:

$\frac{T}{4}$

Correct Answer:

$\frac{T}{4}$

Solution:

Time difference -

If phase difference between alternating current and voltage is ϕ .

- wherein

$$T.D. = \frac{T}{2\pi} \times \phi$$

Phase difference between voltage and current -

$$\phi = 90^\circ \text{ or } (+\pi/2)$$

So, $TD = T/4$

Q. 7 In potentiometer, a cell of emf 1.25V gives a balance point at 35 cm length of wire. If the cell is replaced by another cell and balance point shifts to 70 cm., what is the emf of second cell?

Option 1:

2.25 V

Option 2:

5V

Option 3:

2.5V

Option 4:

5.5V

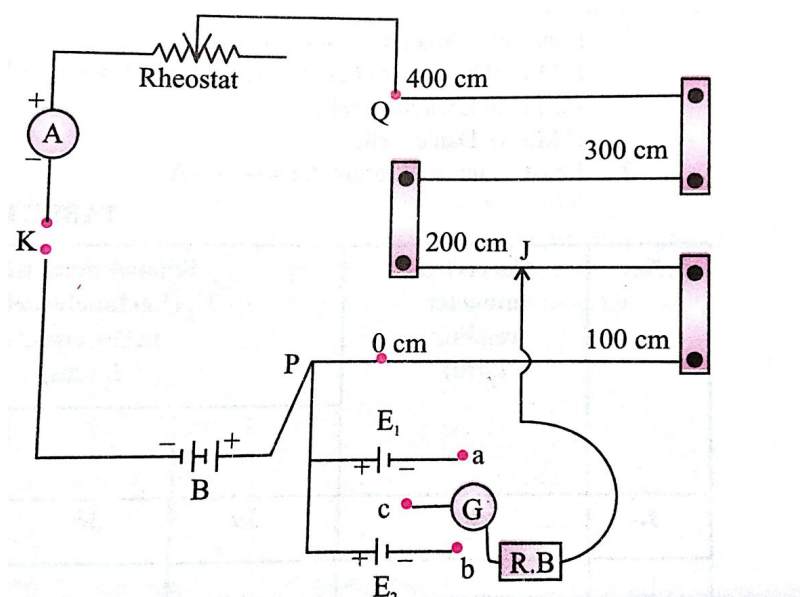
Correct Answer:

2.5V

Solution:

as we learn

To compare emf of two given primary cells using potentiometer -



$$\frac{E_1}{E_2} = \frac{Kl_1}{Kl_2} = \frac{l_1}{l_2}$$

E_1 = Emf of first cell

$E_2 =$ Emf of second cell

- wherein

$K =$ Constant of proportionality

$l_1, l_2 =$ balancing length's of both

Procedure:

1. Draw a circuit diagram as shown in figure.
2. Measure E.M.F (E) of the battery and the e.m.f. (E_1 and E_2) of the cells. See that $E > E_1$ and also $E > E_2$.
3. Connect the positive pole of the battery (a battery of constant e.m.f.) to the zero end (P) of the potentiometer and the negative pole through a one way key, an ammeter and a low resistance rheostat to the other end (Q) of the potentiometer.
4. Connect the positive poles of the cells E_1 and E_2 to the terminal at the zero end (P) and the negative poles to the terminals a and b of the two key.
5. Connect the common terminal c of the two-way key through a galvanometer (G) and a resistance box (R.B.) to the jockey J.
6. Take maximum current from the battery making rheostat resistance zero.
7. Insert the plug in the one way key (K) in circuit and also in between the terminals a and c of the two way key.
8. Take out a 2,000 ohms plug from the resistance box (R.B.)
9. Press the jockey at the zero end and note the direction of deflection in the galvanometer.
10. Press the jockey at the other end of the potentiometer wire. If the direction of deflection is opposite to that in the first case, the connection are correct. (If the deflection is in the same direction then either connections are wrong or e.m.f. of the auxiliary battery is less).

$$\frac{E_1}{E_2} = \frac{l_1}{l_2} = E_2 = E_1 \times \frac{l_2}{l_1} = \frac{1.25 \times 70}{35} = 2.5V$$

-
- Q. 8** The workdone in rotating an electric dipole of dipole moment P in an electric field E . Through an angle θ from the direction of electric field is:

Option 1:

PE

Option 2:

$$PE(1 - \sin \theta)$$

Option 3:

$$PE(1 - \cos \theta)$$

Option 4:

Zero

Correct Answer:

$$PE(1 - \cos \theta)$$

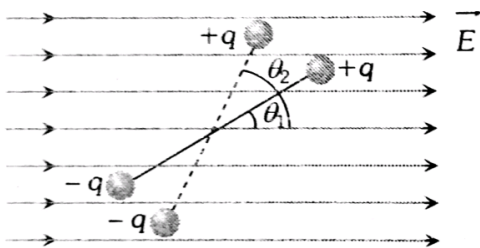
Solution:

As we learn

Work done in rotation -

$$W = PE(\cos \Theta_1 - \cos \Theta_2)$$

- wherein



as

$$W = PE(\cos \theta_1 - \cos \theta_2)$$

if initially we take $\theta_1 = 0$ and $\theta_2 = \theta$

then,

$$W = PE(1 - \cos \theta)$$

Q. 9 A body of mass 5 kg under the action of constant force $\vec{F} = F_x \hat{i} + F_y \hat{j}$ has velocity at $t = 0$ s as $\vec{v} = (6\hat{i} - 2\hat{j})$ m/s and at $t = 10$ s as $\vec{v} = +6\hat{j}$ m/s. The force \vec{F} is :

Option 1:

$$(-3\hat{i} + 4\hat{j}) \text{ N}$$

Option 2:

$$\left(-\frac{3}{5}\hat{i} + \frac{4}{5}\hat{j}\right) N$$

Option 3:

$$(3\hat{i} - 4\hat{j}) N$$

Option 4:

$$\left(\frac{3}{5}\hat{i} - \frac{4}{5}\hat{j}\right) N$$

Correct Answer:

$$(-3\hat{i} + 4\hat{j}) N$$

Solution:

Given :

$$\vec{v}_i = (6\hat{i} - 2\hat{j}) m/s \quad (\text{At } t = 0 \text{ sec})$$

$$\vec{v}_f = 6\hat{j} m/s \quad (\text{At } t = 10 \text{ sec})$$

$$m = 5 \text{ kg}$$

$$\text{Constant force, } F = \frac{dP}{dt}$$

$$F = m \frac{dv}{dt}$$

$$F = 5 \left(\frac{\vec{v}_f - \vec{v}_i}{t_f - t_i} \right)$$

$$F = 5 \left(\frac{(6\hat{j}) - (6\hat{i} - 2\hat{j})}{10} \right)$$

$$F = \frac{-6\hat{j} + 8\hat{j}}{2}$$

$$F = (-3\hat{i} + 4\hat{j})$$

Q. 10 For extrinsic semiconductors; when doping level is increased;

Option 1:

Fermi-level of p-type semiconductor will go upward and Fermi-level of n-type semiconductors will go downward.

Option 2:

Fermi-level of p-type semiconductors will go downward and Fermi-level of n-type semiconductor will go upward.

Option 3:

Fermi-level of both p-type and n-type semiconductors will go upward for $T > T_F$ K and downward for $T < T_F$ K, where T_F is Fermi temperature.

Option 4:

Fermi-level of p and n-type semiconductors will not be affected.

Correct Answer:

Fermi-level of p-type semiconductors will go downward and Fermi-level of n-type semiconductor will go upward.

Solution:

For extrinsic semiconductors;

when doping level is increased then

Fermi-level of p-type semiconductors will go downward and Fermi-level of n-type semiconductor will go upward.

Q. 11 A man standing in a lift carrying a bag of 5 Kg. If lift moves vertically upwards with acceleration $g/2$ then find tension (in Newton) force in the handle of the bag
use $(g = 10m/s^2)$

Correct Answer:

75

Solution:

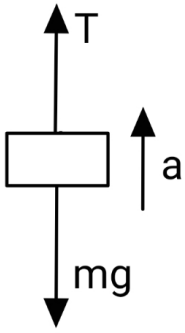
Given-

Acceleration of the block, $a = \frac{g}{2} = 5m/s^2$

mass of the block, $m=5kg$

Let the tension in the string be T.

F.B.D of the block-



Using $F_{net} = ma$

$$T - mg = ma$$

$$\Rightarrow T = m(g + a)$$

$$\Rightarrow T = 5 \times (10 + 5) = 75N$$

- Q. 12** A plane electromagnetic wave has a frequency of $2.0 \times 10^{10} Hz$ and its energy density is $1.02 \times 10^{-8} J/m^3$ in vacuum. The amplitude of the magnetic field (in nT) of the wave is close to $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \frac{Nm^2}{C^2} \text{ and speed of light} = 3 \times 10^8 ms^{-1} \right)$

Correct Answer:

160

Solution:

$$\text{Energy density} = \frac{dU}{dV} = \frac{B_0^2}{2\mu_0}$$

$$1.02 \times 10^{-8} = \frac{B_0^2}{2 \times 4\pi \times 10^{-7}}$$

$$B_0^2 = (1.02 \times 10^{-8}) \times (8\pi \times 10^{-7})$$

$$\Rightarrow B_0 = 16 \times 10^{-8} T = 160nT$$

- Q. 13** A certain mass of hydrogen is changed to He by the process of fusion. The mass defect in fusion reaction is 0.02866μ . The energy liberated (in MeV) per μ is ($1\mu=931MeV$)

Correct Answer:

6.675

Solution:

As we learn

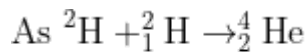
Mass of electron, proton & neutron in terms of energy -

$$m_e = 0.511 Mev/c^2$$

$$m_p = 938.27 \text{ Mev}/c^2$$

$$m_n = 939.56 \text{ Mev}/c^2$$

$$1 \text{ amu} = 931.5 \text{ Mev}/c^2$$



$$\text{Here, } \Delta m = 0.02866\text{u}$$

∴ The energy liberated per u is

$$= \frac{\Delta M \times 931}{4} \text{ MeV}$$

$$= \frac{0.02866 \times 931}{4} \text{ MeV}$$

$$= \frac{26.7}{4} \text{ MeV} = 6.675 \text{ MeV}$$

-
- Q. 14** The surface of a metal is illuminated alternatively with photons of energies $E=4\text{eV}$ and $E=2.5\text{eV}$ resp. The ratio of maximum speeds of the photoelectrons emitted in the two cases is 2. The work function of the metal in eV is

Correct Answer:

2

Solution:

$$E_1 = \phi + K_1 \dots (1)$$

$$E_2 = \phi + K_2 \dots (2)$$

$$E_1 - E_2 = K_1 - K_2 \dots (3)$$

$$\text{Now } \frac{V_1}{V_2} = 2$$

$$\frac{K_1}{K_2} = 4$$

$$K_1 = 4 K_2$$

$$\text{Now from equation (3)} \Rightarrow 4 - 2.5 = 4 K_2 - K_2$$

$$1.5 = 3 K_2$$

$$K_2 = 0.5\text{eV}$$

Now putting This Value in equation (2)

$$2.5 = \phi + 0.5\text{eV}$$

$$\phi = 2\text{eV}$$

-
- Q. 15** A 100 V carrier wave is made to vary between 160 V and 40 V by a modulating signal . What is the modulation index ?

Correct Answer:

0.6

Solution:

$$m_a = \frac{E_m}{E_c}$$

$$A_c = 100V$$

$$A_c + A_m = 160V = A_{max} \quad (1)$$

$$A_c - A_m = 40 = A_{min} \quad (2)$$

From (1) & (2)

$$A_c = 100V \text{ \& } A_m = 60m$$

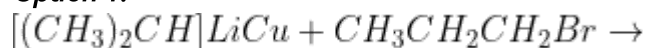
So,

$$\mu = \frac{A_m}{A_c} = 0.6$$

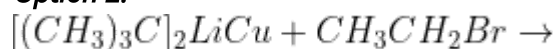
Chemistry

Q. 1 2,2-Dimethylbutane can be obtained by which of the following reaction?

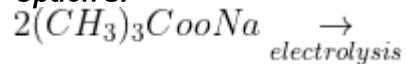
Option 1:



Option 2:



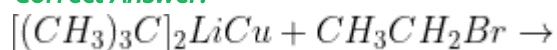
Option 3:



Option 4:

All of the above

Correct Answer:



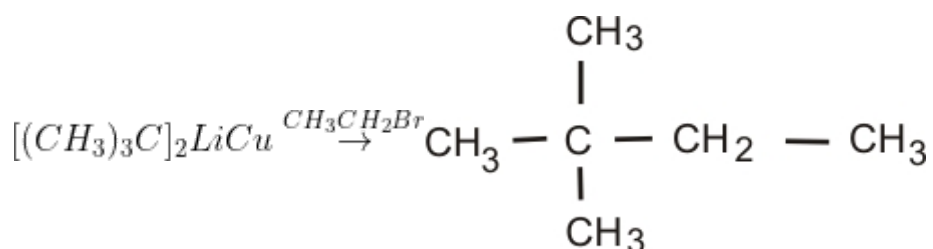
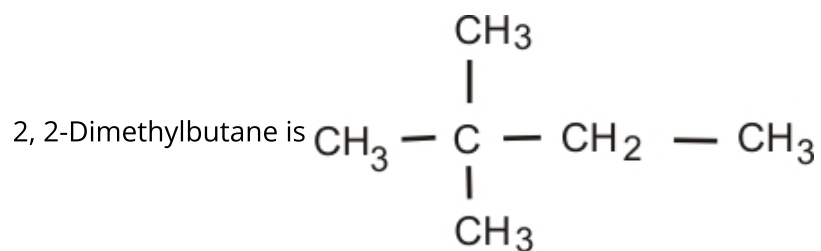
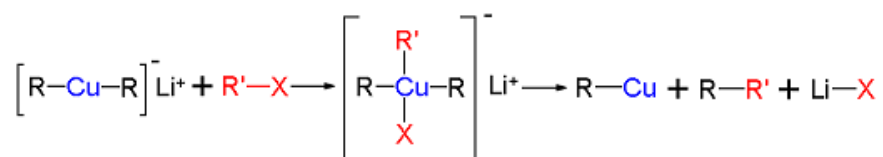
Solution:

As we learn

Corey House Synthesis -

When Gilman's reagent reacts with a primary alkyl halide, it gives higher alkane by S_N2 mechanism.

- wherein



This is Corey - House alkane synthesis.

The correct option is 2

Q. 2 The purest form of commercial iron is:

Option 1:

wrought iron

Option 2:

pig iron

Option 3:

scrap iron and pig iron

Option 4:

cast iron

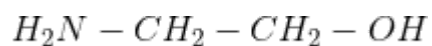
Correct Answer:

wrought iron

Solution:

The purest form of iron is wrought iron.
Therefore, **Option(1) is correct.**

Q. 3 IUPAC name of this compound is:



Option 1:

2-aminoethanol

Option 2:

2-hydroxyethaneamine

Option 3:

1-aminoethanol

Option 4:

Ethaneamine

Correct Answer:

2-aminoethanol

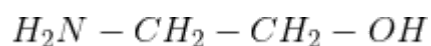
Solution:

As we learn:

Nomenclature of Primary Amines -

As per the IUPAC system, primary amines are named as alkanamines.

2- aminoethanol



Q. 4 Which of the following alkaline earth metal does not give flame test?

Option 1:

Ba

Option 2:

Sr

Option 3:

Ca

Option 4:

Mg

Correct Answer:

Mg

Solution:

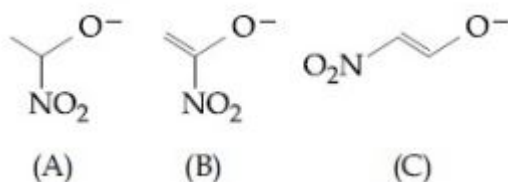
As we learn

Colour of flame due to be and al -

Both do not impart colour to flame

Both Be and Mg do not give flame test because electrons are strongly bound to excited by flame.

Q. 5 The correct order of stability for the following alkoxides is:

**Option 1:**

C > A > B

Option 2:

C > B > A

Option 3:

B > A > C

Option 4:

B > C > A

Correct Answer:

C > B > A

Solution:

When a negative charge is delocalised with an electron-withdrawing group like (NO₂) then stability increases.

(A) The negative charge is localised

(B) The negative charge is **de**localised with the carbon of the alkene

(C) Negative charge is **de**localised with NO₂ group

So, the order will be

C > B > A

Therefore, **Option(2) is correct.**

Q. 6 The correct statement is:

Option 1:

leaching of bauxite using concentrated NaOH solution gives sodium aluminate and sodium silicate.

Option 2:

the Hall-Heroult process is used for the production of aluminum and iron

Option 3:

pig iron obtained from cast iron

Option 4:

the blistered appearance of copper during the metallurgical process is due to the evolution of CO_2

Correct Answer:

leaching of bauxite using concentrated NaOH solution gives sodium aluminate and sodium silicate.

Solution:

Sodium Fusion Extract -

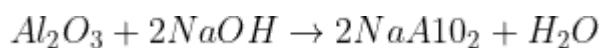
A small pieces of sodium metal is heated with organic compound for 2-3 minutes.

- wherein

The red hot tube is plunged in to the distilled water after filtering this solution. It is known as sodium fusion extract

leaching of Bauxite using concentrated NaOH solution gives sodium aluminate and sodium silicate

It is Bayer's process



sodium aluminate

silica + NaOH \rightarrow sod. silicate

Q. 7 The rate of a chemical reaction doubles for every $10^\circ C$ rise of temperature, if the temperature is raised by $40^\circ C$ the rate of the reaction of the reaction increases by above

Option 1:

10 times

Option 2:

16 times

Option 3:

32 times

Option 4:

64 times

Correct Answer:

16 times

Solution:

As we have learned

Temperature Coefficient -

In homogenous thermal reaction, the rate constant of the reaction becomes double / thrice by changing the temperature by 10° .

- wherein

Formula:

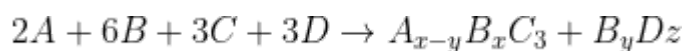
$$\frac{K_t + 10}{K_t} \approx 2 \text{ to } 3$$

K_t = Rate constant of the reaction which is temperature dependent

$$(\text{rate at } 50^\circ\text{C} / \text{Rate at } T_1\text{C}) = (2)^{\Delta T/T_1} = (2)^{40/10} = 2^4$$

16 times

Q. 8 Given the reaction ;



Option 1:

3,2,3

Option 2:

2,4,3

Option 3:

4,2,1

Option 4:

4,2,3

Correct Answer:

4,2,3

Solution:

The number of moles of atoms of **reactant** is equal to the number of moles of atoms of the **product**.

So, Balancing A

$$x - y = 2 \quad - (1)$$

In B,

$$x + y = 6 \quad - (2)$$

In D,

$$z = 3$$

from (1) & (2),

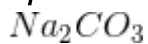
$$x = 4$$

$$y = 2$$

Therefore, **Option(4) is correct**

Q. 9 Which of the following substance can be used as an acidic flux

Option 1:



Option 2:



Option 3:



Option 4:



Correct Answer:



Solution:

As we learn

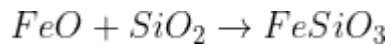
Flux -

A chemical substance which combines with the impurities present in the roasted or calcined ore to form an easily fusible material.

- wherein

Flux + Impurity \rightarrow Slag

SiO_2 can be used as an acidic flux to remove basic impurities.



- Q. 10** 500 ml of an aqueous solution contains 0.1 mole of the solute AB. If its specific conductance is $x \text{ Scm}^{-1}$, Its molar conductance will be
(in $\text{Scm}^2 \text{ mol}^{-1}$)

Option 1:

$10x$

Option 2:

$5000x$

Option 3:

x

Option 4:

$200x$

Correct Answer:

$5000x$

Solution:

As we learned

The formula of Molar Conductivity -

$$\Lambda_m (\text{S cm}^2 \text{ mol}^{-1}) = \frac{\kappa (\text{S cm}^{-1})}{1000 \text{ L m}^{-3} \times \text{molarity} (\text{mol L}^{-1})}$$

$$\Lambda_m = \frac{1000x \text{ specific conductance}}{\text{Molarity}}$$

$$\Lambda_m = \frac{1000x}{0.2} = 5000x \text{ S cm}^2 \text{ mol}^{-1}$$

Q. 11 Calculate the number of atoms of oxygen present in 88 g of CO₂. What would be the mass (in gm) of CO having the same number of oxygen atoms?

Correct Answer:

112

Solution:

LAWS OF CHEMICAL COMBINATIONS -

Law of Multiple Proportions :

This law was proposed by Dalton in 1803. According to this law, if two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element, are in the ratio of small whole numbers.

No. of moles of CO₂ = $88 / (44 \text{ g/mol}) = 2$ moles

As one mole of CO₂ contains two moles of oxygen atoms, so two moles of CO₂ contain 4 moles of oxygen atoms.

Number of oxygen atoms = $4 \times 6.023 \times 10^{23} = 2.5092 \times 10^{24}$

As 1 mole oxygen atoms present in 1 mole of CO so, 4 moles oxygen atoms are present in 4 moles of CO.

It's mass is $4 \times 28 = 112$ g.

Q. 12 Sulphur forms the chlorides S₂Cl₂ and SCl₂. The equivalent mass (in g/mol) of sulphur in SCl₂ is:

Correct Answer:

16

Solution:

We know that atomic weight of sulphur is 32.

In SCl₂, the valency of sulphur is 2. Thus equivalent of sulphur in SCl₂ is given by:

Equivalent weight of sulphur = $32 / 2$
= 16

Q. 13 The percentage composition of carbon by 1 mole in methane is:

Correct Answer:

20

Solution:

Number of Moles -

No of moles = given mass of substance/ molar mass of substance

-

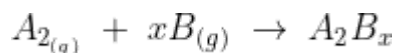
$$\begin{aligned}\text{mole \% of 'C' in CH}_4 &= \frac{\text{mole of C}}{\text{mole of C} + \text{mole of hydrogen}} \times 100 \\ &= \frac{n_c}{n_H + n_c} \times 100\end{aligned}$$

For 1 mole of C, there are 4 moles of hydrogen

$$\therefore n_c = 1 \text{ and } n_H = 4$$

$$= \frac{1}{1+4} \times 100 = 20\%$$

Q. 14 Given the reaction :



If the volumes occupied by A_2 and B required at STP are 22.4L and 44.8L for complete reaction, then the value of x is ?

Correct Answer:

2

Solution:

By Gay Lussac's Law, volume occupied by gases in a reaction are in simple ratio, that is fixed.

$$\text{Moles of } A_2 = \frac{22.4}{22.4} = 1 \text{ mole}$$

$$\text{Moles of } B = \frac{44.8}{22.4} = 2 \text{ mole}$$

$$\therefore x = 2$$

Q. 15 A 100 ml solution of 0.1 N HCl was titrated with 0.2 N NaOH solution. The titration was discontinued after adding 30 ml of NaOH solution. The remaining titration was completed by adding 0.25 N KOH solution, the volume (in ml) of KOH required for completing the titration is

Correct Answer:

16

Solution:

For HCl, NaOH and KOH, normality = molarity

mmoles of HCl = $100 \times 0.1N = 10$

Thus, mmoles of base required for titration = 10

Now, mmoles of NaOH added = $30 \times 0.2 = 6$

Now, for complete titration, mmoles of KOH needed = $10 - 6$

$$= 4$$

Therefore, the volume of KOH required = $4/0.25$

$$= 0.016L \text{ or } 16ml$$

Maths

Q. 1 Solution of the D.E

$$\sin x dy = y (\cos x \cdot y) dx, 0 < x < \frac{\pi}{2} \text{ is}$$

Option 1:

$$\cos(x) = y(x \cdot c)$$

Option 2:

$$\sin(x) = y(x - c)$$

Option 3:

$$\sin(x) = x(y - c)$$

Option 4:

$$\cos(x) = x(y + c)$$

Correct Answer:

$$\sin(x) = y(x - c)$$

Solution:

As we learnt

Bernoulli's Equation -

$$\frac{1}{y^{n-1}} = v$$

$$\frac{1}{y^n} \frac{dy}{dx} = \frac{1}{(1-n)} \frac{dv}{dx}$$

- wherein

$$\frac{1}{y^n} \frac{dy}{dx} + \frac{p}{y^{n-1}} = Q$$

Since,

$$\sin(x)dy = y \cos(x)dx - ydx$$

$$\Rightarrow \frac{1}{y^2} \frac{dy}{dx} - \frac{1}{y} \cot x = \operatorname{cosec}(x)$$

$$\text{Put } \frac{-1}{y} = z \Rightarrow \frac{1}{y^2} \frac{dy}{dx} = \frac{dz}{dx}$$

$$\Rightarrow \frac{dz}{dx} + z(\cot(x)) = -\operatorname{cosec}(x)$$

This is linear D.E.

$$\therefore I f = e^{\int \cot x dx} = e^{\ln|\sin(x)|} = \sin(x)$$

Solution is

$$z(\sin(x)) = \int \sin x.(-\operatorname{cosec}x)dx = -x + c$$

$$\frac{-1}{y} \sin(x) = -x + c$$

$$\sin(x) = y(x - c)$$

Q. 2 A and B are two matrix. If $AB = B$ and $BA = A$ Then $A^2 + B^2 = ?$

Option 1:

$$a + b$$

Option 2:

$$A^2 B + B^2$$

Option 3:

$$B^2 A + A^2$$

Option 4:

All of the above.

Correct Answer:

$$a + b$$

Solution:

As we have learnt

Property of matrix multiplication -

It is associative .

- wherein

$$(AB)C = A(BC)$$

$$A^2B = A(AB) = AB$$

$$A^2B + B^2 = AB + B^2$$

$$= B + B^2$$

$$B^2A = BBA = BA = A$$

$$B^2A + A^2 = BA + A^2 = A + A^2$$

$$AB = B$$

$$BAB = B^2$$

$$(BA)B = AB = B$$

$$(BA) = A$$

$$A(BA) = A^2$$

$$(AB)A = A^2$$

$$(AB) = A$$

$$BA = A$$

Q. 3 If z is origin, then $|z| =$

Option 1:

1

Option 2:

-1

Option 3:

0

Option 4:

None of these

Correct Answer:

0

Solution:

As we learned

Property of Modulus of z(Complex Number) -

$$|z|=0 \text{ iff } z=0$$

- wherein

$$|z|= \text{Modulus of } z$$

Q. 4 If $\sin A = \frac{2}{3}$, then $\left| \sin \frac{A}{2} - \cos \frac{A}{2} \right| =$

Option 1:

$$\frac{1}{3}$$

Option 2:

$$\frac{2}{\sqrt{3}}$$

Option 3:

$$\frac{1}{\sqrt{3}}$$

Option 4:

$$\sqrt{\frac{4}{9}}$$

Correct Answer:

$$\frac{1}{\sqrt{3}}$$

Solution:

As we have learnt

Results from Submultiples of an angle -

$$\left| \sin \frac{A}{2} - \cos \frac{A}{2} \right| = \sqrt{1 - \sin A}$$

$$\left| \sin \frac{A}{2} - \cos \frac{A}{2} \right| = \sqrt{1 - \frac{2}{3}} = \frac{1}{\sqrt{3}}$$

Q. 5 What should be added to complex no $2 + 3i$ to get $1 - i$

Option 1:

$$-1 - 4i$$

Option 2:

$$-1 + 4i$$

Option 3:

$$1 + 5i$$

Option 4:

$$2 - 4i$$

Correct Answer:

$$-1 - 4i$$

Solution:

As we learned

Addition of Complex Numbers -

$$(a+ib)+(c+id)=(a+c)+i(b+d)$$

$$(2 + 3i) + (a + ib) = 1 - i$$

$$(2 + a) + i(3 + b) = 1 - i$$

$$2 + a = 1, 3 + b = -1$$

$$a = -1, b = -4$$

Q. 6 Find the intersection of the plane $x + y - 2z = 10$ and $3x - 4 + z = 5$

Option 1:

$$(4x + 15)/3 = (4y - 25)/5 = z$$

Option 2:

$$(4x - 15)/-3 = (4y - 25)/-5 = z$$

Option 3:

$$(4x - 15)/3 = (4y - 25)/5 = -z$$

Option 4:

none of these

Correct Answer:

$$(4x - 15) / -3 = (4y - 25) / -5 = z$$

Solution:

As we learnt

Equation of line as intersection of two planes -

Let the two intersecting planes be

$$ax + by + cz + d = 0 \text{ and}$$

$$a_1x + b_1y + c_1z + d_1 = 0$$

then the parallel vector of line formed their intersection can be obtained by

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a & b & c \\ a_1 & b_1 & c_1 \end{vmatrix} = A\hat{i} + B\hat{j} + C\hat{k} (\text{assumed})$$

and points can be obtained by putting $z = 0$ and solving

$$ax + by + d = 0 \text{ and}$$

$$a_1x + b_1y + d_1 = 0 \text{ say } \alpha, \beta$$

Now the equation will be

$$\frac{x - \alpha}{A} = \frac{y - \beta}{B} = \frac{z - 0}{C}$$

Given $x+y-2z = 10$ and $3x-y+z = 5$

Let $z = \lambda$

$$x+y = 10-2\lambda \text{ and } 3x-y = 5-\lambda$$

solve the equations

$$\text{we get } 4x = 15 - 3\lambda$$

$$4y = 25 - 5\lambda$$

equation of line is

$$(4x-15)/-3 = (4y-25)/-5 = z$$

Q. 7 The sum of two forces is 18 N and resultant whose direction is at right angles to the smaller force is 12 N. The magnitude of the two forces are

Option 1:

13,5

Option 2:

12,6

Option 3:

14,4

Option 4:

11,7

Correct Answer:

13,5

Solution:

As we learn

laws of vector addition -

$$\vec{a} + \vec{0} = \vec{a} = \vec{0} + \vec{a}$$

$$\text{We have } |\vec{P}| + |\vec{Q}| = 18N \quad |\vec{R}| = |\vec{P} + \vec{Q}| = 12N$$

$$\alpha = 90^\circ \Rightarrow P + Q \cos \Theta = 0 \Rightarrow Q \cos \Theta = -P$$

$$\text{Now, } R^2 = P^2 + Q^2 + 2PQ \cos \Theta \Rightarrow R^2 = P^2 + Q^2 + 2P(-P) = Q^2 - P^2$$

$$\Rightarrow 12^2 = (P + Q)(Q - P) = 18(Q - P)$$

$$\Rightarrow Q - P = 8 \text{ and } Q + P = 18 \Rightarrow Q = 13, P = 5$$

∴ Magnitude of two forces are 5 N , 13 N .

Q. 8 Find arithmetic mean of the following observations

x	2	9	7	5
f(frequency)	5	2	5	2

Option 1:

3.7

Option 2:

5.2

Option 3:

9

Option 4:

7

Correct Answer:

5.2

Solution:

As we learned

ARITHMETIC Mean -

In case of discrete frequency distribution:

If the observations x_1, x_2, \dots, x_n occur with frequencies f_1, f_2, \dots, f_n then

$$\begin{aligned}\bar{x} &= \frac{f_1x_1 + f_2x_2 + \dots + f_nx_n}{f_1 + f_2 + f_3 + \dots + f_n} \\ &= \frac{\sum_{i=1}^n f_i x_i}{\sum_{i=1}^n f_i} = \frac{1}{N} \sum_{i=1}^n f_i x_i\end{aligned}$$

- wherein

where

$$N = \sum_{i=1}^n f_i$$

$$\begin{aligned}\bar{x} &= \frac{2 \times 5 + 9 \times 2 + 7 \times 5 + 5 \times 2}{5 + 2 + 5 + 2} \\ &= \frac{73}{14} \approx 5.2\end{aligned}$$

Q. 9 The median AD of the triangle ABC is bisected at E, BE meets AC in F. Then AF:AC =

Option 1:

3/4

Option 2:

1/3

Option 3:

1/2

Option 4:

1/4

Correct Answer:

1/3

Solution:

As we learn

Mid point formula -

$$\frac{\vec{a} + \vec{b}}{2}$$

- wherein

If \vec{a} and \vec{b} , position vector of mid-point of AB

Let position vector of A with respect to B is a and that of C w.r.t. B is position vector of D w.r.t. B

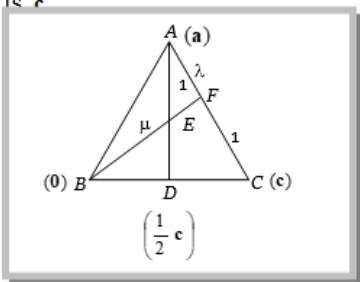
$$B = \frac{0 + c}{2} = \frac{c}{2}$$

Position vector of $E = \frac{a + \frac{c}{2}}{2} = \frac{a}{2} + \frac{c}{4}$ (i)

Let AF:FC = $\lambda : 1$ and BE:EF = $\mu : 1$

Position vector of $F = \frac{\lambda c + a}{1 + \lambda}$

B IS C



Now, position vector of $E = \frac{\mu(\frac{\lambda c + a}{1 + \lambda}) + 1.0}{\mu + 1}$ (ii)

$$\text{From (i) and (ii), } \frac{a}{2} + \frac{c}{4} = \frac{\mu}{(1+\lambda)(1+\mu)}a + \frac{\lambda\mu}{(1+\lambda)(1+\mu)}c$$

$$\Rightarrow \frac{1}{2} = \frac{\mu}{(1+\lambda)(1+\mu)} \text{ and } \frac{1}{4} = \frac{\lambda\mu}{(1+\lambda)(1+\mu)} \Rightarrow \lambda = \frac{1}{2}, \therefore \frac{AF}{AC} = \frac{AF}{AF+FC} = \frac{\lambda}{1+\lambda} = \frac{\frac{1}{2}}{1+\frac{1}{2}} = \frac{1}{3}$$

Q. 10 What is the no. of ways to distribute 20 objects equally among 4 persons?

Option 1:

$${}_{20}P_5 \cdot (4!)$$

Option 2:

$$\frac{(20)!}{(5!)^4}$$

Option 3:

$${}_{20}P_4 \cdot (5!)$$

Option 4:

$$\frac{(20)!}{(4!)^5}$$

Correct Answer:

$$\frac{(20)!}{(5!)^4}$$

Solution:

Rule for Division into Groups -

Number of ways in which $m \times n$ different objects can be distributed equally among n persons

$$= \frac{(mn)!n!}{(m!)^n n!} = \frac{(mn)!}{(m!)^n}$$

$$\frac{(20)!}{(5!)^4}$$

Q. 11 If $-2 - 3i$ is a root of quadratic equation with real coefficient what will be the product of roots

Option 1:

13

Option 2:

24

Option 3:

6I

Option 4:

-24

Correct Answer:

13

Solution:

As we learned

The behavior of Imaginary roots -

For any polynomial equation with real coefficients, Imaginary roots always occur in conjugate pairs.

-

$-2 + 3i$ is another root

So, $(-2 - 3i)(-2 + 3i)$

$= 4 + 9 = 13$

Q. 12 What is the number of ways of selecting Letters from 3 A's, 2B's and 4C's

Option 1:

24

Option 2:

60

Option 3:

9

Option 4:

36

Correct Answer:

60

Solution:

Theorem of Combinations -

The number of ways of selecting from a collection of m objects of one kind, n objects of another kind and p objects of another kind are $(m + 1)(n + 1)(p + 1)$.

$$(3 + 1)(2 + 1)(4 + 1)$$

$$= 60$$

Q. 13 $\lim_{x \rightarrow 0} \frac{\sin 3x}{\tan 2x} = ?$

Option 1:

$$\frac{2}{3}$$

Option 2:

$$\frac{-1}{2}$$

Option 3:

$$\frac{3}{2}$$

Option 4:

$$1$$

Correct Answer:

$$\frac{3}{2}$$

Solution:

As we learned

Condition of Trigonometric Limits -

$$\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$$

$$\lim_{x \rightarrow 0} \frac{\tan x}{x} = 1$$

- wherein

because $\frac{\sin x}{x} < 1$ (in the neighbourhood of $x=0$)

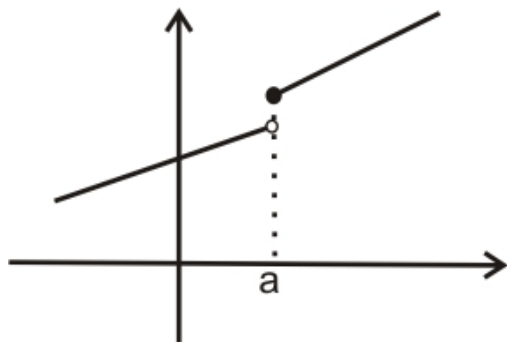
$\frac{\tan x}{x} > 1$ (in the neighbourhood of $x=0$)

$$\lim_{x \rightarrow 0} \frac{\sin 3x}{\tan 2x} = \frac{\lim_{x \rightarrow 0} \left(\frac{\sin 3x}{3x} \right) * 3}{\lim_{x \rightarrow 0} \left(\frac{\sin 2x}{2x} \right) * 2}$$

$$= \frac{1 * 3}{1 * 2} = \frac{3}{2}$$

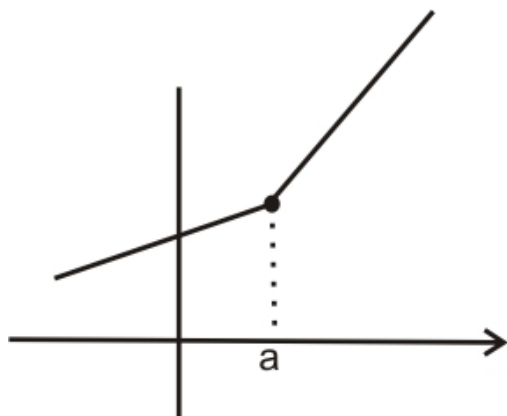
Q. 14 Match the following

(i)



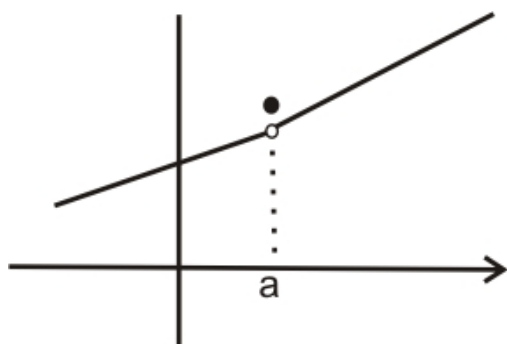
(p) Limit exist at $x=a$ but not continuous

(ii)



(q) Continuous at $x=a$

(iii)



(r) Limit doesn't exist at $x=a$

Option 1:

(i) – (r); (ii) – (p); (iii) – (q)

Option 2:

(i) – (q); (ii) – (p); (iii) – (r)

Option 3:

(i) – (r); (ii) – (q); (iii) – (p)

Option 4:

(i) - (p); (ii) - (q); (iii) - (r)

Correct Answer:

(i) - (r); (ii) - (q); (iii) - (p)

Solution:

As we learned

Geometrical interpretation of continuity at a point -

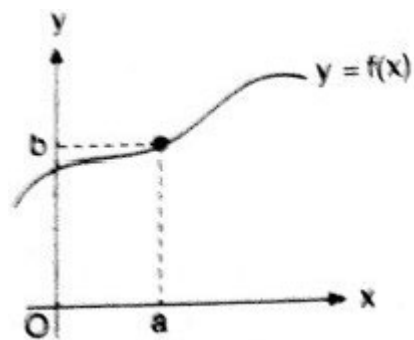
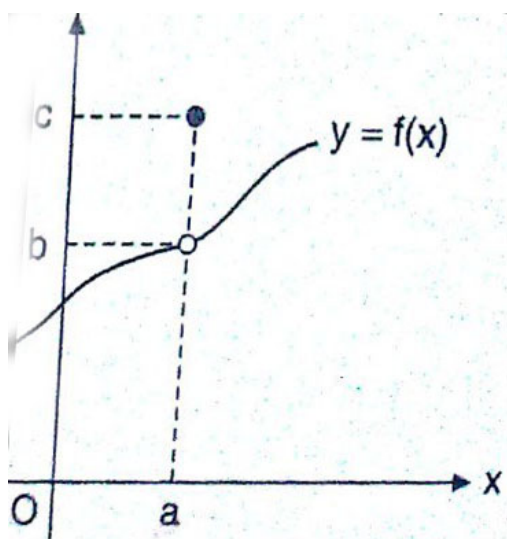
When a graph breaks at a particular point when it approaches from left and right.

$$\therefore \lim_{x \rightarrow a^-} f(x) = \lim_{x \rightarrow a^+} f(x)$$

So limit exist but not continuous: but when it is equal to $f(a)$ at $x = a$ then $f(x)$ is continuous.

$$\lim_{x \rightarrow a^-} f(x) = \lim_{x \rightarrow a^+} f(x) = f(a)$$

- wherein



Q. 15

If $A = \begin{vmatrix} -1 & \sin C & \sin B \\ \cos C & -1 & \cos A \\ \cos B & \cos A & -1 \end{vmatrix}$ is symmetric, then $[A, B, C \in (0, \frac{\pi}{2})]$

Option 1:

A, B, C are angles of triangle.

Option 2:

A=B=C

Option 3:

both (a) and (b)

Option 4:

None of the above

Correct Answer:

A=B=C

Solution:

As we have learnt

Symmetric determinants -

The elements situated at equal distance from the diagonal are equal both in magnitude and sign

- wherein

$$\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix}$$

A is symmetric. $\cos c = \sin c$

$\tan c = 1$

$$c = 45^\circ = \pi/4$$

correct option b

Q. 16

In cartesian coordinate system point A = (3,5) and B = (2,7), if point 'C' divides AB in ratio 3:5 point 'C' is :

Solution:

As we have learned

Section formula -

$$x = \frac{mx_2 + nx_1}{m + n}$$

$$y = \frac{my_2 + ny_1}{m + n}$$

- wherein

If P(x,y) divides the line joining A(x₁,y₁) and B(x₂,y₂) in ratio $m : n$

3:5

A  B

C

$$x_c = \frac{3x_B + 5x_A}{3 + 5} = \frac{3 \times 2 + 5 \times 3}{3 + 5} = 21/8$$

$$y_c = \frac{3y_B + 5y_A}{3 + 5} = \frac{3 \times 7 + 5 \times 5}{3 + 5} = \frac{46}{8}$$

Q. 17 In cartesian coordinate system Point A = (2,7) , B= (3,10) , C = (5/2,17/2) and D = (4,13) then

Option 1:

'C' divides AB internally 1:1 and D divides externally in ratio 1:1

Option 2:

'C' divides AB internally 2:1 and D divides externally in ratio 2:1

Option 3:

'C' divides AB internally 1:1 and D divides externally in ratio 2:1

Option 4:

none of these

Correct Answer:

'C' divides AB internally 1:1 and D divides externally in ratio 2:1

Solution:

As we have learned

Internal and external division -

For internal ratio , $\frac{m}{n}$ is positive.

For external ratio, $\frac{m}{n}$ is negative.

- wherein

If P(x,y) divides the line joining A(x₁,y₁) and B(x₂,y₂) in ratio $m : n$



$$D = (4, 13) = \left(\frac{2 \times 3 - 1 \times 2}{2 - 1}, \frac{2 \times 10 - 1 \times 7}{2 - 1} \right) \text{ D divides externally in 2:1}$$

$$C = (5/2, 17/2) = \left(\frac{1 \times 3 - 1 \times 2}{1 + 1}, \frac{1 \times 10 - 1 \times 7}{1 + 1} \right) \text{ 'C' divides internally in 1:1}$$

Q. 18 Find the mid point of line segment AB where A = (3,5) and B = (2,7)

Option 1:

(5,12)

Option 2:

(1,-2)

Option 3:

(6,35)

Option 4:

none of these

Correct Answer:

none of these

Solution:

As we have learned

Mid-point formula -

$$x = \frac{x_1 + x_2}{2}$$

$$y = \frac{y_1 + y_2}{2}$$

- wherein

If the point P(x,y) is the mid point of line joining A(x₁,y₁) and B(x₂,y₂) .

Mid point of AB =

$$\left(\frac{x_A + x_B}{2}, \frac{y_A + y_B}{2} \right)$$
$$= \left(\frac{3 + 2}{2}, \frac{5 + 7}{2} \right) = (5/2, 6)$$

Q. 19 Find the coordinate of circum centre of a triangle ABC if A = (5,0) , B = $(5/\sqrt{2}, 5/\sqrt{2})$ and C = (0,5)

Option 1:

(0,0)

Option 2:

(0,5)

Option 3:

(5/2,5/2)

Option 4:

none of these

Correct Answer:

(0,0)

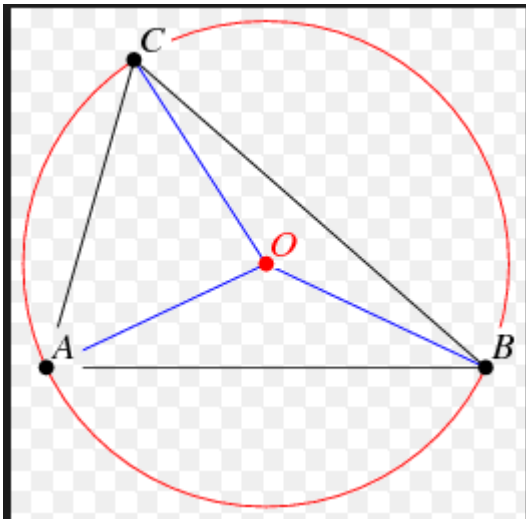
Solution:

As we have learned

Circumcentre of triangle -

Equate the distance of circumcentre from the three vertices.

- wherein



since $A = (5,0)$ distance of all 3 point from origin is = 5

$$B = (5/\sqrt{2}, 5/\sqrt{2})$$

$$C = (0,5)$$

circumcentre is (0,0)

Q. 20 In $\triangle ABC$; $A = (3, 5), B = (1, 2), C = (8, 8)$ find the centroid of this $\triangle ABC$

Option 1:

(1,2)

Option 2:

(4,5)

Option 3:

(5,4)

Option 4:

(2,2)

Correct Answer:

(4,5)

Solution:

As we have learned

Centroid formula -

$$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$

- wherein

$A(x_1, y_1)$; $B(x_2, y_2)$ and $C(x_3, y_3)$ are the vertices of $\triangle ABC$.

Centroid of a $\triangle ABC$

$$\begin{aligned} & \left(\frac{(x_A + x_B + x_C)}{3}, \frac{(y_A + y_B + y_C)}{3} \right) \\ &= \left(\frac{3 + 1 + 8}{3}, \frac{5 + 2 + 8}{3} \right) = (4, 5) \end{aligned}$$

English

Q. 1 Read the following passage and answer the question that follows:

There is a wave of unrest among the students of today. Not a single day passes without the news of a strike in some college or some university. Undisciplined behavior on the part of the students has become a matter of everyday occurrence. On frivolous pretexts, students choose to go on rampage. They do not hesitate from burning national property, insulting and attacking their teachers, stoning buses and creating chaos and disorder. Sometimes it is a question of the cinema tickets that makes them go violent; at some another time it is the issue of increased bus fares or fees that makes them go on a rampage. Everyday there is a new pretext. They are never in a mood to take to their books seriously and attend the classes in a disciplined manner.

Now, this is a very sad state of affairs. Students of today are the leaders of tomorrow. The problem of student unrest cannot, therefore, be dismissed as something unimportant. Those in authority must go into the causes of unrest and see if some corrective steps can be taken to save the situation.

The most important reason of this unrest is the spirit of the age. It is an age of science and intellect. The modern young man is not prepared to take anything for granted or to accept anything without questioning. He wants to know how and why things happen as they do. He is not prepared to accept the established moral values or faith. He has lost his spiritual moorings and wants to find a new cult to sustain himself. It is a rootless generation cut off from the past, facing an uncertain future. Students are a part of this generation. They are full of doubts and questions. Elders fail to present any enviable image before them and do not win their respect or admiration. Students are a witness to the hypocrisy of their elders. They notice a sharp contrast in what they preach and what they practice. It is, therefore, natural for them to get frustrated.

Which of the following should be the best title for the passage?

Option 1:

Discipline and its need

Option 2:

Importance of discipline among students

Option 3:

Indiscipline among students and its causes

Option 4:

Students and their rowdiness

Option 5:

Record of disorderliness among students

Correct Answer:

Indiscipline among students and its causes

Solution:

“Indiscipline among students and its causes” catches the central idea of the passage.

Q. 2 Find the correct adjective.

The conflict was ____ for both parties.

Option 1:

uncanny

Option 2:

internecine

Option 3:

munificent

Option 4:

lavish

Option 5:

appealing

Correct Answer:

internecine

Solution:

Conflicts are dangerous to both sides

Q. 3 Change the voice

They will help us

Option 1:

We will help them

Option 2:

We will be helped by them

Option 3:

We shall be helped

Option 4:

They will be helping us

Option 5:

We would be helped

Correct Answer:

We will be helped by them

Solution:

The subject-object change is best observed in the correct option. Thus, "We will be helped by them" is the answer.

Q. 4 Read the paragraph and choose a suitable summary from the given options:

Nationalism is a concept according to which the nation is considered to be supreme, deserving the highest priority. Nationalism is an ideology that promotes the shared identity of the citizens of any country. For a nation's progress and prosperity, it is imperative that its citizens rise above their regional identities and strengthen the sense of pride in their nation. There are many countries, including India which are culturally, religiously and linguistically diverse and in these countries the sense of nationalism helps achieve unity in diversity.

Option 1:

Nationalism promotes integrity and hence, it should be promoted.

Option 2:

Nationalism deserves the highest priority

Option 3:

Nationalism is a champion of unity and deserves precedence and preference

Option 4:

Nationalism advocates unity

Option 5:

Nationalism is intrigued into various spheres of life and sets high standards of moral values

Correct Answer:

Nationalism is a champion of unity and deserves precedence and preference

Solution:

'Nationalism is intrigued into various spheres of life and sets high standards of moral values' is beyond context. Other options are incomplete and are blended in the correct option. Thus, "Nationalism is a champion of unity and deserves precedence and preference" is the answer.

Q. 5 Find out the correct form of tense.

I _____you the next week.

Option 1:

will be killing

Option 2:

will kill

Option 3:

could be killing

Option 4:

shall be killing

Option 5:

would be killing

Correct Answer:

will kill

Solution:

In accordance with the context, we need the simple future tense. 'Will be killing' will change the meaning and create ambiguity.

Q. 6 Find out the correct antonym for the given word:

Exalt

Option 1:

Estrange

Option 2:

Obviate

Option 3:
Deride

Option 4:
Extravagant

Option 5:
Implore

Correct Answer:
Deride

Solution:

Exalt means to praise and deride means to ridicule or criticize.

Q. 7 Find out the part of the sentence which is contextually incorrect:
His being savage to people and also his ungracious nature is sometimes imputed to his being serene.

Option 1:
His being savage to people

Option 2:
and also his ungracious nature

Option 3:
No error

Option 4:
is sometimes imputed to

Option 5:
his being serene

Correct Answer:
and also his ungracious nature

Solution:

The sentence describes that he is discourteous and aggressive. Thus, it cannot be attributed to his serene (peaceful) nature.

Q. 8 Change the speech

I asked my classmate if he had paid off the money to his teacher.

Option 1:

I said to my classmate, "Have you paid off the money to his teacher?"

Option 2:

I said to my classmate, "Have you paid off the money to your teacher?"

Option 3:

I said to my classmate "Had I paid off the money to my teacher."

Option 4:

I said to my classmate "Had you paid off the money to my teacher."

Option 5:

I said to my classmate that do you paid off the money to his teacher

Correct Answer:

I said to my classmate, "Have you paid off the money to your teacher?"

Solution:

We need to include direct words and quotes and "I said to my classmate, "Have you paid off the money to your teacher" is grammatically correct.

Q. 9 Find out the synonym for the given word:

Marginalize

Option 1:

Diverse

Option 2:

Alienate

Option 3:

Divulge

Option 4:

Decline

Option 5:

Accept

Correct Answer:

Alienate

Solution:

Alienate and marginalize mean to isolate.

Q. 10 Find out the countable noun in the following question:

I need to get my account opened in this bank with a meager amount of Rs 1000.

Option 1:

Need

Option 2:

Account

Option 3:

with

Option 4:

I

Option 5:

My

Correct Answer:

Account

Solution:

It is correct to use 's' or 'es' with account.