MET 2023

Sample Papers

Physics

Q. 1 A ball is thrown from ground with velocity u and angle θ with horizontal then the horizontal range is 10m. If the ball is thrown with velocity 3u and with same angle of projection then the horizontal range will become

Option 1:
10 m

Option 2:
40 m

Option 3:
90 m

Option 4:
60 m

Correct Answer:
90 m

Solution:
As we learned

Projectile Projected at angle ? -

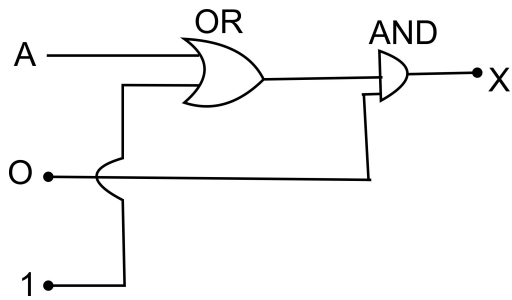When the velocity of projectile increased n time then

- wherein

horizontal range is increased by a fator of n²

$$R = \frac{u^2 \sin 2\Theta}{g}$$

for sameθ

$$R \propto u^2 \qquad \frac{R_2}{R_1} = \left(\frac{3u}{u}\right)^2 \Rightarrow R_2 = 9R_1$$

Q. 2 The output, in the folowing gate logic, would be:

Option 1:
0

Option 2:
1

Option 3:
A

Option 4:
1+A

Correct Answer:
0

Solution:
As we have learned

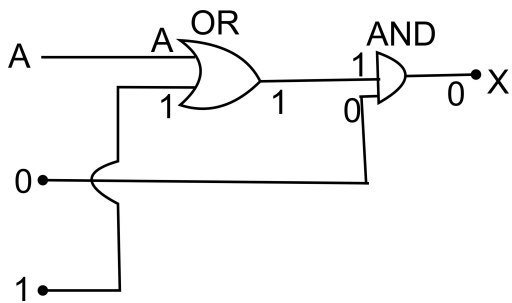Some Important relation -

$$A + A = A$$

$$A \cdot A = A$$

$$A + 1 = 1$$

$$A \cdot 1 = 1$$

$$A \cdot 0 = 0$$

$$A + 0 = A$$

-

We know 1+A=1 always, hence the output of OR gate would be always 1, irrespective of any value of A

1	A	OR
1	0	1
1	1	1

Similarly $1 \cdot 0 = 0$

We know that output of AND gate is zero, if atleast one input to AND gate is zero.

A	0	AND
1	0	0
0	0	0

Hence X=0

Q. 3   If the magnitude of voltage in a circuit changes with time between zero to peak value and direction changes periodically then the voltage is called:

Option 1:
Alternative voltage

Option 2:
direct voltage

Option 3:
constant voltage

Option 4:
reversible voltage

Correct Answer:
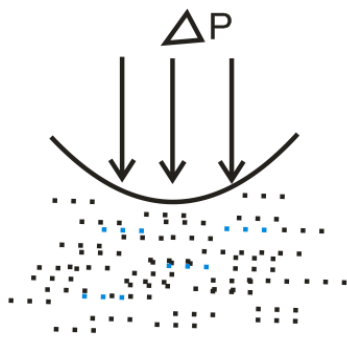Alternative voltage

Solution:
As we learn

Alternating Voltage (V) -

An alternating voltage (V) is one whose magnitude changes with time between zero to peak value (0 to V_0)

- wherein

Where voltage changes periodically.

Q. 4 For the gluon concave surface the excess oressure $\triangle P$ is

Option 1:
$Zero$

Option 2:
$\dfrac{T}{R}$

Option 3:
$\dfrac{2T}{R}$

Option 4:
$\dfrac{4T}{R}$

Correct Answer:
$\dfrac{2T}{R}$

Solution:
As we have learnt in

Excess pressure for concave surface -

$$\Delta P = \frac{2T}{R}$$

-

ΔP for concave surface = $\frac{2T}{R}$

Q. 5　　Faraday's law of electromagnetic induction is conservation of -

Option 1:
charge

Option 2:
magnetic flux

Option 3:
energy

Option 4:
magnetic field

Correct Answer:
energy

Solution:
As we have learnt

Faraday Second Law of Induction emf -

$$\varepsilon = \frac{-d\phi}{dt} = -L\frac{dI}{dt}$$

-

(concept not mentioned)

Induced charge is given by the rate of change of magnetic flux

Q. 6 Which of the following is true about the mass of the body?

Option 1:
It's value does not change with g

Option 2:
It is a scalar quantity

Option 3:
it's unit is in kilogram

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we learn

Mass -

Quantity of matter contained in body

$$S.I. \rightarrow [Kg]$$

dimension $[M]$

- wherein

(i) Value does not change with g

(ii) Can never be zero

(iii) Scalar quantity

Q. 7 A constant retarding force of 50m is applied to a body of mass 20kg moving initially with the speed of 15m/s. How long does the body take to stop ?

Option 1:
4s

Option 2:
5s

Option 3:
10s

Option 4:
6s

Correct Answer:
6s

Solution:
As we learn

Newton's 2nd Law -

$$F \propto \frac{dp}{dt}$$

$$F = \frac{kdp}{dt}$$

$$F = \frac{d(mv)}{dt}$$

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

$$\frac{dv}{dt} = a$$

Therefore $F = ma$

- wherein

$K = 1$ in C.G.S & S.I

Force can be defined as rate of change of momentum.

Retardation $a = \dfrac{F}{m} = \dfrac{50}{20} = 2.5 m/s^2$

Now by equation of motion

$$v = u + at = 0 = u - at$$

$$t = \frac{u}{a} = \frac{15}{2.5} = 6sec$$

Q. 8   If a 5 Kg mass is suspended by a spring balance in a lift which is accelerated downward at 10 m/s ^{2} .The reading of the balance is

Option 1:
more than 5Kg weight

Option 2:
is less than 5Kg weight and greater than zero

Option 3:
is equal to 5 Kg weight

Option 4:
zero

Correct Answer:
zero

Solution:

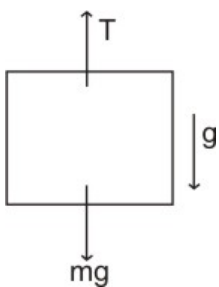**Apparent weight of body in a lift when Lift is moving down with a = g**

As $a = g$

$$mg - R = mg$$

$$R = 0$$

Apparent weight = 0 (weightlessness)

Draw FBD of block

mg- T = mg

T= 0

so reading of balance is zero

Q. 9   In the experiment of obtaining velocity of transverse wave using sonometer we found λ_1 and λ_2 as two succesive responce length then velocity will be proportional to

Option 1:
$V \propto (l_1 \times l_2)$

Option 2:
$V \propto (l_2/l_1)$

Option 3:
$V \propto (l_1/l_2)$

Option 4:
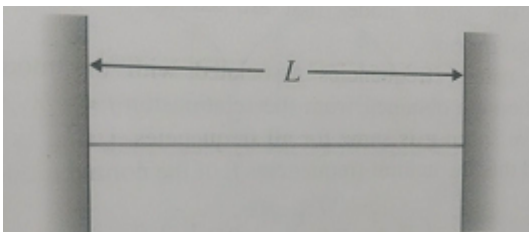$V \propto (l_2 - l_1)$

Correct Answer:
$V \propto (l_2 - l_1)$

Solution:
As we learned from

Velocity of transverse wave using sonometer -

$v = n_0 \lambda$

$= 2 n_0 (l_2 - l_1)$

- wherein

where $\dfrac{\lambda}{2} = l_2 - l_1$

l_2 and l_1 are the two successive resonance length.

$$V = n_0(\lambda)$$

$$\lambda = 2\left(l_2 - l_1\right)$$

so $V = 2n_0\left(l_2 - l_1\right)$

Q. 10   Axis of rotation of earth is called:

Option 1:
Magnetic axis

Option 2:
Geographic pole

Option 3:
geographic axis

Option 4:
Magnetic pole

Correct Answer:
Geographic pole

Solution:
As we learn

Geographic Axis -

Axis of rotation of Earth is called Geographic axis.

-

Q. 11   The current gain of a common emitter amplifier is 69. If the emitter current is 7.0 mA, collector current (in mA) is :

Correct Answer:
6.9

Solution:
As we have learnt,

Relation between α and β -

$$\beta = \frac{\alpha}{1-\alpha}$$

- wherein

$$\alpha = \frac{I_C}{I_E}$$

$$\beta = \frac{I_C}{I_B} \text{ (current gain)}$$

Current gain $\beta = \frac{\Delta I_C}{\Delta I_B} = 69$

$$\frac{\Delta I_C}{\Delta I_E - \Delta I_C} = 69 \Rightarrow \frac{\Delta I_E}{\Delta I_C} - 1 = \frac{1}{69}$$

$$\frac{\Delta I_C}{\Delta I_E} = 1 + \frac{1}{69} = \frac{70}{69}$$

$$\Rightarrow \Delta I_C = (\Delta I_E)\frac{70}{69} = (7mA) \times \frac{69}{70} = 6.9mA$$

Q. 12 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 (1μ=931MeV)
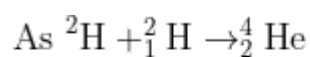

Correct Answer:
6.675

Solution:
As we learn

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

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

$$m_p = 938.27 \, Mev/c^2$$

$$m_n = 939.56 \, Mev/c^2$$

$$1 \, amu = 931.5 \, Mev/c^2$$

As $^2\text{H} +_1^2\text{H} \rightarrow_2^4\text{He}$
Here, $\Delta m = 0.02866\text{u}$

$\therefore$ 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. 13 When radiation of wavelength λ is used to illuminate a metallic surface, the stopping potential is V. When the same surface is illuminated with radiation of wavelength 3λ, the stopping potential is V/4 . If the threshold wavelength for the metallic surface is $n\lambda$ then value of n will be_____

Correct Answer:
9

Solution:

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_0} + eV \quad \ldots\ldots (i)$$

$$\frac{hc}{3\lambda} = \frac{hc}{\lambda_0} + \frac{e \cdot V}{4} \quad \ldots\ldots (ii)$$

$(multiply \ \ equation(ii) \ by \ 4)$

$$we \ get \quad \frac{4hc}{3\lambda} = \frac{4hc}{\lambda_0} + eV \quad \ldots (iii)$$

$Now \ From \ (i) \ \& \ (iii) \ we \ get$

$$\frac{hc}{\lambda} - \frac{hc}{\lambda_0} = \frac{4hc}{3\lambda} - \frac{4hc}{\lambda_0}$$

$$-\frac{hc}{3\lambda} = -\frac{3hc}{\lambda_0}$$

$$\Rightarrow 9\lambda = \lambda_0$$

$$n = 9$$

Q. 14 A car is moving with a speed of 30 m/s on a circular path of radius 500m. Its speed is increasing at the rate of $2m/s^2$. What is the acceleration (in m/s^2) of the car?

Correct Answer:
2.7

Solution:

Given :
Tangential acceleration, $(a_t) = 2 \ m/s^2$
Centripetal acceleration, $(a_c) = \dfrac{v^2}{r} = \dfrac{900}{500} = 1.8 \ m/s^2$

$\therefore$ Net acceleration , $(a) = \sqrt{(a_t)^2 + (a_c)^2}$

$$a = \sqrt{(2)^2 + (1.8)^2} = 2.7 \ m/s^2$$

Q. 15

A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5m/s2. What would be the reading on the scale. (g=10m/s2)

Correct Answer:
1200

Solution:
Solution :
Reading of weighing scale = m(g+a) = 80(10 + 5) = 1200 N

Chemistry

Q. 1   Which of the following is a colourless neutral gas:

Option 1:
NO

Option 2:
NO_2

Option 3:
N_2O_3

Option 4:
N_2O_5

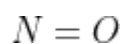*Correct Answer:*
NO

Solution:
As we learn

Nitric oxide -

NO (+2), colourless

- wherein

$$N = O$$

N_2O : Colourless neutral gas

NO : Colourless neutral gas

NO_2 : Brown gas

N_2O_3 : Blue Solid

N_2O_5 : Colourless solid

Q. 2 A gas expands from 10 ltr to 12 ltr against 1 atm pressure and absorb 10 Ltr – atm heat. Then change in its internal energy will be

Option 1:
12 Ltr- atm

Option 2:
-2 Ltr – atm

Option 3:
8 Ltr - atm

Option 4:
2 Ltr – atm

Correct Answer:
8 Ltr - atm

Solution:
As we learn

First law of Thermodynamics -

The energy of universe is always conserved or total energy of an isolated system is always conserved

$$\Delta E = q + W$$

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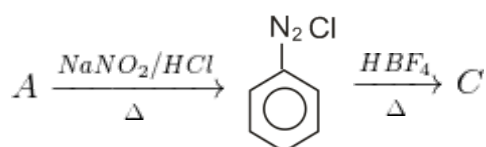- wherein

$\Delta E =$ Internal Energy

$Q =$ Heat

$W =$ work

$\Delta E = q + w$

$$q = 10 Ltr - atm$$
$$w = -P(V_f - V_i)$$
$$= -1(12 - 10)$$
$$= -20 Ltr - atm$$

$\Delta E = 10 - 2$

$\Delta = 8 Ltr - atm$

Q. 3

$$A \xrightarrow[\Delta]{NaNO_2/HCl} \overset{N_2Cl}{\underset{}{\bigcirc}} \xrightarrow[\Delta]{HBF_4} C$$

In the above reaction what is A ans C respectively?

Option 1:

NH₂ , F
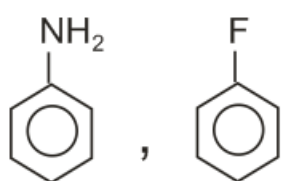
Option 2:

NO₂ , BF₂
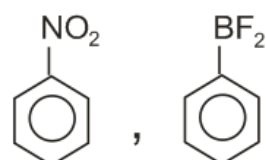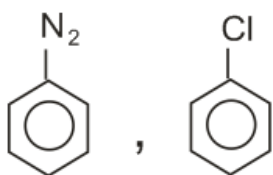
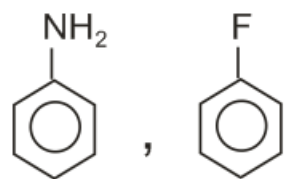**Option 3:**

Option 4:
None of these

Correct Answer:

Solution:
As we learn

Reaction with Nitrous Acid Primary Amines -

Primary amines react with nitrous acid to produce diazonium ion.

- wherein

$$R - NH_2 + HNO_2 \rightarrow R - N^{\oplus} \equiv N$$

$$ArNH_2 + HNO_2 \rightarrow Ar - N^{\oplus} \equiv N$$
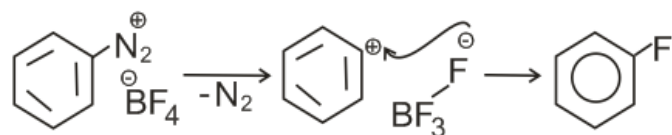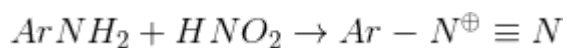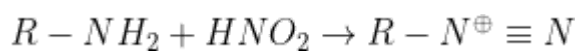
Q. 4 Na$_2$O$_2$ is pale yellow in colour due to

Option 1:
Presence of traces of superoxides (NaO$_2$)

Option 2:
O_2^{-2} ion has unpaired electrons.

Option 3:
O_2^{-2} ion is paramagnetic in nature

Option 4:
Its high oxidising power.

Correct Answer:
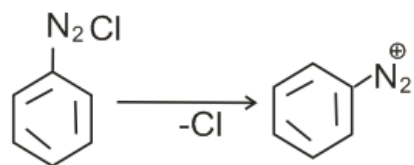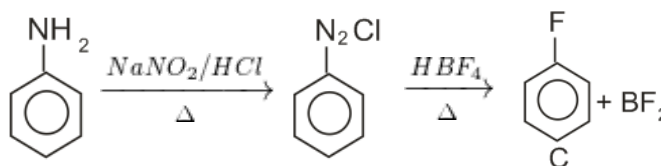Presence of traces of superoxides (NaO$_2$)

Solution:

Properties of Na$_2$O$_2$-

Colourless in pure state, faint yellow is due to presence of small amount of superoxide NaO_2

-

Though O_2^{-2} ion does not has any unpaired electron yet Na$_2$O$_2$ is pale yellow in colour due to the presence of traces of NaO$_2$.

Correct option is 1.

Q. 5 Which of the following metal cation has least heat of hydration?

Option 1:
Li$^+$

Option 2:
Na$^+$

Option 3:
K$^+$

Option 4:
Rb$^+$

Solution:
As we learn-

Rb$^+$ has minimum charge density .

So its $\Delta_{hydration} H$ is minimum.

Q. 6   Which of the following element has the lowest melting point?

Option 1:
B

Option 2:
Al

Option 3:
Ga

Option 4:
In

Solution:
As we have learnt,

Melting Point of Boron Family -

Decreases from B to Ga then increases

- wherein

Due to strong crystalline lattice, boron has usually high melting point

Element: B	Al	Ga	In
M.P:	2180	660	30	157
(^{O}C)			

Melting point of Ga is lowest $\approx 30^\circ C$

Q. 7   Which statement is correct for cross Aldol Reaction ?

Option 1:
Reactants must contain $\alpha - H \, aton$

Option 2:
The product of the Reaction is hydroxy Aldehyde or hydroxy Ketone.

Option 3:
Condensation carried out between two different Aldehydes or Ketones or between one aldehyde and one ketone

Option 4:
All of the above

Correct Answer:
All of the above

Solution:
As we learned

Cross aldol condensation -

Aldol condensation carried out between two different aldehydes or ketones or between one aldehyde and one ketone.

- wherein
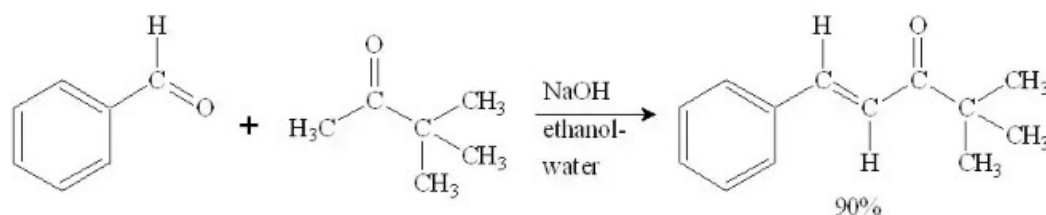
Q. 8   The dilute aqueous solution of which acid is used as a weak antiseptic for eyes:

Option 1:
H_3BO_3

Option 2:
H_2SO_4

Option 3:
H_2CO_3

Option 4:
H_3PO_3

Correct Answer:
H_3BO_3

Solution:

Boric acid -

Its dilute solution is used as weak antiseptic for eyes and form a part of antiseptic baby talcum powder

-

 Boric acid in dilute aqueous solution is weak antiseptic for eyes.

Q. 9   In Lassaigne's test of Sulphur containing compound the appearance of violet colour is due to the presence of

Option 1:
$Na_4[Fe(CN)_6]$

Option 2:
$FeSO_4$

Option 3:

$[\mathrm{Fe(CN)_5NOS}]^{4-}$

Option 4:
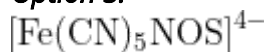
$[\mathrm{Fe(CN)_5NO}]^{2-}$
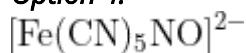
Correct Answer:
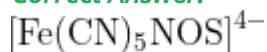
$[\mathrm{Fe(CN)_5NOS}]^{4-}$

Solution:
As we have learnt,

Test for Sulphur:

In Lassaigne's test of Sulphur containing compound, the violet colour is due to the formation of $[\mathrm{Fe\,(CN)_5\,NOS}]^{4-}$ upon reaction of sodium fusion extract with Nitroprusside anion.

The reaction is given below:

$$\mathrm{S}^{2-} + [\mathrm{Fe(CN)_5NO}]^{2-} \longrightarrow [\mathrm{Fe(CN)_5NOS}]^{4-}$$
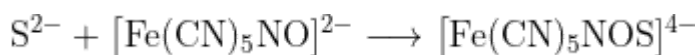
Hence, the correct answer is Option (3)

Q. 10   THe primary valency of the central metal ion in the complex $[Co(NH_3)_5Cl]Cl_2$ is

Option 1:
1

Option 2:
2

Option 3:
3

Option 4:
6

Correct Answer:
2

Solution:
As we have learned

Primary valency -

These are normally ionisable and satisfied by negative ions.

- wherein

eg:

$COCl_2 \rightarrow$ Primary Valency is 2

$CrCl_3 \rightarrow$ Primary Valency is 3

Postulates of Werner's theory

Q. 11   Solve the following equation with correct significant figures: 1.5×6.423

Correct Answer:
9.6

Solution:
The number of significant figures in the result would not exceed the number in the equation with the least number of significant figures.

So, solution is 9.6 as 1.5 has just 2 significant figures

Therefore, **Option (1) is correct**

Q. 12   At 518º C, the rate of decomposition of a sample of gaseous acetaldehyde, initially at a pressure of 363 Torr, was 1.00 Torr s⁻¹ when 5% had reacted and 0.5 Torr s⁻¹ when 33% had reacted. The order of the reaction is :

Correct Answer:
2

Solution:
nth-order reaction -

The rate of the reaction is proportional to the nth power of the reactant

Differential rate law (r)

$$= \frac{dx}{dt} = k(a - x)^n$$

a-x = left amount.

5% reacted means 100-5 = 95% left amount

33% reacted means 100-33 = 67% left amount

Then

At 363 torr 95% of Total = a-x = 0.95 P_o

And after 33% reacted then 67% of Total = a-x = 0.67 P_o

Let rate law be:

$$r = K \, [\text{Acetaldehyde}]^n$$

after 5% reaction

$$\therefore 1 = K \, (0.95 \, P_o)^n$$

After 33% reaction

$$0.5 = K \, (0.67 \, P_o)^n$$

$$So \; 2 = \left(\frac{0.95}{0.67}\right)^n \Rightarrow 2 = (1.41)^n$$

$$\therefore n = 2$$

Q. 13 The formula of a gaseous hydrocarbon which requires 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is $C_x H_y$. The value of y is _____.

Correct Answer:
8

Solution:

$$C_x H_y + 6O_2 \longrightarrow 4CO_2 + \frac{y}{2} \, H_2O$$
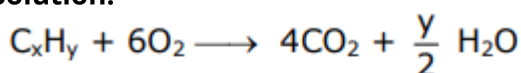
Applying POAC on 'O' atoms
6 × 2 = 4 × 2 + y/2 × 1
y/2 = 4 $\Rightarrow$ y = 8

Answer : 8

Q. 14 What is the total number of moles if we have a mixture of 34g of Ammonia, 78g of Benzene and 10g Hydrogen?

Correct Answer:
8

Solution:

$$Number \; of \; moles \; of \; ammonia = \frac{mass \; of \; ammonia}{molar \; mass \; of \; ammonia} = \frac{34}{17} = 2$$

$$Number\ of\ moles\ of\ benzene = \frac{78}{78} = 1$$

$$Number\ of\ moles\ of\ hydrogen = \frac{10}{2} = 5$$

Total number of moles = 2 + 1 + 5 = 8

Therefre, **Option(1) is correct**

Q. 15   Calculate the number of atoms of oxygen present in 88 g of CO_2. 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 CO_2 = 88/(44 g/mol) = 2 moles

As one mole of CO_2 contains two moles of oxygen atoms, so two moles of CO_2 contain 4 moles of oxygen atoms.

Number of oxygen atoms = 4 X 6.023 X 10^{23} = 2.5092 X 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 X 28 = 112 g.

(correct option is a.)

Maths

Q. 1   WHich of the follwoing is a paradox :

Option 1:
That yellow car is running at 60 Km /h

Option 2:
My car is chauffeur driven

Option 3:
The black car over there is running fast

Option 4:
None

Correct Answer:
The black car over there is running fast

Solution:
As we have learned

Statement -

A sentence which is both true or false is not a statement rather it is a paradox.

- wherein

Example: "I must be cruel to be kind."

Q. 2 $I = \int \dfrac{x^2}{(x^3 + 1)^4} dx$

Option 1:
$\dfrac{1}{9(x^3 + 1)^3} + C$

Option 2:
$\dfrac{1}{3(x^3 + 1)^3} + C$

Option 3:

$$-\frac{1}{3(x^3+1)^3}+C$$

Option 4:

$$-\frac{1}{9(x^3+1)^3}+C$$

Correct Answer:

$$-\frac{1}{9(x^3+1)^3}+C$$

Solution:

As we have learned

Type of integration by substitution -

$$\int (f(x))^n \cdot f'(x)\,dx$$

$$\therefore \frac{[f(x)]^{n+1}}{n+1}+c$$

- wherein

Let $f(x)=t$

$$f'(x)\,dx=dt$$

$$put: \quad x^3+1=u \Rightarrow dx=\frac{1}{3x^2}$$

$$I=\frac{1}{3}\int 1/u^4\,du$$

$$\int u^n\,du=\frac{U^{n+1}}{n+1} here\, n=-4$$

$$I=\frac{1}{3}\left[\frac{4^{-4+1}}{-4+1}\right]=-\frac{1}{9u^3}$$

$$\frac{-1}{9(x^3+1)^3}+C$$

Q. 3 The value of $\lim\limits_{x\to 0}(\sin x+\cos(3x))^{2/x}$ *is*

Option 1:

e

Option 2:

e^{-2}

Option 3:

e^2

Option 4:

1/e

Correct Answer:

e^2

Solution:

$$\lim_{x \to 0} (1 + \sin x + \cos(3x) - 1)^{2/x}$$

$$\Rightarrow e^{\lim_{x \to 0} 2/x(\sin x + \cos(3x) - 1)}$$

Apply L' hospital rule

$$\Rightarrow e \lim_{x \to 0} \frac{2(\cos x) - 3\sin(3x)}{1}$$

$$= e^2$$

Q. 4 $\frac{d}{dx}(2x^2 - 3x) = ?$

Option 1:

$4x - 3$

Option 2:

$4x$

Option 3:

$4x + 3$

Option 4:

$-4x + 3$

Correct Answer:

$4x - 3$

Solution:
As we have learnt,

Rule for differentiation -

The derivative of constant times a function is constant times the derivative of the function.

- wherein

$$\frac{d}{dx}(c.f(x)) = c.\frac{d}{dx}f(x)$$

$$\frac{d}{dx}(2x^2 - 3x) = \frac{d}{dx}(2x^2) - \frac{d}{dx}(3x)$$

$$= 2\frac{d}{dx}(x^2) - 3\frac{d}{dx}(x)$$

$$= 4x - 3$$

Q. 5 Find the geometric mean of the new observations obtained by multiplying each of old observations by 7 whole geometric mean was 14.

Option 1:
98

Option 2:
2

Option 3:
28

Option 4:
None of these

Correct Answer:
98

Solution:
As we learned

Properties of Geometric Mean -

Multiplying each observation by a non-zero constant multiplies the (h) of the observations by the same constant.

$$G' = (x_1 x_2 x_3 \cdots x_n)^{\frac{1}{n}} \cdot (k^n)^{\frac{1}{n}}$$

$$= (x_1 x_2 x_3 \cdots x_n)^{\frac{1}{n}} k = kG$$

-

$$G' = 7 \times 14$$

$$= 98$$

Q. 6   How many squares are present in a chessboard?

Option 1:
204

Option 2:

$$\sum_{r=1}^{8} r^3$$

Option 3:
64

Option 4:
144

Correct Answer:
204

Solution:

Number of squares -

Number of squares of any size from $n \times n$ is $\displaystyle\sum_{r=1}^{n} r^2$.

- wherein

$$\sum_{r=1}^{n} r^2 = 1^2 + 2^2 + \ldots + n^2$$

Here n=8

Sum= $1^2 + 2^2 + \ldots 8^2$

$$= (8 * 9 * 17)/6$$

$$= 204$$

Q. 7　　Differential equation of $y^3.9a(x + b)$ is, where a,b are constant.

Option 1:

$$y^2 \frac{d^2 y}{dx^2} + 2 \left(\frac{dy}{dx} \right)^2 = 0$$

Option 2:

$$y^2 \frac{dy}{dx} = 3x$$

Option 3:

$$2 \frac{d^2 y}{dx^2} + y \left(\frac{dy}{dx} \right)^2 = 0$$

Option 4:

$$y \frac{d^2 y}{dx^2} + 2 \left(\frac{dy}{dx} \right)^2 = 0$$

Correct Answer:

$$y \frac{d^2 y}{dx^2} + 2 \left(\frac{dy}{dx} \right)^2 = 0$$

Solution:
As we learnt

Differential Equations -

An equation involving independent variable (x), dependent variable (y) and derivative of dependent variable with respect to independent variable

$$\left(\frac{dy}{dx} \right)$$

- wherein

eg:

$$\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 5x = 0$$

Differentiating $y^3 = 9x(x+b)$ wrt x

$$3y^2\frac{dy}{dx} = 9a \ \ i.e \ \ y^2\frac{dy}{dx} = 3a$$

Again differentiating wrt x

$$y^2\frac{d^2y}{dx^2} + 2y\left(\frac{dy}{dx}\right)^2 = 0$$

OR

$$y\frac{d^2y}{dx^2} + 2\left(\frac{dy}{dx}\right)^2 = 0$$

The elimination of arbitrary constant leads to formation of differential equation.

Q. 8 $f(x) = \sin^{-1} x + \cos^{-1} x$ is differentiable in:

Option 1:
$$x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$$

Option 2:
$$x \in [0, \pi]$$

Option 3:
$$x \in \left[0, \frac{\pi}{2}\right]$$

Option 4:
$$x \in [-1, 1]$$

Correct Answer:
$$x \in [-1, 1]$$

Solution:
As we have learnt in

Properties of differentiable functions -

Trigonometric and inverse trigonometric functions are differentiable in their respective domain.

$$f(x) = \sin^{-1} x + \cos^{-1} \frac{x}{2}$$

$has \ [-1, 1] \ common \ domain$

-

Q. 9 The product $2^{1/4} \cdot 4^{1/16} \cdot 8^{1/48} \cdot 16^{1/128} \ldots$ is equal to :

Option 1:
$2^{1/4}$

Option 2:
2

Option 3:
$2^{1/2}$

Option 4:
1

Correct Answer:
$2^{1/2}$

Solution:
Sum of an infinite GP

If a is the first term and r is the common ratio of a G.P. Then,

$$S_\infty = \frac{a}{1 - r}$$

S_∞ is the sum to infinite terms of the G.P.

Now,

$$2^{1/4} \cdot 4^{1/16} \cdot 8^{1/48} \ldots = 2^{\frac{1}{4} + \frac{1}{8} + \frac{1}{16} \cdots}$$
$$\Rightarrow 2^{\frac{\frac{1}{4}}{1 - \frac{1}{2}}} = \sqrt{2}$$

Q. 10 What is the value of $w + w^2$, if these are Cube roots of unity, other than 1.

Option 1:

0

Option 2:

1

Option 3:

-1

Option 4:

2

Correct Answer:

-1

Solution:

As we learned

Cube roots of unity -

$$z = (1)^{\frac{1}{3}} \Rightarrow z = \cos\frac{2k\pi}{3} + i\sin\frac{2k\pi}{3}$$

k=0,1,2 so z gives three roots

$$\Rightarrow 1, \frac{-1}{2} + i\frac{\sqrt{3}}{2}\,(\omega)\,, \frac{-1}{2} - i\frac{\sqrt{3}}{2}\,(\omega^2)$$

- wherein

$$\omega = \frac{-1}{2} + \frac{i\sqrt{3}}{2}, \omega^2 = \frac{-1}{2} - \frac{i\sqrt{3}}{2}, \omega^3 = 1, 1 + \omega + \omega^2 = 0$$

$1, \omega, \omega^2$ are cube roots of unity.

We have, $1 + w + w^2 = 0$

$$\Rightarrow w + w^2 = -1$$

Q. 11   Find p and q if system of linear equation have many solution.

$$x + y + z = 6$$

$$x + 2y + 3z = 12$$

$$x + 2y + pz = q$$

Option 1:
$p = -3, q = -12$

Option 2:
$p = 3, q = -12$

Option 3:
$p = 3, q = 12$

Option 4:
$p = -3, q = 12$

Correct Answer:
$p = 3, q = 12$

Solution:
As we have learnt

Solution of a non-homogeneous system of linear equations by matrix method -

If A is a singular matrix and $adj(A).b = 0$ then the system of equations given by $Ax = b$ has infinitely many solutions or no solution.

- wherein

The solution of n simultaneous linear equations with n unknowns

$$a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n = b_1$$
$$a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n = b_2$$
$$\vdots \qquad \vdots$$
$$a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n = b_n$$

In matrix notation $\mathbf{Ax} = \mathbf{b}$, when

$$A = \begin{bmatrix} a_{11} & a_{11} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{22} \\ \vdots & & & \vdots \\ a_{n1} & a_{n2} & & a_{nn} \end{bmatrix} \quad \mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} \quad \mathbf{b} = \begin{bmatrix} b_1 \\ b_2 \\ \vdots \\ b_n \end{bmatrix}$$

The linear system is said to be of order n and has a unique solution if $\det(\mathbf{A}) \neq 0$.

3

For many solution or infinite solution

For the equation, $Ax = b$

$|A| = 0$

As, $|A| = 0$

So, $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & 3 \\ 1 & 2 & p \end{bmatrix} = 0, p = 3$

Now, $(\text{adj}A)B = 0$

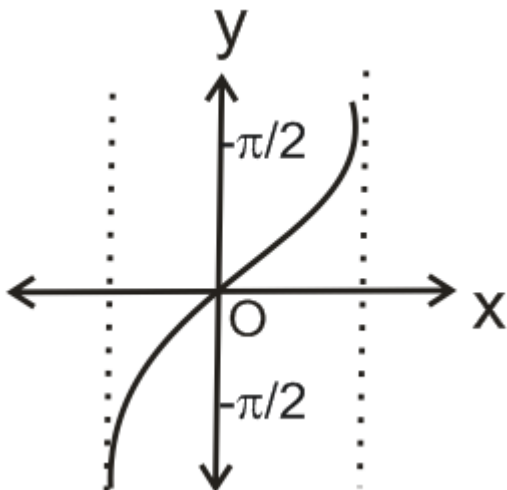$(\text{adj}A) = \begin{bmatrix} 0 & 3 & -3 \\ 0 & 0 & 0 \\ 0 & -1 & 1 \end{bmatrix}$

$(\text{adj}A)B = 0$

$\begin{bmatrix} 0 & 3 & -3 \\ 0 & 0 & 0 \\ 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} 6 \\ 12 \\ q \end{bmatrix}$

q = 12,   So, p=3, q=12

correct option c

Q. 12   Which of the following functions as the below graph?

Option 1:
$$\sin^{-1} x$$

Option 2:
$$\cos^{-1} x$$
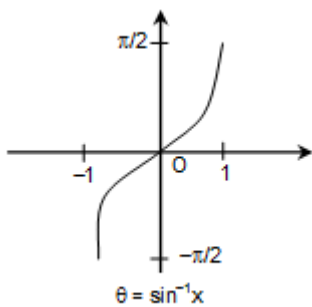
Option 3:
$$\sec^{-1} x$$

Option 4:
None of these

Correct Answer:
$$\sin^{-1} x$$

Solution:
As we have learned

Graphs of Inverse Trigonometric Functions -

$\theta = \sin^{-1}x$

- wherein

This is the graph for $\sin^{-1} x$

Q. 13   If the roots of $(b - c)x^2 + (c - a)x + (a - b) = 0$ are equal then $a + c =$

Option 1:
$2b$

Option 2:
b^2

Option 3:
$3b$

Option 4:
b

Correct Answer:
$2b$

Solution:
As we learn

Product of Roots in Quadratic Equation -

$$\alpha\beta = \frac{c}{a}$$

- wherein

$\alpha \ and \ \beta$ are roots of quadratic equation:

$$ax^2 + bx + c = 0$$

$$a, b, c \in C$$

$$b - c + c - a + a - b = 0$$

Hence one root is 1. Also as roots are equal, other root will also be equal to 1.

Also $\alpha.\beta = \dfrac{a - b}{b - c} \Rightarrow$ using product of roots in quadratic equation

$\rightarrow 1.1 = \dfrac{a - b}{b - c} \Rightarrow a - b = b - c \Rightarrow 2b = a + c$

Q. 14 $A * (B - D) =$

Option 1:
$(A - B) * (A - D)$

Option 2:
$(A * B) - (A * D)$

Option 3:
$A * (B - D)$

Option 4:
$(A \cap B') - D$

Correct Answer:
$(A * B) - (A * D)$

Solution:
As we learnt

Theorem of Cartesian Product -

AX(B-C)=(AXB)-(AXC)

-

Q. 15 Find $|3\vec{a}|$ if $\vec{a} = \hat{i} + 2\hat{j} - 3\hat{k}$

Option 1:
$\sqrt{126}$

Option 2:
9

Option 3:
3

Correct Answer:

$\sqrt{126}$

Solution:
As we have learnt

Scalar multiplication -

If $\vec{A}$ is a vector and m is a scalar, then $m\vec{a}$ is a vector whose modulus is m times $\vec{A}$.

-

$$3\vec{a} = 3\hat{i} + 6\hat{j} - 9\hat{k} = |3\vec{a}| = \sqrt{9 + 36 + 81} = \sqrt{126}$$

Q. 16   What is the rank of word "AGAIN" in a dictionary with all possible arrangements of its letters?

Correct Answer:
7

Solution:
As we learnt

The rank of any Word -

We arrange the words according to the dictionary.

- wherein

$A \to A \to 3!$

$A \to G \to A \to I \to N$

$3! + 1 = 7^{th}$

Q. 17   If a, b are natural numbers such that $2013 + a^2 = b^2$, then the minimum possible value of ab is

Solution:

$(b - a)(b + a) = 2013 = 3 \times 11 \times 61$

the value of ab is minimum when

$b - a = 33..........(i)$
and, $b + a = 61......(ii)$
by solving eq^n (i) and (ii) we get
$a = 14$ and $b = 47$
$\therefore$ $ab = 14 \times 47 = 658$

Q. 18   What is the exponent of 5 in (45)!?

Solution:
As we learned

The exponent of Prime P in n! -

If m is the index of the highest power of a prime p that divides n! then

$$m = \left[\frac{n}{p}\right] + \left[\frac{n}{p^2}\right] + \left[\frac{n}{p^3}\right] + \ldots\ldots\ldots$$

- wherein

Where [x] stands for the greatest integer value of $x \epsilon R$.

$$\left[\frac{45}{5}\right] + \left[\frac{45}{5^2}\right] + 0$$

=9+1

=10

Q. 19   Modulus of 2 complex no's are 4 and 7 and modulus of sum of these complex numbers is 9, then $z_1 \bar{z}_2 + \bar{z}_1 z_2 =$

Solution:

As we learned

Property of Modulus of z(Complex Number) -

$$|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + z_1.\bar{z_2} + z_2.\bar{z_1}$$

- wherein

$|.|$ denotes modulus of z

$\bar{z}$ denotes conjugate of z

$$|z_1| = 4, |z_2| = 7,$$

$$|z_1 + z_2| = 9$$

So, $|z_1 + z_2|^2 = |z_1|^2 + |z_2|^2 + z_1\bar{z_2} + \bar{z_1}z_2$

81=16+49+$z_1\bar{z_2} + \bar{z_1}z_2$

$$z_1\bar{z_2} + \bar{z_1}z_2 = 16$$

Q. 20 What is the no. of positive integral solutions of : x+y+z=8 and zero values of x, y, z are included?

Correct Answer:
45

Solution:
As we have learnt in

Theorem of Number of Solutions -

Number of non-negative integral solutions of the equation $x_1 + x_2 + x_3 + \ldots\ldots + x_r$=n is $^{n+r-1}C_n$.

- wherein

Where $x_i \geq 0$

$$^{8+3-1}C_{3-1} = {}^{10}C_2$$

English

Q. 1   Find out the correct conjunction:

There are many people who book a ticket _____would sill miss the bus.

Option 1:
And

Option 2:
But

Option 3:
Therefore

Option 4:
Because

Option 5:
Still

Correct Answer:
But

Solution:
There is a contrast between the two actions. Thus, we need 'but'.

Q. 2   Find out the correct prepositions in the following question:

Don't bother him; he is ____ a train.

Option 1:
On

Option 2:
upon

Option 3:
at

Option 4:
into

Option 5:
in

Solution:
For public transport, we use on

Q. 3   Change the speech.

Amit told my brother, "I will meet you in your class".

Option 1:
Amit told my brother that he will meet her in her class.

Option 2:
Amit told my brother that he would meet you in your class.

Option 3:
Amit told my brother that he would meet him in his class.

Option 4:
Amit told my brother that she would meet him in her class.

Option 5:
Amit told my brother that I would meet you in your class.

Correct Answer:
Amit told my brother that he would meet him in his class.

Solution:
Rest of the options change the meaning.

Q. 4   Find errors of pronoun.

It is a well-known fact that one must not reveal their secrets to people who do not care.

Option 1:
that one must not reveal

Option 2:
their secrets to people

Option 3:
who do not care

Option 4:
No error

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Option 5:
It is a well-known fact

Correct Answer:
their secrets to people

Solution:
One is a singular subject. Thus, the usage of 'their' is wrong here.

Q. 5   Complete the following phrasal verb from the given choices:

My heart is sinking. The failure may be imputed ____ my inability.

Option 1:
to

Option 2:
for

Option 3:
on

Option 4:
in

Option 5:
with

Correct Answer:
to

Solution:
Impute takes 'to'.

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

Destitution

Option 1:
Poverty

Option 2:
Affluence

Option 3:
Paucity

Option 4:
Sumptuous

Option 5:
Penury

Solution:
Destitution is poverty and affluence is richness.

Q. 7   Find out the objective pronoun:

She wants to help him notwithstanding the trying circumstances.

Option 1:
She

Option 2:
Wants

Option 3:
Him

Option 4:
circumstances

Option 5:
Help

Solution:
She is the subject as she is taking the action. The impact will be on 'Him'.

Q. 8   Find out the meaning of the following foreign expression:

Carte blanche

Option 1:
. Unlimited authority

Option 2:
Main portion

Option 4:
 Blank paper

Option 5:
Blank cheque

Correct Answer:
. Unlimited authority

Solution:
The French expression denotes unlimited authority.

Q. 9   Change the speech

She said, "I am sorry, I did not speak".

Option 1:
She explained she is sorry; she did not speak.

Option 2:
She explained she is sorry, she did not speak.

Option 3:
She explained and added that she was sorry, she had not spoken.

Option 4:
She explained she is sorry, she has not spoken.

Option 5:
She explained for I did not speak.

Correct Answer:
She explained and added that she was sorry, she had not spoken.

Solution:
'was sorry' and had not 'spoken' are needed to rephrase the sentence.

Q. 10   Find out the part which contains an error of subject-verb agreement

It is evident that the British people has never been compassionate for the Asians.

Option 1:
No error

Option 2:
has never been compassionate

Option 3:
for the Asians

Option 4:
the British people

Option 5:
It is evident that

Correct Answer:
has never been compassionate

Solution:
The use of 'has' with the plural subject 'people' is wrong.