M Prakash Institute   **30 April 2023**   **XI Entrance Test 3**
Each question carries five marks   **2pm to 5pm**   **Paper Type AD**

<center>Chemistry</center>

Useful information:
Atomic Masses: H : 1, He : 4, C : 12, O : 16, Na : 23, P : 31, Cl : 35.5, Ca : 40

Q.1 1 mole of potassium chlorate when slowly heated produces a gas and a salt. What will be the mass in grams of the gas liberated ?

Q.2 In the year 1866, scientist Newland arranged known elements in the order of their increasing atomic masses for the periodic classification starting from Hydrogen upto Thorium. According to his periodic law, chemical and physical properties of 4th element would resemble with the xth element. What is 'x' ?
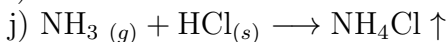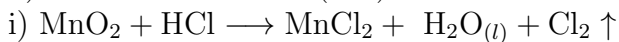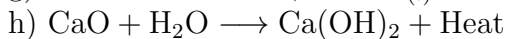
Q.3 x = Number of total atoms in the formula of compound potassium dichromate. Write the value of 'x' as your answer.

Q.4 What volume of O_2 gas (in ml) would be required to react with nitrogen monoxide gas to produce 500 ml of nitrogen dioxide gas, under similar conditions of temperature and pressure?
Given: $NO_{(g)} + O_{2\,(g)} \longrightarrow NO_{2\,(g)}$

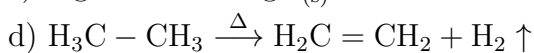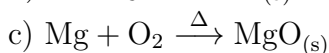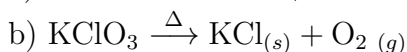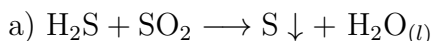**Q.5** What is the total number of acidic radicals among the following?
$SO_4^{2-}, NH_4^+, PO_4^{3-}, F^-, Cl^-, Br^-, Fe^{2+}, Al^{3+}, Na^+$

Q.6 Identify from the following the total number of redox reactions $\rightarrow$

a) $H_2S + SO_2 \longrightarrow S \downarrow + H_2O_{(l)}$
b) $KClO_3 \xrightarrow{\Delta} KCl_{(s)} + O_{2\,(g)}$
c) $Mg + O_2 \xrightarrow{\Delta} MgO_{(s)}$
d) $H_3C - CH_3 \xrightarrow{\Delta} H_2C = CH_2 + H_2 \uparrow$
e) $FeSO_4 + KMnO_4 + H_2SO_4 \longrightarrow MnSO_4 + K_2SO_4 + Fe_2(SO_4)_3 + H_2O$
f) $CaCO_3 \longrightarrow CaO + CO_2 \uparrow$
g) $NiO + H_2 \longrightarrow Ni \downarrow + H_2O_{(l)}$
h) $CaO + H_2O \longrightarrow Ca(OH)_2 + Heat$
i) $MnO_2 + HCl \longrightarrow MnCl_2 + H_2O_{(l)} + Cl_2 \uparrow$
j) $NH_{3\,(g)} + HCl_{(s)} \longrightarrow NH_4Cl \uparrow$
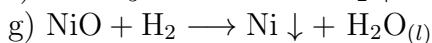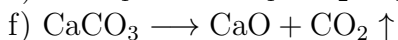
Q.7 How many -(CH_2)- groups are present in the ester produced when ethanoic acid reacts with ethanol?

Q.8 Study the following reactions. Identify compound (C) and write its molecular moss.
$Al_2O_3 + (A) \longrightarrow NaAlO_2 + (B)$
$CH_3COOH + (A) \rightarrow (C) + (B)$
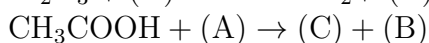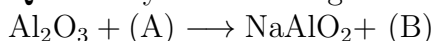
Q.9 Write the molecular mass of chemical (X) from the chemical reactions given below.
(X) $+ H_2SO_4 \rightarrow CaSO_4 + Cl_2 + H_2O$
$Ca(OH)_2 + Cl_2 \rightarrow (X) + H_2O$
$(X) + CO_2 \rightarrow CaCO_3 + Cl_2$
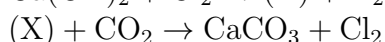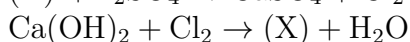
Q.10 Water of crystallization in 1 mole of Epsom salt $(\text{MgSO}_4 \cdot x\text{H}_2\text{O})$ is represented by 'x'. What is the value of 'x'?

Physics

Use $g = 10 \ m/s^2$ wherever required.

Q.11 An object is thrown vertically up from a tall building with initial speed $u \ m/s$. The object fell through a distance of 35 meters in the 5th second. Find u.

**Q.12** A force of 1 N is applied in a horizontal direction on a block of mass 1 kg which is kept on a frictionless horizontal surface. The force is applied for t seconds. Then, for additional t seconds, there is no force acting on the object. After a total time of $2t$ seconds from the start, a force of 1 N is applied in the opposite direction for t seconds. Total distance travelled by the object in these $3t$ seconds is 200 meters. Find t (in seconds).

Q.13 A wooden cube (density 0.5 g/cc) of size $40cm \times 40cm \times 40cm$ is floating in water (desnity 1 g/cc). A metal cube (density 4.5 g/cc) of size $20cm \times 20cm \times 20cm$ is now gently placed on the top of the wooden block. What is the height (in cm) of the portion of the metal block which is above water level?

Q.14 Consider a straight line with four points A, B, C, D on it in this order, i.e. A is the leftmost point and then towards the right of A are B, C, D in this order. The points are equally spaced, i.e. $AB = BC = CD$. Static charge $+Q_1$ is present at A and $-Q_1$ at C. Charge $+Q_2$ is present at D. A static charge is at B and the net force on it due to A, C, D is zero. Calculate $\dfrac{Q_2}{Q_1}$

Q.15 A water heater consists of three resistances which are R_1, R_1 and R_2 ohms. It is given that $R_2 > R_1$. When the heater is formed by connecting all of them in parallel, it takes t minutes to increase the temperature of 10 liters of water by 20°. It takes $10t$ minutes to increase the temperature of 10 liters of water by 20° when all the resistances are connected in series. Calculate $\frac{R_2}{R_1}$.

Q.16 As shown in the figure, AB and BC are two plane mirrors. $m\angle ABC = 132°$. A light ray PQ is reflected as ray QR, which is reflected from the second mirror as ray RS. $m\angle AQP = 35°$. The rays PQ and RS when extended backward, intersect at T. Find $m\angle PTS$. (The figure drawn here is not to scale.)
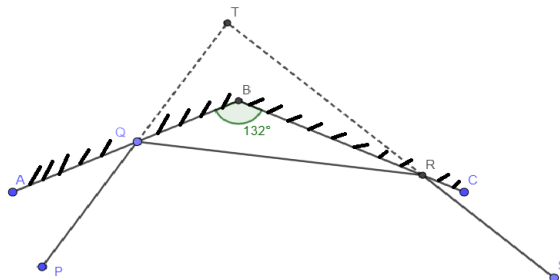
Q.17 Image of an object through a convex lens is real and half the size of the object. When the object is moved towards the lens by 10 cm, its image is real and of the same size of the object. Calculate the focal length of the lens in cm.

Q.18 A solid block of metal of mass 600 gm (specific heat 0.1 $cal/gm°C$) at temperature $1500°C$ is put in 950 gm of water at $40°C$. All of this is kept in an insulated container. After some time, equilibrium temperature is reached. Calculate the mass of steam present in the container in grams. Take latent heat of vaporisation of water as 540 cal/gm and specific heat capacity of water as 1 $cal/gm°C$.

Q.19 Two point masses A (mass 10 kg, speed $= 1$ m/s) and B (mass 20 kg, speed $= 4$ m/s) are moving on a straight line in the same direction. B is behind A. At the same time, point mass C (mass 30 kg, speed $= u$ m/s) is coming towards them on the same straight line from the opposite side. All three collide at the same instant. Their velocity after collision is zero. Calculate u in m/s.

Q.20 Team A and team B are participating in a relay race. Player A_1 from team A and B_1 from team B are at the start line. Once the match starts, i.e. at $t = 0$,
A_1 starts with acceleration of 1.2 m/s^2. A_1 runs with this acceleration for 5 seconds and then runs with constant speed till he reaches the 75 m mark where he passes the baton to player A_2. A_2 starts from rest with acceleration of 1 m/s^2, maintains acceleration for 5 seconds and then runs with constant speed.
B_1 starts with 1 m/s^2, maintains acceleration for 6 seconds and then runs with constant speed. He hands over the baton to B_2 who is standing at the 72 m mark. B_2 starts from rest with acceleration $\frac{5}{3}$ m/s^2, maintains the acceleration for 5 seconds and runs with constant speed thereafter. At what time in seconds after $t = 0$ do B_2 and A_2 cross each other?

Maths

Q.21 The diagram shows three touching semicircles with radius 1 inside an equilateral triangle, which each semicircle also touches. The diameter of each semicircle lies along a side of the triangle. What is the area of square whose length of side is same as that of the equilateral triangle?
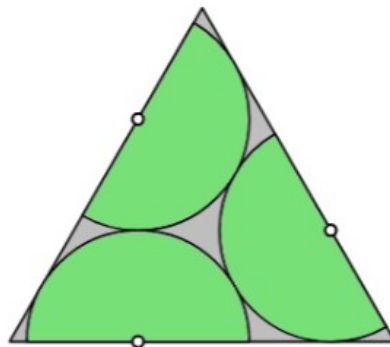

Q.22 For a given arithmetic series the sum of the first 50 terms is 1275 , and the sum of the next 148 terms is 6882 . What is the first term of the series?

Q.23 A hexagon has consecutive angle measures of $90°, 120°, 150°, 90°, 120°$ and $150°$. If all of its sides are 4 units in length, the area of the hexagon is $K\left(1 + \dfrac{1}{\sqrt{3}}\right)$. Find K?

Q.24 There are four unequal, positive integers a, b, c, and N such that $N = 5a + 3b + 5c$. It is also true that $N = 4a + 5b + 4c$ and N is between 131 and 150. What is the value of $a + b + c$?

Q.25 In triangle $ABC, \angle B = 2\angle C$. Ray AD is the angle bisector of $\angle A$ and $DC = AB$. Then the measure of $\angle A$ is

Q.26 $ABCD$ is a square inscribed in a circle of radius 1 unit. The tangent to the circle at C meets AB produced at P. Find PD^2
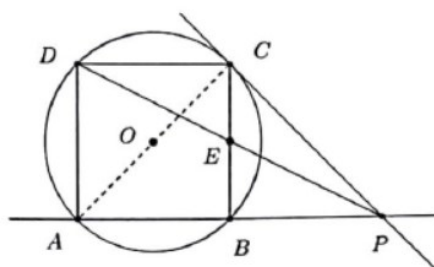
Q.27 If $f(x) = ax + b$ and $f(f(f(x))) = 27x + 26$ then $a + b =$

Q.28 In $\triangle ABC, AB = 13, AC = 20$ and median $AM = \dfrac{\sqrt{697}}{2}$. Find area of $\triangle AMB$.

Q.29 $A(3, 7), P\left(\dfrac{47}{11}, \dfrac{91}{11}\right), B(5, 9)$ are collinear and P is between A, B.

$C(-10, 1), Q\left(\dfrac{-22}{13}, \dfrac{-35}{13}\right), D(-1, -3)$ are collinear and Q is between C, D.

Let $\lambda_1 = \dfrac{AP}{PB}$ and $\lambda_2 = \dfrac{CQ}{QD}$. Find $\lambda_1 \times \lambda_2$.

Q.30 n is a natural number. It is given that

$$(n + 1999) + (n + 2000) + \cdots + (n + 2023)$$

is a perfect square. The least value of n is

Key:

Q.No.	1	2	3	4	5	6	7	8	9	10
Answer	48	11	11	25	5	7	1	82	27	7
Q.No.	11	12	13	14	15	16	17	18	19	20
Answer	10	10	10	8	2	84	10	50	3	18
Q.No.	21	22	23	24	25	26	27	28	29	30
Answer	12	15	24	33	72	10	5	63	21	14