

M Prakash Institute

19 January 2025

XI Entrance Test 2

Each question carries five marks

10 am to 1 pm

Paper Type AD

Student Receipt number:

Student Name:

Chemistry**Scientific data:**Avogadro Number = 6×10^{23} per mole

Atomic Number: H = 1, Li = 3, Be = 4, B = 5, C = 6, N = 7, O = 8, Ne = 10, Na = 11, Mg = 12, Al = 13, P = 15, S = 16, Cl = 17, K = 19, Ca = 20, Sc = 21, Ti = 22, V = 23, Cr = 24, Mn = 25, Fe = 26, Cu = 29, Zn = 30, Ga = 31, Ge = 32, Cd = 48, In = 49, Cs = 55, Ba = 56, Tl = 81, Po = 84

Atomic Mass: H = 1, Li = 7, Be = 9, B = 11, C = 12, N = 14, O = 16, Ne = 20, Na = 23, Mg = 24, Al = 27, K = 39, Ca = 40, S = 32, P = 31, Cl = 35.5, K = 39, Sc = 45, Ti = 48, V = 51, Cr = 52, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65, Ga = 70, Ge = 72, Cd = 112, In = 115, Cs = 133, Ba = 137, Tl = 204, Po = 209

Q.1 The number of neon atoms present in 2×10^{-24} Kg sample of pure neon is ——— atoms.

Q.2 Write the molar mass of any one of the chemical species which has molar mass equal to the other chemical species from the given list $\Rightarrow \text{CH}_3\text{COOH}, \text{NH}_4\text{NO}_2, \text{CO}_3^{2-}, \text{SO}_4^{2-}, \text{H}_2\text{CO}_3, \text{SO}_3$

Q.3 The difference between the pH values of 0.01 M NaOH and 0.001 M HCl solution is

Q.4 What is the total number of moles of oxygen atoms present in 3 moles of aluminium dichromate salt?

Q.5 An element present in group number six and period number six in the modern periodic table. The atomic number of the element is ———

Q.6 Last element of second series of transition element say (A) combines with second element of sixteenth group say (B), forming a compound having molecular formula A_xB_y . The value of $\left(\frac{\text{Molar Mass of } A_xB_y}{2} \right)$ is ———

Q.7 The amount of reactive form of oxygen gas produced when $\frac{1}{6}$ mol of $\text{K}_2\text{Cr}_2\text{O}_7$ (potassium dichromate) is treated with dilute H_2SO_4 is ——— grams.

Q.8 $\frac{2}{3}$ mol of copper is obtained by heating ——— grams of Cu_2S ore in air while performing metallurgy of copper.

Q.9 The minimum molar mass of a saturated open chain alcohol which can show two different structural isomeric alcohols is ———

Q.10 How many of the following can decolourise bromine water?

- | | | |
|----------------------------|-------------------------------|---|
| 1) C_2H_4 | 2) C_4H_{10} | 3) $\text{C}_{17}\text{H}_{35}\text{COOH}$ |
| 4) C_2H_2 | 5) C_3H_4 | 6) $\text{C}_{15}\text{H}_{31}\text{COOH}$ |
| 7) C_3H_8 | 8) C_6H_{14} | 9) $\text{C}_{17}\text{H}_{31}\text{COOH}$ |
| 10) C_5H_8 | 11) C_5H_{10} | 12) $\text{C}_{17}\text{H}_{33}\text{COOH}$ |

Physics

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

Q.11 Object A is thrown vertically upwards from the top of a tower with speed $u \text{ m/sec}$ at $t = 0$. The top of the tower is $12u \text{ m}$ from the ground. At the same time, object B is thrown vertically upwards from ground at speed $ku \text{ m/sec}$. It is observed that object A and object B are at the same height from the ground at $t = 3 \text{ sec}$. Calculate k and **mark 10k as your answer**.

Q.12 Object A is thrown vertically upwards at $u \text{ m/sec}$ speed at $t = 0 \text{ sec}$. Object B is dropped from the height of 200 meters at $t = 0 \text{ sec}$ with initial speed zero. Object C is dropped from the same height at $t = 2 \text{ sec}$ with initial speed zero. It is observed that object A and object B cross each other at $t = t_1 \text{ sec}$. Object A and object C cross each other at $t = t_1 + 2 \text{ sec}$. Calculate u in m/sec .

Q.13 Consider a circular horizontal track of length 200 meters. (i.e. the circumference of the circular track is 200 meters.) Ajay starts running at a constant acceleration of $a \text{ m/sec}^2$ from the northmost point of the track in the anticlockwise direction, i.e. north-west-south-east at $t = 0$. Akshay and Mohan start running at $t = 0$ from the southmost point. Akshay starts running in clockwise direction. Mohan starts running in anticlockwise direction.

Akshay starts running from zero speed at constant acceleration of $ka \text{ m/sec}^2$ for 2 seconds and then decelerates at $ka \text{ m/sec}^2$ for two seconds. He continues running in the same pattern.

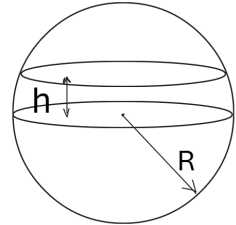
Mohan starts running from zero speed at constant acceleration of $\frac{3ka}{2} \text{ m/sec}^2$ for 2 seconds and then decelerates at $\frac{3ka}{2} \text{ m/sec}^2$ for two seconds. He continues running in the same pattern.

Ajay crosses Akshay at $t = 10 \text{ sec}$. Ajay catches Mohan at $t = 20 \text{ sec}$. Calculate k and **mark 4k as your answer**.

Q.14 Refer to the diagram.

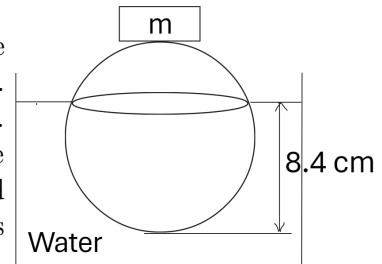
The problem is based on the following formula:

Consider a sphere of radius R . It is cut by two parallel planes. First plane is passing through the centre of the sphere. The second plane is at a distance of h from the first plane. The volume of the cut section of width h is given $V = \pi(R^2h - \frac{h^3}{3})$



Now the problem:

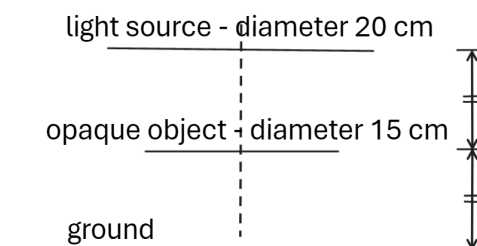
Take the value of π as $\frac{22}{7}$. A spherical ball of radius 6.3 cm made of wood (density 0.5 gm/cc) is floating in water (density 1 gm/cc). A solid of mass $m \text{ gm}$ is kept on the top of the sphere carefully. It is observed that the depth of the portion of the wooden sphere inside the water is 8.4 cm . Calculate m in grams. Calculate $\frac{m}{10}$ and mark the integer part of $\frac{m}{10}$ as your answer. E.g. if your answer is $m = 123.456 \text{ gm}$ or $m = 128.898 \text{ gm}$, then mark the answer as 12.



Q.15 There are four points A, B, C, D on a straight line in this order from left to right. Various distances are $AB = \frac{d}{2} \text{ cm}$, $BC = \frac{3d}{2} \text{ cm}$, $CD = 4d \text{ cm}$. There are static point charges at A, C, D . Charge at A is $+Q_1$ coulombs. Charge at C is $+Q_2$ coulombs. Charge at D is $+Q_3$ coulombs. The net static force on $+Q_2$ due to $+Q_1$ and $+Q_3$ is zero. Now, the charge at A is moved to point B . The charge at D is replaced by $+kQ_3$ coulombs. The net static force on $+Q_2$ due to $+Q_1$ and $+kQ_3$ is zero. Calculate k and **mark 9k as your answer**.

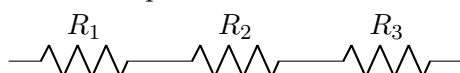
Q.16 Refer to the diagram.

An extended light source in the form of a circular disc of diameter 20 cm is at some distance from ground and horizontal. An opaque object in the form of a circular disc of diameter 15 cm is kept exactly midway between the light source and the ground. The light source and the opaque object are coaxial. The object is horizontal. A penumbra (in the shape of a ring with inner and outer circles) is formed on the ground. Calculate the outer diameter of the penumbra in centimeters.

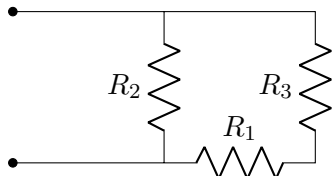


Q.17 Refer to the diagram. The equivalent resistance of circuit 4 has two possible values, say R_4 and R_5 where $R_4 > R_5$. $R_4 - R_5 = \frac{p}{q}$ where p, q are prime numbers. Write the product pq as your answer.

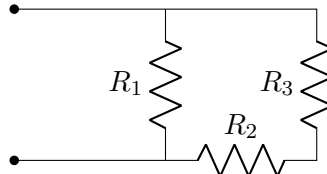
circuit 1 equivalent resistance 11 ohms



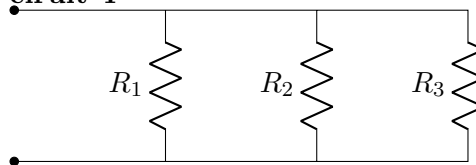
circuit 3 equivalent resistance $\frac{24}{11}$ ohms



circuit 2 equivalent resistance $\frac{18}{11}$ ohms



circuit 4



Q.18 A solid block of metal of mass 50 gm (specific heat $0.3 \text{ cal/gm}^\circ\text{C}$) at temperature 460°C , 250 gm of ice at 0°C and x gm of steam at 100°C are kept in an insulated container. After some time, equilibrium temperature of 60° is reached. Calculate x . Assume the following values: Latent heat of fusion of water: 80 cal/gm , latent heat of vaporisation of water = 540 cal/gm , specific heat of water = $1 \text{ cal/gm}^\circ\text{C}$.

Q.19 A bullet of mass m gm is fired vertically upwards with initial speed of 400 m/sec from point A on the ground at $t = 0$. At the same time, a wooden ball of mass 370 gm is dropped from a cliff which is 400 meters directly above point A. (Initial speed of the ball is zero.) The bullet hits the wooden ball and gets stuck in the ball. The direction of movement of the bullet and the wooden ball after collision is vertically upwards. The height of the bullet and ball from ground at $t = 12 \text{ sec}$ is 10 meters. Calculate m .

Q.20 An object is kept in front of a screen. A converging lens is kept between them so that a sharp image of the object is obtained on the screen. Image is of the same size as that of object. Now, the screen is moved towards the lens by 10 cm. The object is moved away from the lens by 30 cm so that a sharp image is obtained on the screen. Calculate the focal length of the lens in centimeters.

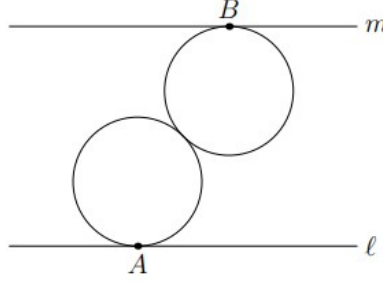
Maths

Q.21 Let $ABCD$ be a trapezoid with $AB \parallel CD$, $AB = 20$, $CD = 24$, and area 880 . Compute the area of the triangle formed by the midpoints of AB , AC , and BD .

Q.22 Points A and B lie on a circle centered at O such that $AB = 14$. The perpendicular bisector of AB intersects $\odot O$ at point C such that O lies in the interior of $\triangle ABC$ and $AC = 35\sqrt{2}$. Lines BO and AC intersect at point D . Let λ be the ratio of the area of $\triangle DOC$ to the area of $\triangle DBC$. Report 98λ .

Q.23 Let ω be the circle inscribed in regular hexagon $ABCDEF$ with side length 14 , and let the midpoint of side BC be M . Segment AM intersects ω at point $P \neq M$. Compute the length of AP . Report AP^2

Q.24 The figure below shows two parallel lines, ℓ and m , that are distance 35 apart:



A circle is tangent to line ℓ at point A . Another circle is tangent to line m at point B . The two circles are congruent and tangent to each other as shown. The distance between A and B is 37 . Let R be the radius of each circle such that $N < R < N + 1$ where N is natural number. Report the largest value of N .

Q.25 If a, b, c, d , and e are constants such that every $x > 0$ satisfies

$$\frac{5x^4 - 8x^3 + 2x^2 + 4x + 7}{(x+2)^4} = a + \frac{b}{x+2} + \frac{c}{(x+2)^2} + \frac{d}{(x+2)^3} + \frac{e}{(x+2)^4},$$

then what is the value of $a + b + c + d + e$?

Q.26 Sum of all real solutions of $\sqrt{x+14-8\sqrt{x-2}} + \sqrt{x+23-10\sqrt{x-2}} = 3$. is

Q.27 If $a = (\sqrt{3} + \sqrt{2})^{-3}$ and $b = (\sqrt{3} - \sqrt{2})^{-3}$, find the value of $(a+1)^{-1} + (b+1)^{-1}$

Q.28 ABC is a right angled triangle with $\angle B = 90^\circ$. M is the midpoint of AC and $BM = \frac{\sqrt{193}}{2}$. Sum of the lengths of the other two sides AB and BC is 19 . Find the area of the triangle.

Q.29 A circle is drawn through points $A(4, 6), B(6, 2), C(-3, 5)$. D is diametrically opposite point of C on the circle. AD is distance between A and D . Find AD^2

Q.30 Let S_n denote the sum of first n terms of an arithmetic progression. If $S_{20} = 790$ and $S_{10} = 145$, then sum of the digits of $S_{15} - S_5$ is :