M Prakash Institute **XI Entrance Test 2**
Each question carries five marks **10 am to 1 pm** **Paper Type AD**
Student Receipt number: **Student Name:**

Chemistry

Given:
Atomic numbers:

$H = 1, B = 5, C = 6, N = 7, O = 8, Na = 11, Mg = 12, Al = 13, P = 15, S = 16, Cl = 17,$
$K = 19, Ca = 20, Sc = 21, Ti = 22, Mn = 25, Fe = 26, Cu = 29, Zn = 30, Br = 35,$
$Se = 34, Sn = 50, Te = 52, Ta = 73, W = 74, Re = 75$

Atomic mass:

$H = 1, B = 11, C = 12, N = 14, O = 16, Na = 23, Mg = 24, Al = 27, P = 31, S = 32$
$Cl = 35.5, K = 39, Ca = 40, Sc = 45, Ti = 48, Mn = 55, Fe = 56, Cu = 63.5, Zn = 65,$
$Se = 79, Br = 80, Sn = 118, Te = 127, Ta = 181, W = 184, Re = 186$

Q.1 Elements of fourth period A, B and C belong to the group number third, eleventh and seventeenth of the modern periodic table respectively. The sum of the electrons present in the outermost shell of the elements A, B and C is

Q.2 Dobereiner's triad elements X, Y and Z belong to 16^{th} group of the modern periodic table. The sum of atomic number and period number of the middle element is

Q.3

$$KMnO_4 + FeSO_4 + H_2SO_4 \rightarrow \ K_2SO_4 + MnSO_4 + Fe_2\left(SO_4\right)_3 + H_2O$$

The amount of $KMnO_4$ required to oxidize 2.5 moles of $FeSO_4$ in dilute sulphuric acid medium is ____ gm.

Q.4 How many from the followings are redox reactions:

$CaCO_{3(\ s)} \xrightarrow{1000^\circ C} CaO_{(s)} + CO_{2(\ g)}$	$2H_2O_{2(l)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$
$CuO_{(s)} + H_{2(g)} \rightarrow Cu_{(s)} + H_2O_{(l)}$	$2KMnO_{4(s)} \xrightarrow{\text{Heat}} K_2MnO_{4(s)} + MnO_{2(s)} + O_{2(g)}$
$NH_4NO_{3(s)} \xrightarrow{\text{Heat}} N_2O_{(g)} + H_2O_{(l)}$	$MgH_{2(s)} \xrightarrow{\text{Heat}} Mg_{(s)} + H_{2(g)}$
$C_{(s)} + O_{2(\ g)} \rightarrow CO_{2(\ g)}$	$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$
$NH_4NO_{2(s)} \xrightarrow{\text{Heat}} N_{2(g)} + H_2O_{(l)}$	$MnO_{2(s)} + 4HCl_{(aq)} \rightarrow MnCl_{2(aq)} + H_2O_{(l)} + Cl_{2(g)}$
$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$	$CuSO_{4(aq)} + Zn_{(s)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$
$NH_{3(\ g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$	$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$

Q.5 Cassiterite is a tin ore. It contains mainly the nonmagnetic ingredient SnO_2 and the magnetic ingredient $FeZO_4$. Identify the element ' Z '. The sum of group number and period number of element ' Z ' in the modern periodic table is

Q.6 The amount of water-soluble sodium aluminate formed when 0.25 mole of pure bauxite is treated with aqueous solution of sodium hydroxide is ____ gm.

Q.7 When 397.5 gm of cuprous sulphide is treated with sufficient amount of oxygen to produce copper metal, then the volume of sulphur dioxide gas produced at STP is ____ lit.

Q.8 $CH_3COOH, NH_3, H_2CO_3, KOH, H_3PO_4, Ca(OH)_2, H_3BO_3, H_2SO_4, HNO_3$

The sum of maximum numbers of H^+ions & OH^-ions produced by given acids and bases in water is

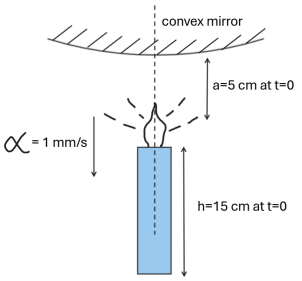
Q.9 The minimum molecular mass of smallest organic ester is ____ amu.

Q.10 The molecular mass of monomer unit used for the preparation of polyacrylonitrile polymer is ____ amu.

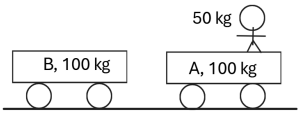
Physics

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

Q.11 A candle of height $h = 15$ cm is placed below a convex mirror. The candle is oriented along the principle axis of the mirror as shown in the figure. The tip of the candle is at the distance of $a = 5$ cm from the pole of the mirror. Candle is lighted at $t = 0$. The wax is consumed such that the flame starts descending at the constant rate of $\alpha = 1$ mm/s. Treat the flame as a point object. At $t = 50$ second the distance between the flame and its image in the mirror is $d = 15$ cm. Determine the value of the focal length of the mirror.

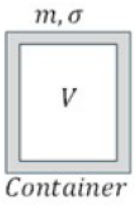


Q.12 Figure shows two trolleys A and B each of mass $M = 100$ kg. They are at rest on the ground. Their wheels (of negligible mass) ensure that they can move with negligible friction on the ground. A woman of mass $m = 50$ kg is standing at the right edge of trolley A. She begins to run with speed $u = 90$ cm/s relative to the trolley and after a short time jumps onto trolley B. She comes to rest on trolley B and both move with speed v towards left. Determine value of v in cm/s. When the woman jumps between the trolleys, ignore her downward motion.

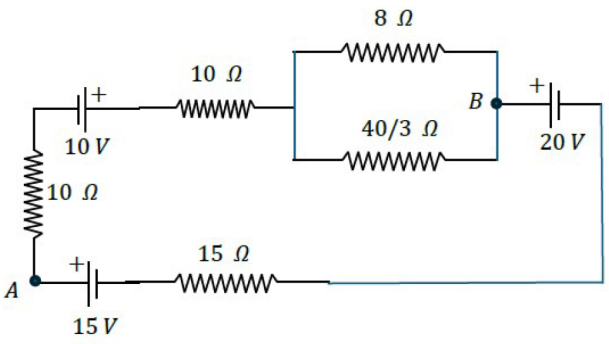


Q.13 A body is thrown upwards from the ground. Consider the situation in which the resistance offered by the air is not negligible. As a matter of fact, assume that this resistance, expressed as a force, is constant and is expressed as $F = \dfrac{W}{\alpha}$. Here W is the weight of the body and α is some fraction. The resistive force always acts in the direction opposite to the velocity of the body. It is observed that the time it takes the body to fall back to the ground is twice the time it takes to reach a maximum height. If $\alpha = \dfrac{N}{21}$, calculate the value of N.

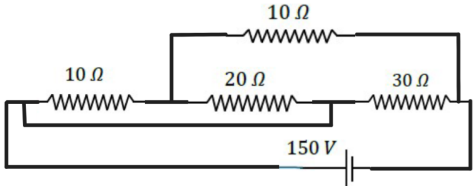
Q.14 An empty closed container has mass $m = 100$ gram and is made of material of density $\sigma = \dfrac{10}{23}$ gram/cc. Space enclosed inside the container has volume $V = 100$ cm^3. See figure. The container is now partially filled with water having volume $V' < V$. When the container is placed in a large body of water, it is found to be half submerged. Determine value of V', the volume of water inside the container (not shown in the figure). Express your answer in cm^3. Take density of water as 1 gram/cc.



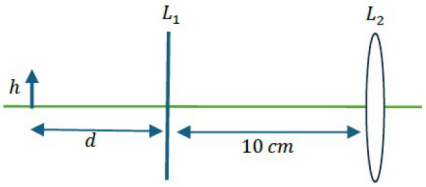
Q.15 In the following circuit a steady current is flowing in all the branches. Let the magnitude of the potential difference between points A and B be V_{AB}. Now assume that all the batteries are shorted, that is, they are removed and replaced by conducting wires in their place. Then let the equivalent resistance between the points A and B be equal to R_{AB}. Let the ratio $\dfrac{V_{AB}}{R_{AB}}$ be equal to $\dfrac{N}{15}$ Ampere. Determine value of N.



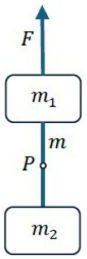
Q.16 The following circuit has steady current flowing through all the branches. Let the maximum power dissipated in any resistor be expressed as $P = 10 \times N$ [Watt]. Determine the value of N.



Q.17 Consider lens L_1 which may be convex or concave. It's nature is such that a real object of height $h = 5$ mm placed to its left side, at the distance of $d = 5$ cm forms an image that is erect, virtual and having a size of $h' = 4$ mm. Lens L_2 is a convex lens. Magnitude of its focal length is $\frac{3}{10}$ times the magnitude of focal length of lens L_1. Distance between L_1 and L_2 is 10 cm. Determine height h'' of the final image formed. Express your answer in mm.



Q.18 Two blocks of masses $m_1 = 5$ kg and $m_2 = 3$ kg are connected by a heavy and inextensible rope of mass $m = 2$ kg. The system of blocks and the rope is pulled up with a force $F = 110$ N. Determine tension T at the midpoint P of the rope. Take $g = 10$ m/s^2.



Q.19 Assume a straight road connecting two cities A and B. Two buses left city A at an interval of 10 minute and they travel towards city B. Speed of both buses is constant and equals 30 km/h. A bus going from city B towards city A passed these two buses at an interval of 4 minute. Determine the speed of the bus going from B to A. Assume this speed to be constant. Express your answer in km/h.

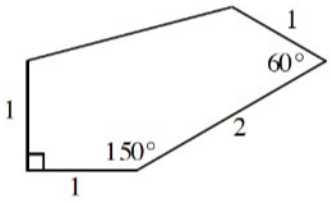
Q.20 5 gram of ice at -20° C is mixed with 21 gram of water at 30° C in an insulated container which does not absorb any heat. Determine the final temperature of the mixture. Round off your answer to the nearest integer. For example, if the answer is 12.3 write it as 12; if it is 12.5 write it as 12; if it is 12.6 write it as 13.

Given: Specific heat capacity of ice: 0.5 cal/(g.$^\circ$ C),
Latent heat of fusion of ice: 80 cal/g

Maths

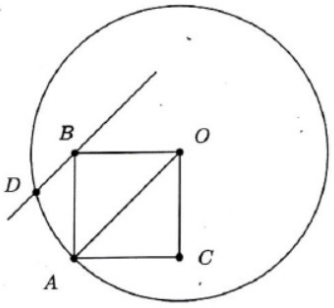
Q.21 The x-coordinates of the vertices of a square in the plane are $1, 3, 8$ and 10. Determine the area of the square.

Q.22 If area of the pentagon shown in the figure is $\frac{a+b\sqrt{c}}{d}$ then $a + b + c + d$ equals.
Note that c is a prime number and a, d and b, d are relatively prime numbers.

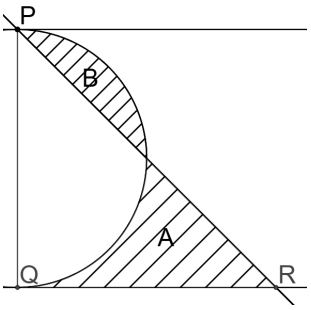


Q.23 Natural numbers a, b are such that
(i) the sum of their squares is S
(ii) the sum of their cubes is C times the sum of the numbers
(iii) $S - C = 28$.
The number of such pairs (a, b) is

Q.24 As shown in figure, O is the centre of the circle. $ACOB$ is a square with A on the circle. Through B a line parallel to OA is drawn to cut the circle at D nearer to A. Then $\angle BOD$ equals



Q.25 As shown in figure 6, $PQ = 42$. QR is the tangent to the semicircle at Q. If the difference of the areas of regions A, B is 357 , then QR equals.Take $\pi = \frac{22}{7}$.



Q.26 If $f(x)$ is a polynomial of degree three with leading coefficient 1 such that $f(1) = 1, f(2) = 4, f(3) = 9$, then the value of $f(4)$ is

Q.27 Given

$$a = -\sqrt{99} + \sqrt{999} + \sqrt{9999}$$
$$b = \sqrt{99} - \sqrt{999} + \sqrt{9999}$$
$$c = \sqrt{99} + \sqrt{999} - \sqrt{9999}$$

then find the sum of the digits of

$$\frac{a^4}{(a-b)(a-c)} + \frac{b^4}{(b-c)(b-a)} + \frac{c^4}{(c-a)(c-b)}$$

Q.28 The polynomial $g(x) = x^3 + ax^2 + x + 10$ has three distinct roots and each root of $g(x) = 0$ is also a root of $f(x) = x^4 + x^3 + bx^2 + 100x + c$. Find sum of the digits of $|f(1)|$ that is absolute value of $f(1)$.

Q.29 In an infinite geometric progression with common ratio $r < 1$, every term is 4 times as large as the sum of all its successive terms. The value of $\frac{1}{r}$ is .

Q.30 If $\sec x + \tan x = \frac{22}{7}$ and $\operatorname{cosec} x + \cot x = \frac{m}{n}$, where m, n are integers and have no common factors > 1, the value of $m + n$ is.