M Prakash Institute **Chemistry**

26 April 2020 10am to 1pm

Atomic numbers: H : 1, C : 6, N : 7, O : 8, F : 9, Na:11, Mg:12,S:16, Cl:17, K:19, Ca:20, Mn:25, Fe:26, Cu:29, Zn:30, Ag:47 Sn:50,W:74.
Atomic masses: H:1, C:12, N:14, O:16, F : 19, Na:23, Mg:24,S:32, Cl:35.5, K:39, Ca: 40, Mn:55, Fe: 56, Cu : 63.5, Zn : 65, Ag : 108, Sn : 119, W : 184.

11) Atomic number of an element 'A' is 46 . Write the group number in which 'A' is present in the Modern periodic table.
Solution:
Electronic Configuration of 'A' = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^0 4d^{10}$ hence, the last electron enters in penultimate (n-1)th shell. The element belongs to 'd' block. Total 1d' electrons in it are 10. Hence, it represents the group number of element 'A'.
Answer = 10

12) What is the amount in grams of water produced when 1 mole of Copper metal is treated with dilute nitric acid solution?
Solution:
Copper reacts with cold and dilute nitric acid to yield cupric nitrate, water and nitric oxide.
$3\ Cu + 8\ HNO_3 \longrightarrow 3\ Cu\,(NO_3)_2 + 4\ H_2O + 2\ NO$
According to this equation,
3 mole Cu $\equiv$ 4 mole of water
Hence, 1 mole of Cu $\equiv 4/3$ mole of water.
Hence, Mass of water is grams $= 4/3 \times 18 = 24$ grams
Answer = 24

13) Following are the IUPAC names of some compounds. Write the molar mass of the compound with CORRECT name.
(i) 4- Chloropentane (ii) Propan -1-ol (iii) Butan-3-oic acid.
Solution:
Correct IUPAC Name among the given ones is Propan-1-ol. Its molar mass is 60
Answer = 60

14) 34 gm $AgNO_3$ is present in it's aqueous solution. It is completely reacted with NaCl. The product is filtered. The filtrate is heated to dryness. Write the mass of the dry filtrate in grams.
Solution:
The reaction involved in the given situation is : $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
The filtrate is $NaNO_3$ and precipitate in this situation is AgCl.
Now,
1 mole of $AgNO_3$ = 1 mole of $NaNO_3$
$\therefore$ 170 grams of $AgNO_3$ = 85 grams of $NaNO_3$
$\therefore$ 34 grams of $AgNO_3$ = 17 grams of $NaNO_3$
Answer = 17

15) Write the molar mass of the lowest hydrocarbon with one double bond and one triple bond in it.
Solution:
Hydrocarbon is vinylacetylene with structural formula : $H_2C - HC - C \equiv CH$
Its molar mass = 52
Answer = 52

16) When Copper is treated with concentrated and dilute Nitric acid separately, we get a gaseous product in each reaction. Write the difference in the molar masses of gaseous products of both the reactions.
Solution:
Copper reacts with concentrated nitric acid to yield cupric nitrate, water and nitrogen dioxide gas.
$\mathrm{Cu} + 4\mathrm{HNO_3} \rightarrow \mathrm{Cu\,(NO_3)_2} + 2\mathrm{NO_2} + 2\mathrm{H_2O}$
Copper reacts with dilute nitric acid to yield cupric nitrate, water and nitric oxide gas.
$3\ \mathrm{Cu} + 8\ \mathrm{HNO_3} \longrightarrow 3\ \mathrm{Cu\,(NO_3)_2} + 4\ \mathrm{H_2O} + 2\ \mathrm{NO}$
The gases are nitrogen monoxide and nitrogen dioxide.
Difference in their molar masses = 16
Answer = 16

17) Take 171 grams of Sugar in an evaporating dish and heat it with the help of a bunsen burner. After some time, you will see the formation of a burnt out black substance. What will be the mass in grams of the black substance?
Solution:
This reaction shows the dehydration of sugar crystals.

$$\mathrm{C_{12}H_{22}O_{11}} + \mathit{Strong\ Heat} \rightarrow 12\mathrm{C} + 11\mathrm{H_2O}$$

Black spongy charred mass of carbon is obtined and the steam is evolved.
1 mole of sugar gives 12 mole of black substance (carbon)
$\therefore$ 342 grams of sugar gives 144 grams of black substance (carbon)
And 171 grams of sugar gives 72 grams mole of black substance (carbon)
Answer = 72

18) On heating, Potassium chlorate ($\mathrm{KClO_3}$) decomposes slowly.

$$2\mathrm{KClO_3} \rightarrow 2\mathrm{KCl} + 3\mathrm{O_2}$$

The rate of the above reaction neither increases by reducing the particle size nor by increasing the reaction temperature.. However $\mathrm{KClO_3}$ decomposes rapidly in presence of a metal oxide to liberate $\mathrm{O_2}$ gas. No chemical change takes place in the metal oxide in the above reaction. What is the molar mass of the metal oxide used?
Solution:
$2\mathrm{KClO_3}(\ \mathrm{s}) + MnO_2\ (Catalyst) \xrightarrow{\text{Heat}} 2\mathrm{KCl(s)} + 3\mathrm{O_2}(\ \mathrm{g})$
Molar Mass of catalyst = 87
Answer = 87

19) Casseterite is a Tin ore. It contains mainly the non magnetic ingredient, a metal oxide, MO_2 and the magnetic ingredient, Ferrous tungstate, $FeWO_4$. Identify MO_2 and write the atomic number of 'M'.
Solution:
Casseterite contains SnO_2
Atomic number of Sn = 50
Answer = 50

20) The reactions in which simultaneous oxidation and reduction of reacting species takes place are called as redox reactions. Transfer of electrons in a reaction from one species to another is also a form of oxidation and reduction. Study the following reactions. How many of them are redox reactions?
(i) $CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2 \uparrow$
(ii) $4Na_{(s)} + O_2 \rightarrow 2Na_2O$
(iii) $MgO + H_2O \rightarrow Mg(OH)_2$
(iv) $Cl_{2(g)} + H_2O_{(l)} \rightarrow HOCl_{(aq)} + HCl_{(aq)}$
(v) $Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)} \uparrow$
(vi) $2\ K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_{2(g)}$
(vii) $CaCO_3 \rightarrow CaO + CO_2 \uparrow$
(viii) $CuSO_{4(aq)} + Mg(s) \rightarrow MgSO_{4(aq)} + Cu_{(s)}$
(ix) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
(x) $SO_2 + 2H_2\ S \rightarrow 3\ S \downarrow + 2H_2O$
(xi) $2KClO_3 \rightarrow 2KCl + 3O_2 \uparrow$
Solution:
Reaction number (ii), (iv), (v), (vi), (viii), (x) and (xi) are redox type.
Total redox reactions are 7.
(There is a typo error in the provided key.)
Answer = 7

Physics – Entrance Test 26 April 2020 Solutions

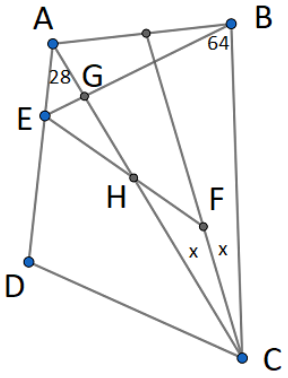
1. Net downward force on the assembly at the moment of release is 20N. The total mass of the assembly at release is (4 + 4 + 2) = 10kg. Therefore, the net acceleration of the assembly is 20/10 = 2 m/s^2. Because of the inextensible string displacement of both blocks will be the same.

   Block a starts from rest (u = 0), a = +2 m/s^2 and S = 1 m, using $v^2 – u^2 = 2aS$ we get v = 2 m/s.

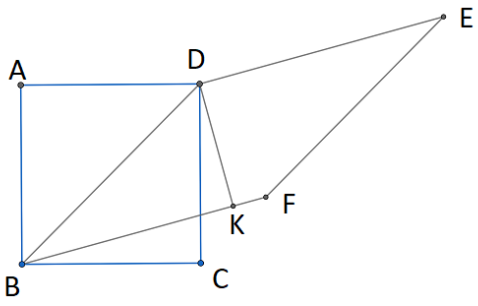
2. The ball is shot up when it is (29+1) = 30m above the ground and reaches maximum height at 75m above ground. So it covers 45m as a projectile shot vertically up. Using $v^2 – u^2 = 2aS$ we get u = 30 m/s and total time of flight as 2u/g = 6 sec. So the time taken for ball to reach 75m is 3 sec. In these 3 seconds the lift reaches 60m above the ground. From this point the ball is falling down with u = 0 and lift is travelling up with u = 10 m/s and the distance separating them is (75 – 60) = 15m. They will meet each other after 1 second. In this 1 second the ball would have travelled 5m. So the total distance the ball has travelled by the time it is caught again is (45 + 5) = 50m.
3. Since the graph makes an angle of 45 degrees, for any point on the line x = y or the magnitude of u is equal to the magnitude of v. The lens formula is 1/f = 1/v – 1/u. So for the given convex lens we get u = -u and v = u. Substituting in the lens formula we get u = 2f. So the y coordinate is v = 2f = 40cm
4. Let the wooden block and the bullet collide after time t. Displacement of wooden block = - ½ ($10t^2$) and displacement bullet 100 – distance travelled by wooden block = 100t – ½ ($10t^2$). Solving for t gets us t = 1 second and so they collide 5m below the cliff top. Using v = u + at, we get the velocity of wooden block and velocity of bullet just before collision as -10 m/s and +90 m/s. Using conservation of linear momentum $mu_w + mu_b = 2mV$ and solving for V gives V = +40 m/s. At maximum height v of combined mass is 0. Using $v^2 – u^2 = 2aS$ for combined mass, we get S = 80m. So height above cliff top 80 – 5 = 75m.
5. Answer not matching
6. Answer not matching
7. At t = 40 seconds velocity is 2 m/s. So u = 2 m/s, a = 2 m/s^2 , the displacement during t = 60 and t = 62 is ($S_{62} – S_{60}$). Using $S = ut + ½ at^2$ and substituting the values we get 88m.
8. Let H be the height of tank and A be its area. The density of boat is 1000/4 = 250 kg/m^3 and density of water is 1000 kg/m^3. Let V_{in} be the volume of boat submerged when floating. So $250V_{in}g = 1000V_{water\ displaced}\ g$. Now Vol = Area x height. So $250H_{in} = 1000H$. Solving this gives percentage of volume till water flows from the top as 75 percent.
9. Let time taken by car A be t, so time taken by car B is (t + 5). Now $V_1 = a_At$ and $V_2 = a_B(t + 5)$ So V1 – V2 = $(a_A - a_B)t – 5a_B$. Now $S_A = S_B$ so we get $a_At^2 = a_B(t + 5)^2$ solving this gives $(a_A^{1/2} - a_B^{1/2})t = 5a_B^{1/2}$. Substituting the value of t from this equation into V1 – V2 equation gives us $5(a_Aa_B)^{1/2}$, so answer is 15 m/s.
10. The resistors r/2 and r at the inverted triangle on the top are in parallel to each other. Their equivalent resistance is r/3. This is in series with the adjacent r. So their equivalent is 4r/3. This 4r/3 is in parallel with the r at the bottom. So equivalent resistance is 4r/7. This is in series with the next 4r/7. So total equivalent resistance is 8r/7, substituting r = 7 ohm gives answer as 8 ohm.

M Prakash Institute **XI Entrance Test**
26 April 2020 **Maths- Solutions**

21. Let $m\angle FCB = x$
$\Rightarrow m\angle GCF = x$... Angle bisector
$\Rightarrow m\angle EGH = 64 + 2x$.. Exterior angle of $\triangle GBC$
$\Rightarrow m\angle AEG = (64 + 2x) - 28 = 36 + 2x$
$\Rightarrow m\angle GED = 180 - (36 + 2x) = 144 - 2x$
$\Rightarrow m\angle GEH = 72 - x$... Angle bisector
$\Rightarrow m\angle EHC = (64 + 2x) + (72 - x)$
$= 146 + x \Rightarrow m\angle HFC = (146 + x) - x = 146 = K \Rightarrow \frac{K}{2} = 73.$



22. Note $\triangle BDC$ is $45 - 45 - 90$, Let side $AC = S \Rightarrow BD = \sqrt{2}S$
Distance between BD and CE is half of AC as $AC \perp BD = \frac{S}{\sqrt{2}}$.
K is foot of perpendicular from D on $\overline{BF}$.
Note $m\angle BKD = 90$ and $BD = 2DK \quad \left(\sqrt{2}S = 2 \times \frac{S}{\sqrt{2}}\right) \Rightarrow \triangle BDK$ is $30-60-90$.
$\Rightarrow m\angle DBK = 30$
$\Rightarrow m\angle CBF = 45 - 30 = 15.$



23. Given $m\angle XOZ = 72$

$\Rightarrow m\angle XAZ = 36$ and $m\angle XBZ = 36$

Note $m\angle AXB = m\angle AZB = 90$

$\Rightarrow m\angle ATX = 90 - 36 = 54$

$\Rightarrow m\angle RTQ = 54$

Note $\square RYTQ$ is cyclic

$\Rightarrow m\angle R = YQ = 54.$

Let $m\angle PQY = 9$ and $m\angle SRY = b$

$\Rightarrow m\angle YQC = 180 - a$

$\Rightarrow m\angle YRC = 180 - b.$

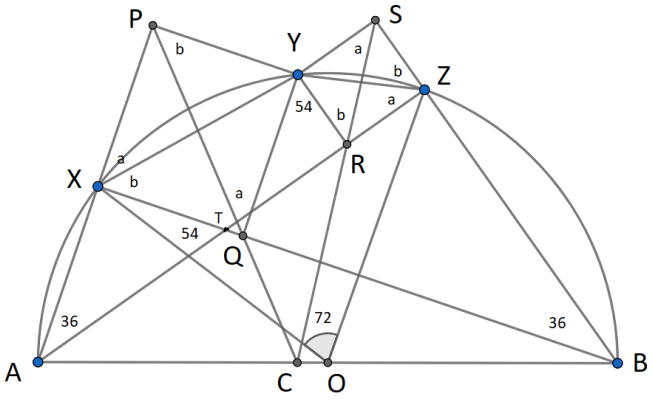
$\Rightarrow m\angle QCR = 360 - [(180 - a) + (180 - b) + 54]$

$= a + b - 54.$

Note $m\angle PXY = a = m\angle YZA \cdots \square AXYZ$ is cyclic

also $m\angle SZY = b = m\angle YXB \ldots . \square BXYZ$ is cyclic

Note $m\angle PXQ = 90 \Rightarrow a + b = 90$



24. Note $\triangle EBC \cong \triangle FCD$ by SAS.

As shown in figure $x + y = 90 \Rightarrow m\angle CPF = 90$

Note $\triangle CPF \sim \triangle CBE$ by AA

$$\Rightarrow \frac{CP}{CB} = \frac{PE}{BE}$$

$$\Rightarrow CP = \sqrt{5} \cdot \frac{CB}{BE} = 2\sqrt{5}$$

Note $\triangle CPF \sim \triangle DPC$ by AA

$$\Rightarrow \frac{CP}{DP} = \frac{PF}{PC}$$

$$\Rightarrow \quad DP = 4\sqrt{5}$$

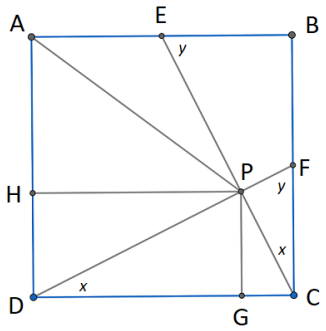
Using Pythagoras we get $CD = 10$

$$\text{Area of DPC } = \frac{DP \times PC}{2} = \frac{4\sqrt{5} \times 2\sqrt{5}}{2} = 40$$

$$= \frac{CD \times PG}{2} = \frac{10 \times PG}{2}$$

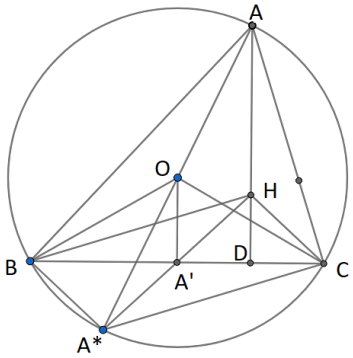
$$\Rightarrow PG = 4 = DH.$$

Using Pythagoras we get $DG = 8 = PH \Rightarrow AH = 6$ and $PH = 8$ Using Pythagoras we get $AP = 10$

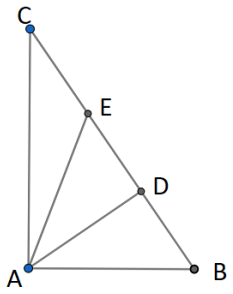


25. Consider diametric opposite point A^*
Join BA^* and CA^*
Note $m\angle ABA^* = m\angle ACA^* = 90$
$\overline{BH} \perp \overline{AC}$ and $\overline{A^*C} \Rightarrow \square HBA^*C$ is parallelogram.
$\Rightarrow A'$ is mid point of $\overline{HA^*}$ and $\overline{BC}$.
$\Rightarrow$ By midpoint theorem $OA' = \frac{1}{2}AH$ and both are perpendicular to BC

As in the given problem $m\angle A = 60,\ \ m\angle BOC = 120, OB = OC = 5\sqrt{3}$.
Note $\triangle OA'B =$ is $30 - 60 - 90$
$\Rightarrow OA' = \frac{5\sqrt{3}}{2};\ \ BA' = \frac{15}{2};\ \ BC = 15$
$[ABC] - [ABC] = \frac{BC(AD-HD)}{2} = \frac{BC \cdot AH}{2}$
We note $AH = 2OA' = 2 \times 5\sqrt{3} \Rightarrow [ABC] - [HBC] = 15 \times 5\sqrt{3} = 75\frac{\sqrt{3}}{2}$
$\therefore$ Required answer $= 75$



26. Drop $\perp$ from A on $\overline{BC}$. Let the foot be D.
Note $AD^2 + BD^2 = AB^2$
$\Rightarrow AD^2 = 7^2 - \frac{(49)^2}{193} = \frac{9457-240)}{193} = \frac{7056}{193} \Rightarrow AD = \frac{84}{\sqrt{193}}$
Note $\triangle ABC \sim \triangle DBA$
$\Rightarrow \frac{AB}{BC} = \frac{DB}{BA} \Rightarrow DB \cdot BC = AB^2$
$\Rightarrow BC = \frac{AB^2}{DB} = 49 \times \frac{\sqrt{193}}{49} = \sqrt{193}$
Also $\Rightarrow \frac{AC}{BC} = \frac{DA}{BA} \Rightarrow AC = \frac{DA}{BA}BC = \frac{84}{\sqrt{193}} \cdot \sqrt{193} \cdot \frac{1}{7} = 12$



27. Consider $(x + b_1y + c_1) \times (x + b_2y + c_2)$
$= x^2 + (b_1 + b_2)\, x_2 + (b_1b_3)\, y^2 + (c_1 + c_2)\, x + (b_2c_2 + b_2c_1)\, y + c_1c_2$
Two polynomials are equal if corresponding coefficients are equal.
$b_1 + b_2 = 1$ and $b_1b_2 = -2$

$$\Rightarrow b_1 = 2 \text{ and } b_2 = -1$$
$$\Rightarrow (x_1 + 2y + c_1)\,(x - y + c_2)$$
$$= x^2 + xy - 2y^2 + (c_1 + c_2)\, x + (2c_2 - c_1) + c_1c_2 = 0$$
$$\Rightarrow c_1 + c_2 = 8 \text{ and } c_1c_2 = -9$$

We have to find values of $2c_2 - c_1$
Case 1: $c_1 = 9, c_2 = -1$ then $2c_2 - c_1 = -11 = 9$
Case 2: $C_1 = -1, c_2 = 9$ then $2C_2 - c_1 = 19 = 9$
So sum of all values of $a = 19 - 11 = 8$

28. To find first root of cubic equation, we should try $0, \pm1, \pm2, \pm3$ etc. Note given cubic becomes zero if we put value of $x = 3$.

$$\Rightarrow x^3 - 9x^2 - 37x + 165 = (x - 3)\left(x^2 - 6x - 55\right)$$
$$= (x - 3)(x - 11)(x + 5)$$

Roots of given cubic are $-5, 3, 11$.
Note that they are in an AP. With first term -5 and common difference 8.
Sum of first 40 terms is

$$S_{10} = \frac{10}{2}(2(-5) + (10 - 1)8)$$
$$= 310 = 10T$$
$$\Rightarrow T = 31$$

29. Multiplying first equation by $(1 - k)$

$$(1 - k)x + (1 - k)(1 + k)y = 0.....(1)$$
$$(1 - k)x \qquad\qquad + ky = 1 + k - (2)$$

(2) $-(1) \Rightarrow [k - (1 - k^2)]\, y = 1 + k$

$$\Rightarrow \quad y = \frac{1 + k}{k^2 + k - 1}$$

Putting in first equation we get

$$x = \frac{-(1 + k)(1 + k)}{k^2 + k - 1}$$

Putting these values in third equation

$$(1+k)\left[\frac{-(1+k)(1+k)}{k^2+k-1}\right]+(12-k)\left[\frac{1+k}{k^2+k-1}\right]=-(1+k)$$
$$\Rightarrow -(1+k)^3+(12-k)(1+k)+(1+k)\left(k^2+k-1\right)=0$$
$$\Rightarrow (1+k)(-1+k)^2+(12-15)+k^2+k-1\big)=0$$
$$\Rightarrow (1+k)\left(-k^2-2k-1+12-k+k^2+k-1\right)=0$$
$$\Rightarrow (1+k)(-2k+10)=0\Rightarrow k=5, \text{as k=}-1 \text{ is not positive}$$

$$x=\frac{-25}{29}, y=\frac{5}{29}\Rightarrow y-x=\frac{30}{29}\therefore \text{ Ans } =30$$

30. Given $x^2-3x+1=0$

$$\Rightarrow x+x^2+1=3x$$
$$\Rightarrow x+\frac{1}{x}=3 \text{ if } x\neq 0.$$

To find value of k, rearrange

$$x^{12}+1=7kx^6$$
$$\Rightarrow x^6+\frac{1}{x^6}=7k$$
$$\text{Consider } \left(x+\frac{1}{x}\right)^3=27$$
$$\Rightarrow x^3+\frac{1}{x^3}+3\left(x+\frac{1}{x}\right)=27$$
$$\Rightarrow x^3+\frac{1}{x^3}+3\times 3=27$$
$$\Rightarrow x^3+\frac{1}{x^3}=18$$
$$\Rightarrow \left(x^3+\frac{1}{x^3}\right)^2=x^6+\frac{1}{x^6}+2=18^2=324.$$
$$\Rightarrow x^6+\frac{1}{x^6}=324-2=322=7k$$
$$\Rightarrow k=46$$