M. Prakash Institute Entrance Examination
for IIT JEE Training Batch 2021-23

3 January, 2021 10.00 am to 1.00 pm Total marks: 150

Chemistry

Useful data:

Atomic numbers:H:1; Li:3; C:6; N:7; O:8; Na:11; Mg:12; Al:13; P:15; S:16; Cl:17; K:19; Ca:20; Mn:25; Fe:26; Co:27; Ni:28; Cu:29; Zn:30; Ga:31; Ag:47; Ba:56; Pt:78; Au:79; Hg:80.
Atomic masses: H:1; Li:7; C:12; N:14; O:16; Na:23; Mg:24; Al:27; P:31; S:32; Cl:35.5; K:39; Ca:40; Mn:54.9; Fe:56; Ni:58.7; Co:58.9; Cu: 63.5; Zn:65; Ga:70; Ag:108; Ba:137; Pt:195; Au:197; Hg:200.
Avogadro number : 6×10^{23} per mole.

1. When oil gets converted to fat, reaction is carried out in presence of a metal catalyst, 'A' that belongs to the fourth period. Write the atomic number of 'A' .

2. An element of group 13 exists in liquid state at room temperature. Its boiling point is 2400^0C. Identify the element and write its atomic number .

3. There are in all 28 'f' block elements. The Lanthanides belong to group 'X' and period 'Y'. The actinides belong to group 'X' and period 'Z'. Write the value X+ Y + Z .

4. Write the **number** of **endothermic** chemical reactions /processes from the following list .
(i) $KNO_{3(s)} + H_2O \rightarrow KNO_{3(aq)}$
(ii) $C_6H_{12}O_{6(aq)} + 6O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(l)}$
(iii) $NH_4Cl_{(s)} + H_2O \rightarrow NH_4Cl_{(aq)}$
(iv) $S + O_{2(g)} \rightarrow SO_{2(g)}$
(v)$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$
(vi) $C_{12}H_{22}O_{11(s)} \rightarrow 12C + 11H_2O_{(l)}$
(vii) Addition of NaCl to water.
(viii) A piece of Sodium metal dropped in a trough of water.

5. From the following, write the **number** of reactions that are **NOT** redox reactions .
(i) $CH_{4(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(l)}$
(ii)$H_2O + CO_{2(g)} \rightarrow H_2CO_{3(aq)}$
(iii)$AgNO_3 + NaCl \rightarrow NaNO_3 + AgCl$
(iv) $BaSO_4 + 4C \rightarrow BaS + 4CO$
(v) $C_2H_5OH + Na \rightarrow C_2H_5ONa + H_2\uparrow$
(vi) $2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$
(vii) $4Al + 3O_2 \rightarrow 2Al_2O_3$
(viii) $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$
(ix) $BaS + ZnSO_4 \rightarrow BaSO_4 + ZnS$

6. Two elements 'A' and 'B' belong to the second group of the Modern periodic table. The molecular mass of carbonate of 'A' and nitride of 'B' are same. Identify 'A' and 'B' and write the difference in the atomic mass numbers of 'A' and 'B'.

7. Write the molar mass of the acid produced when ethanol reats with PCl_3.

8. Write the **number** of elements from the following list that produce one of the following oxides of Nitrogen :NO, N_2O *or* NO_2 on reacting with HNO_3:
Zn, Cu, Ag, Hg, Ca, Au, Pt

9. In electrolytic reduction of molten NaCl, 1 mole of Na is deposited at cathode by gaining 'x' mole of electrons. 1 mole of Chlorine gas is liberated at the anode by losing 'y' moles of electrons. Write the value of 'x' +'y' (where x and y are whole numbers).

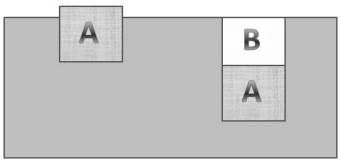
10. Carbonates and bicarbonates of Sodium produce CO_2 on treatment with Vinegar. If equal quantities (in mole) of both are taken,find the compound that contains greater percentage of CO_2. Call it 'A'. If the molecular mass of 'A' is 'M', write the value of $\frac{M}{2}$.

Physics

Important:
Take g = 10 m/s^2, k = 9×10^9 N.(m/C)^2 and G =6.67×10^{-11} m^3/kg.s^2

11. Several people are riding in a hot air balloon. The combined mass of people and the balloon is 425 kg. Air provides the force (called buoyant force) such that the balloon in this case is motionless in the air. If the buoyant force remains constant, how much mass should be removed from the balloon, so that it acquires an upward acceleration of 0.18 m/s^2. Express your answer in kg. Multiply your answer by 2 and write that number as answer.

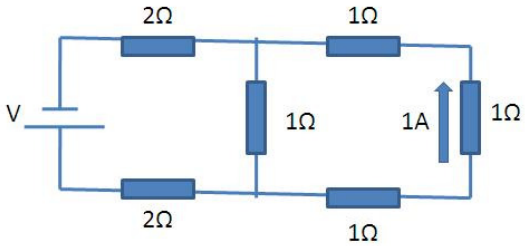
12. A solid wooden cube A ($10cm \times 10cm \times 10cm$) is floating in water such that 20% of cube is above water. Now another block of material B having cross section area $10cm \times 10cm$ is placed on top of the wooden block A such that no part of block is outside water. If specific gravity of material B is 1.4, calculate height of the new block. Express your answer in cm.



13. A thermally insulated container has 24 gm of ice at 0° C. 10 gm of steam at 100° C is introduced in the container. When equilibrium is reached, calculate amount of water in the container. Express your answer in grams.
Given data for water: L for fusion = L_f = 80 cal/g.
L for evaporation = L_f = 540 cal/g
and Specific Heat Capacity = 1 cal/g °C

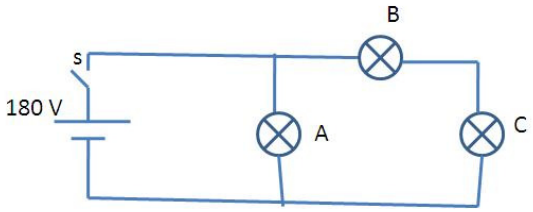
14. In a hundred meter race, Ram gave Sham a start of half a meter and still beat him by 1/5 th of a second. If Sham had received a start of 4.5 meters, he would have beaten Ram by 1/5 th of a second. What is Ram's race time for the 100 meter race. Multiple your answer in seconds with 4 and write that number as answer.

15. In a given circuit diagram, 1A current flows through resistance block of 1Ω as shown in the figure. Find the value of V in volts. Multiple your answer by 4 and write that number as answer.

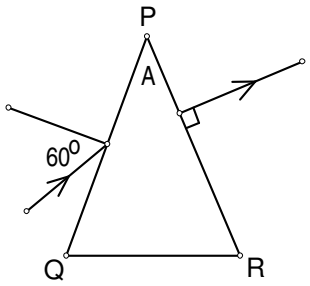


16. A grocer used a defective balance and gave 16 kg of wheat at 30 Rs per kg to a customer. Customer had a doubt and asked the grocer to put the wheat bag in the other pan and weights in the first pan. Now it weighed only 9 kg. The grocer apologized and charged for the average 12.5 $(= \frac{(16+9)}{2})$kg.
How much extra money customer had to pay than that of actual weight of wheat he got? Express your answer in rupees.

17. Consider a circuit consisting of 3 light bulbs as shown. Bulb A (24W), Bulb B(60W) and Bulb C(40W) are all rated at 240V. When switch s is closed, find out the power dissipated in bulb C in Watts. Multiply your answer by 10 and write that number as answer.



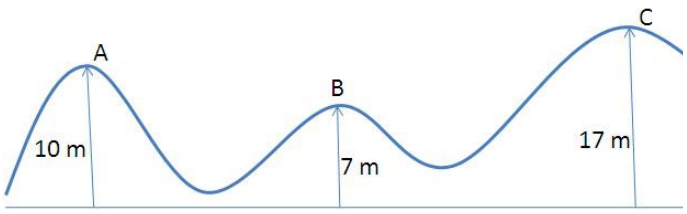
18. Consider a prism made of glass of refractive index n and angle $A = 30°$ as shown in the figure. It is observed that a ray of light incident on the face PQ at angle $\theta = 60°$ emerges from the face PR at 90°. Calculate the value of n. Square the number and multiply it by 4. Write that number as answer.



19. In a hydrogen atom 1 electron revolves around proton. Let F_e and F_g by the electrostatic force (Coulomb force) and gravitational force respectively. Find ratio F_e/F_g. If it is expressed as $N.M \times 10^X$, where N is single digit integer, write X as your answer.

Mass of e $= 9 * 10^{-31}$ kg
Mass of P $= 1.6 * 10^{-27}$ kg
Charge on p and e $= 1.6 * 10^{-19}$ C
Size of Hydrogen atom $= 0.1nm$

20. Consider a frictionless curved path as shown. An object is given velocity v m/s at point A such that it just reaches the maximum height on the path. If same velocity is given to another object at point B, calculated maximum height it will reach. Express your answer in meters.



Mathematics

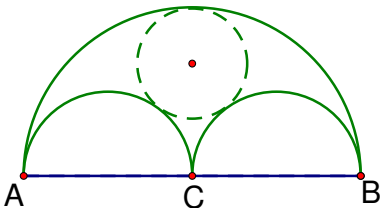
21. In square $ABCD, M$ and N are on $\overline{AB}$ and $\overline{BC}$ respectively such that $m\angle MDN = 45$. $\overline{AC}$ intersects $\overline{MD}$ at R and $\overline{ND}$ at Q. P is midpoint of MN. If $m\angle NRQ = 8$ then $m\angle PRN$ equals.

22. $\square ABCD$ is cyclic with $\overline{AC} \perp \overline{BD}$. If radius of circumcircle is 4 and $AC = 7$ and $BD = 6$ then $(AB^2 + BC^2 + CD^2 + DA^2)/2 =$.

23. In ABC, D is a point on BC such that AD is the internal angle bisector of $\angle A$. Suppose $\angle B = 2\ \angle C$ and $AB = CD$. Then m$\angle BAC$ equals.

24. $\square ABCD$ is parallelogram. X and Y are mid points of $\overline{BC}$ and $\overline{CD}$ respectively. If area of $\square ABCD = 64$ then area of $\triangle AXY$ equals.

25. $\overline{AB}$ is a line segment of length 48. C is mid point. On $\overline{AB}, \overline{AC}, \overline{CB}$ semi circles are drawn on one side of $\overline{AB}$. Find radius of circle drawn tangent to these semicircles.



26. Product of roots of $\sqrt{x+3} - \sqrt{x - \sqrt{x-2}} = 1$ is K. Find $3K$.
Note that: $\sqrt{y}$ represents the non negative square root of a non negative real number y.

27. $3x^2 - x + 1$ is a factor of $ax^4 + bx^3 + 12x^2 - 6x + 1$. Then $a - b$ equals

28. $\triangle ABC$ is right angled at $\angle C$. Let the measure of $\angle ABC = 2\theta$. If $2\sec 2\theta = \sqrt{13}$ find value of $(3\tan\theta + 2)^2$.

29. If A and B work together, they will complete a job in 7.5 days. However if A works alone and completes half the job and then B takes over and completes the remaining half alone, they will be able to complete the job in 20 days. How long will B alone take to do the job if A is more efficient than B?

30. Area of a regular octagon inscribed in a circle is A. Area of a regular hexagon inscribed in the same circle is B. Then $27(A/B)^2$ equals.

Answers:

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	28	31	16	5	4	16	82	5	3	42
Q.No.	11	12	13	14	15	16	17	18	19	20
Ans.	15	5	32	39	76	15	81	12	39	14
Q.No.	21	22	23	24	25	26	27	28	29	30
Ans.	37	64	72	24	8	44	31	13	30	32