M. Prakash Institute Entrance Test for XI std.

Section I - Physics

Please take value of g as **10 m/s^2** wherever required

1. Two identical blocks A and B, each of mass M = 4 kg, are connected by a light in-extensible string as shown. Block A is kept on a smooth horizontal table. Force F is applied such that the blocks are at rest. A small block of mass m=2 kg is now placed over block B as shown, with Force F still applied. Calculate velocity of block A (in m/s) at the instant when Block B has descended through 1 m. Please take value of g as **10 m/s^2**
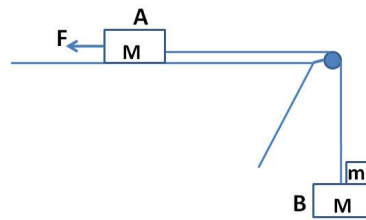
2. An elevator without a ceiling is ascending with a constant speed of 10 m/s. A boy on the elevator shoots a ball directly upward from a height of 1 m above the elevator floor when the elevator floor is 29m above the ground. The ball attains maximum height of 75 m above the ground. Calculate the total distance covered by the ball before the boy catches the ball again at same height of 1 m above the elevator floor. Please take value of g as **10 m/s^2**

3. In an optics experiment, with position of object fixed, a student varies the position of a convex lens of focal length 20 cm and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance 'u' (in cm) and the image distance 'v' (in cm), from the lens, is plotted using the same scale for two axes. A straight line passing through the origin and making an angle of 45 ° with the x-axis meets the experimental curve at point P. Find the y-coordinate of pont P.

4. A wooden block of mass 10 gm is dropped from the top of a cliff 100 m high. Simultaneously, a bullet of mass 10 gm is fired from the foot of the cliff upward with a velocity 100 m/s. The bullet gets embedded in the block. How high will it rise above the cliff before it starts falling back. Express your answer in meters. Please take value of g as **10 m/s^2**

5. A spherical planet has density of 3600 kg/m^3. The gravitational acceleration at its surface is $64\pi m/s^2$. A very small satellite rotating in circular orbit is located at R m away from its surface, where R is the radius of the planet. Find the linear speed of the satellite. Use $G = (20/3) \times 10^{-11} N - m^2/kg^2$. Volume of spherical planet $= \dfrac{4\pi R^3}{3}$. Express your answer as $X \sqrt{\pi} \times 10^Y$ where X and Y are single digit integers. Calculate (X+Y) and mark that as your answer.

6. 80 gm of ice at $-10°$C is mixed with 460 gm of liquid water at 20 °C and 10 gm steam at 100°C. The container is insulated so that no heat is lost. Find the equilibrium temperature of the contents (in °C).
   Given: Specific heat of ice = 0.5 cal/gm°C ; Specific heat of water 1 cal/gm°C
   Latent of fusion(water-ice): 80 cal/gm ;
   Latent heat of evaporation(water-steam): 540 cal/gm

7. A particle is moving with uniform velocity and covers 80 m in a straight line in first 40 seconds. At t=40 it begins to accelerates at 2 m/s^2 in the same direction. Find the distance covered by the particle during the time interval t = 60 s and t = 62 s.

8. A cuboid shaped boat in a lake is floating and stationary. It is made of extremely thin sheets, so that their thickness and volume is negligible. The boat has internal volume of $4\ m^3$. Mass of the boat is 1000 kg and it is empty. It is put in water of density 1 gm/cc and the boat floats. Now, a small hole is drilled in the bottom of the boat and water starts accumulating inside. Find the % of boat volume filled with water, when water starts to come inside from the top of the boat's sides.

9. In a car race on a straight road, car A wins the race by 5 second. Car A crosses finish line with speed V_1 m/s and car B crosses finish line with speed V_2 m/s. Both cars start from rest simultaneously from the starting point. Car B travels with uniform acceleration of 2.25 m/s^2 while car A travels with uniform acceleration of 4 m/s^2. Calculate difference between V_1 and V_2.

10. Eight resistor blocks are connected in a circuit as shown below, where r = 7Ω. Find resistance between A and B (in Ω)
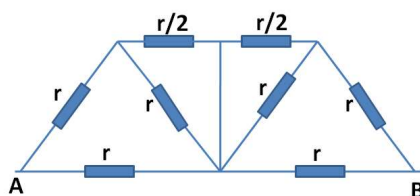
Section II -Chemistry
Atomic numbers: H:1, C:6, N:7, O:8, F:9, Na:11, Mg:12,S:16, Cl:17, K:19, Ca:20, Mn:25, Fe:26, Cu:29, Zn:30, Ag:47 Sn:50,W:74.

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.
    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.
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12. What is the amount in grams of water produced when 1 mole of Copper metal is treated with dilute nitric acid solution?
    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.

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.

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.
    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.
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15. Write the molar mass of the lowest hydrocarbon with one double bond and one triple bond in it.
    Atomic numbers: H:1, C:6, N:7, O:8, F:9, Na:11, Mg:12,S:16, Cl:17, K:19,
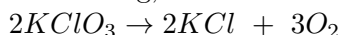   Ca:20, Mn:25, Fe:26, Cu:29, Zn:30, Ag:47 Sn:50,W:74.
    Atomic masses: H:1, C:12, N:14, O:16, F : 19, Na:23, Mg:24,S:32, Cl:35.5,
    K:39, Ca: 40, Mn:55, Fe : 56 , Cu: 63.5, Zn:65, Ag:108, Sn : 119, W:184.

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.
    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.

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?
    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,
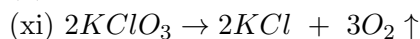   K:39, Ca: 40, Mn:55, Fe : 56 , Cu: 63.5, Zn:65, Ag:108, Sn : 119, W:184.

18. On heating, Potassium chlorate ($KClO_3$) decomposes slowly.
    $2KClO_3 \rightarrow 2KCl + 3O_2$

    The rate of the above reaction neither increases by reducing the particle size nor by increasing the reaction temperature.. However $KClO_3$ decomposes rapidly in presence of a metal oxide to liberate 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?
    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,
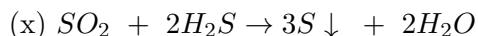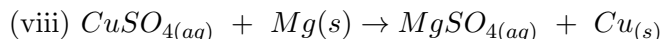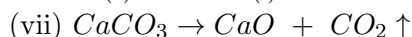   K:39, Ca: 40, Mn:55, Fe : 56 , Cu: 63.5, Zn:65, Ag:108, Sn : 119, W:184.

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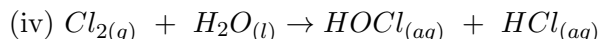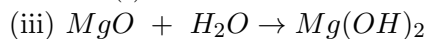   **Atomic numbers:** H:1, C:6, N:7, O:8, F:9, Na:11, Mg:12,S:16, Cl:17, K:19,
    Ca:20, Mn:25, Fe:26, Cu:29, Zn:30, Ag:47 Sn:50,W:74.
    Atomic masses: H:1, C:12, N:14, O:16, F : 19, Na:23, Mg:24,S:32, Cl:35.5,
    K:39, Ca: 40, Mn:55, Fe : 56 , Cu: 63.5, Zn:65, Ag:108, Sn : 119, W:184.

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) $Zn_{(s)} + 2\ HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)} \uparrow$

(vi) $2K_{(s)} + 2H_2O_{(l)} \rightarrow 2KOH_{(aq)} + H_{2(g)}$

(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) $SO_2 + 2H_2S \rightarrow 3S \downarrow + 2H_2O$

(xi) $2KClO_3 \rightarrow 2KCl + 3O_2 \uparrow$
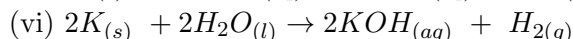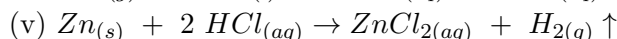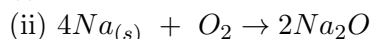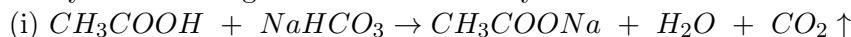
Section III - Maths

21. $\square ABCD$ is convex quadrilateral. E is a point on $\overline{AD}$. F is point inside $\square ABCD$, such that CF and EF bisects $\angle ACB$ and $\angle BED$ respectively. $m\angle CAD = 28°$ and $m\angle CBE = 64°$. Let measure of angle $CFE = K$. Report $\frac{K}{2}$

22. $\square ABCD$ is a square and $\square BDEF$ is a rhombus such that C, F, E are collinear. Find $m\angle CBF$.

23. Let $AXYZB$ be a convex pentagon inscribed in a semicircle centered at O with diameter AB. Let P, Q, R and S denote the feet of the perpendiculars from point Y to lines AX, BX, AZ, BZ respectively. Let PQ and RS intersect at C. If $m\angle XOZ = 72°$. Find $m\angle PCS$.

24. $\square ABCD$ is a square. E is midpoint of $\overline{AB}$ and F is midpoint of $\overline{BC}$. $\overline{CE}$ and $\overline{DF}$ intersect at P. If $PF = \sqrt{5}$, find AP.

25. In acute angled $\triangle ABC$ $m\angle BAC = 60°$. Circumradius of $\triangle ABC = 5\sqrt{3}$. Let H be the orthocenter and O be circumcenter of $\triangle ABC$. Let $[ABC]$ be area of $\triangle ABC$ and $[HBC]$ be area of $\triangle HBC$. Find $\dfrac{2}{\sqrt{3}}([ABC] - [HBC])=$
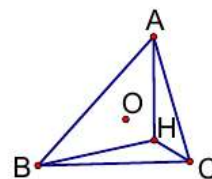
26. In $\triangle ABC$, $m\angle BAC = 90°$. E is on $\overline{BC}$ such that $AB = AE$. If $AE = 7$ and $BE = \frac{98}{\sqrt{193}}$, find AC.

27. Given that $x^2 + xy - 2y^2 + 8x + ay - 9$ gets factorised into two linear polynomials with integer coefficients. Find the sum of all possible values of a.

28. Roots of $x^3 - 9x^2 - 37x + 165 = 0$, in increasing order, form first 3 terms of an Arithmatic Progression (AP). 10 T is sum of first 10 terms of the same AP. Find T.

29. Given that k is positive real number.
$x + (1 + k)y = 0$
$(1 - k)x + ky = 1 + k$
$(1 + k)x + (12 - k)y = -(1 + k)$
Solve system of simultenous equations and find value of x and y. Report $29(y - x)$.

30. Given that $x^2 - 3x + 1 = 0$. Find the value of k if $x^{12} - 7kx^6 + 1 = 0$.