

Chemistry

Atomic numbers:

H:1, C:6, O:8, Na:11, Mg:12, Al:13, S:16, Cl:17, Ca:20, Fe:26, Cu:29, Br:35, I:53, Hg:80

Atomic masses:

H:1, C:12, O:16, Na:23, Mg:24, Al:27, Cl:35.5, S:32, Ca:40, Fe:56, Cu:63.5, Br:80, I:127, Hg:200

Avogadro Number : 6×10^{23}

Q.1 In a chemical reaction of regular fire extinguisher a salt is produced. Assume that molar mass of the salt is "X" gram, then enter the value of X/2 in the bubble sheet.

Q.2 Determine the amount of gas produced in grams when 1 mole of CO_2 is completely treated with bleaching powder.

Q.3 Write the sum of total number of molecules of water of crystallisation in green vitriol, blue vitriol, crystalline alum, crystalline Washing soda and Glauber's salt, together.

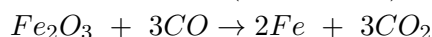
Q.4 Determine the mass of NaOH in grams in 2.5 litre of 0.6 M NaOH solution.

Q.5 Count the number of substances from following list that have pH more than 7.

Limewater, tomato juice, vinegar, toothpaste, blood, black coffee, milk, milk of magnesia, solution of baking soda.

Q.6 From the compounds given below, enter the sum of the valencies of all the metals only in the bubble sheet. $Cu_2O, FeO, MgCl_2, Fe_2O_3, MgCl_2, AlBr_3, HgI_2$

Q.7 The following reaction takes place in a blast furnace at a temperature of about $1500^\circ C$ to produce pig iron (impure iron) from iron ore.



Find the amount (in grams) of Fe_2O_3 required to produce 0.75 mol of Iron.

Q.8 1.125 mol CO_2 gas is produced on thermal decomposition of 150 gm of impure $CaCO_3$. The purity of $CaCO_3$ is%.

Q.9 Three straight chain hydrocarbons; one alkane, one alkene and one alkyne are given. If each hydrocarbon has exactly 4 carbon atoms in it, write the total number of Hydrogen atoms in these 3 compounds together.

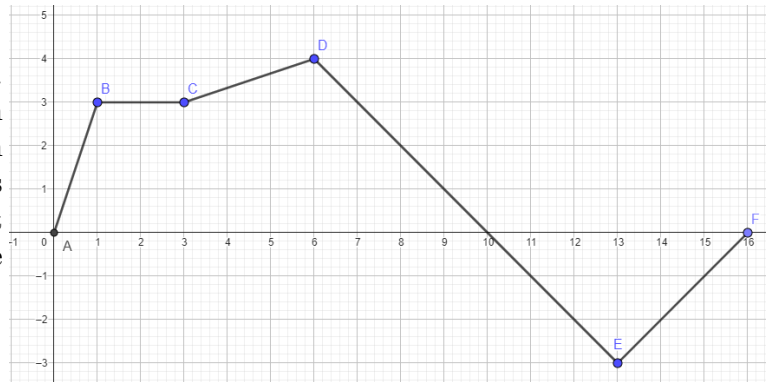
Q.10 9×10^{25} atoms are present in mole of water.

Physics

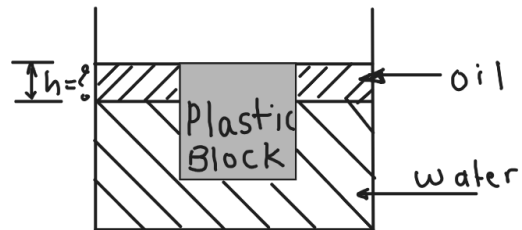
Use $g = 10 \text{ m/s}^2$ wherever required.

Q.11 An object A is dropped from the top of a cliff at $t = 0$ (with zero initial velocity.) At the same instant an object B is thrown vertically upwards with some initial velocity $u \text{ m/sec}$. At $t = 1$, another object C is dropped from the top of the cliff (with initial velocity zero). Objects A and C are in the same vertical line, but object B is not in the same vertical line, i.e. B will not collide with A or C. At $t = 2$ seconds, A and B cross each other. At $t = 2.75$ seconds, objects B and C cross each other. What is the initial velocity of B in meter per second?

Q.12 Refer to the diagram. It is a velocity–time graph with velocity (in m/sec) on Y axis and time in seconds on X axis. Calculate the net displacement of the particle (in meters) from $t = 0$ to $t = 16$.

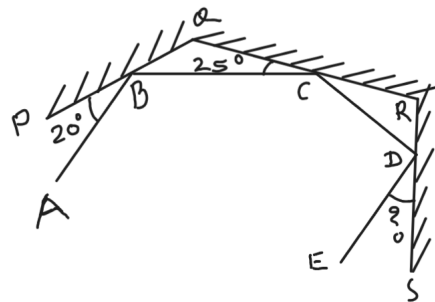


Q.13 Refer to the diagram. There is a container. Water is filled in it to a level. There is a layer of oil above water. A cuboid block of plastic is floating in it. The block size is $40\text{ mm} \times 40\text{ mm} \times 40\text{ mm}$. The top surface of the block coincides with the top surface of oil. The densities are: water: 1 gm/cc , oil: 0.5 gm/cc , plastic: 0.75 gm/cc . Find the height of layer of oil in mm.

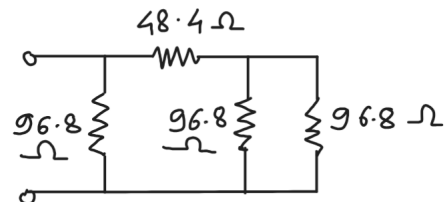


Q.14 There are three points A, B, C on a straight line L such that A is on the left side of B and C is on the right side of B . A static fixed charge of $+Q_A$ coulombs is at point A . A static fixed charge $+Q_C$ coulombs is at C . A charge $-Q_B$ coulombs is at B and it is observed that the net electrostatic force on the charge at B is zero. $AB = 10\text{ cm}$, $BC = 20\text{ cm}$. Now, the charge at A is replaced by a negative charge of the same magnitude, i.e. the charge at A is $-Q_A$ coulombs. The static charge $-Q_B$ is moved at point D which is on the same line L , but is on the left side of A such that the net electrostatic force on the static charge $-Q_B$ is zero. Calculate distance AD in centimeters.

Q.15 Refer to the diagram. PQ, QR, RS are three plane mirrors. Ray AB is reflected as ray BC on mirror PQ . Ray BC is reflected as ray CD on mirror QR . Ray CD is reflected as ray DE on mirror RS . It is found that lines AB and DE are parallel to each other. If $\angle ABP = 20^\circ$ and $\angle BCQ = 25^\circ$ then find $\angle EDS$ in degrees.



Q.16 A water heater consisting of resistances as shown in the diagram is connected to a 220 Volts supply. Calculate the time required (in minutes) to raise temperature of 20 liters of water through 10° C using this heater. Take specific heat capacity of water as $1\text{ cal/gm}^\circ\text{ C}$ and $4.2\text{ J} = 1\text{ cal}$.



Q.17 A solid block of metal of mass 2205 gm (specific heat $0.1\text{ cal/gm}^\circ\text{ C}$) at temperature 1100° C is put in 1000 gm of ice at 0° C . All of this is kept in an insulated container. After some time, equilibrium temperature is reached. Calculate the mass of steam present in the container in grams. Take latent heat of vaporisation of water as 540 cal/gm , specific heat capacity of water as $1\text{ cal/gm}^\circ\text{ C}$ and latent heat of fusion of water as 80 cal/gm .

Q.18 A 10 gm object (A) is moving in a straight line at 1 m/sec. Another object (B) is coming towards A in the same straight line at speed u m/sec. After collision, A travels with same speed but in the opposite direction. B also travels with same speed but with opposite direction. Now B collides with a stationary object C of mass m gm. After collision, B starts travelling with the same speed but in the opposite direction. Object C starts moving with speed 1 m/sec. Find the mass of object C in grams.

Q.19 Image of an object through a convex lens is real and twice the size of the object. When the object is moved towards the lens by 20 cm, its image is virtual and twice the size of the object. Calculate the focal length of the lens in cm.

Q.20 A police car is at rest on a straight road. A thief travelling in a car at the speed of 36 km/hr crosses the police. At the instant the thief is crossing the police, the police starts accelerating at a constant rate. The police car reaches a speed of 48 km/hr in 25 seconds and then travels at the same constant speed for t_2 seconds and catches the thief. Find t_2 in seconds.

Maths

Q.21 Centroid of the triangle formed by lines

$$AB : 13x - 5y + 1 = 0, BC : 6x + 3y + 4 = 0, CA : 2x + 24y - 37 = 0$$

is (h, k) . Find the value of $9h + 6k$.

Q.22 Outside to 12 sided regular polygon $DEFGHIJKLMNO$, square $BCDE$ is constructed. Outside to square $BCDE$ equilateral triangle ABC is drawn. If side of equilateral triangle is $\frac{15}{\sqrt{2+\sqrt{3}}}$ then circumradius of $\triangle AFN$ is.

Q.23 Set A_i has i elements which follow the pattern,

$$A_1 = \{1\}, A_2 = \{3, -5\}, A_3 = \{7, -9, 11\}, A_4 = \{13, -15, 17, -19\},$$

$$A_5 = \{21, -23, 25, -27, 29\}, A_6 = \{31, -33, 35, -37, 39, -41\} \text{ and so on.}$$

S denotes the sum of elements of the set A_{25} . Find \sqrt{S} .

Q.24 $ABCDEF$ is regular hexagon. Point P is in the interior of $\triangle ACD$ such that area of $\triangle PBC = 5$ and area of $\triangle PAD = 6$. Find the area of hexagon.

Q.25 Suppose that x and y are integers such that $x \geq 5, y \geq 3$, and $\sqrt{x-5} + \sqrt{y-3} = \sqrt{x+y}$. Find the minimum possible value of xy .

Q.26 In $\triangle ABC$, $\cos \angle A = \frac{2}{3}$, $\cos \angle B = \frac{1}{9}$, and $BC = 24$. Find the length AC .

Q.27 $x^4 - 4x^3 + Ax^2 + 12x + B$ is a perfect square of some polynomial with integer coefficients. Find $B - A$.

Q.28 For some constant k the polynomial $P(x) = 3x^2 + kx + 117$ has the property that $P(1) = P(10)$. Evaluate $P(3)$

Q.29 X, Y, Z are on circle with center O such that Z and O are on opposite sides of chord XY . A, B are on \overline{XY} such that $OA = OB = ZA = ZB = 5$. If $XY = 12$ then AB^2 equals.

Q.30 $ABCD$ is regular tetrahedron, 3 dimensional figure with all four faces as equilateral triangles. Find distance of A from face BCD if $AB = 5\sqrt{6}$.

