

Physics

1. A body is projected vertically upwards with a velocity of 20 m/s. What is the maximum height reached by the body? ($g = 10 \text{ m/s}^2$)
2. A car is moving with a velocity of 10 m/s on a straight road. The brakes are applied and the car comes to rest in 5 seconds. What is the acceleration of the car?
3. A block of mass 2 kg is placed on a rough horizontal surface. A force of 10 N is applied to the block. The coefficient of friction between the block and the surface is 0.2. What is the acceleration of the block?
4. A simple pendulum has a period of 2 seconds. What is the length of the pendulum? ($g = 10 \text{ m/s}^2$)
5. A convex lens has a focal length of 10 cm. An object is placed at a distance of 20 cm from the lens. What is the nature and position of the image?
6. A ball is thrown horizontally from the top of a tower with a velocity of 10 m/s. It lands on the ground at a distance of 20 m from the foot of the tower. What is the height of the tower? ($g = 10 \text{ m/s}^2$)
7. Two resistors of resistances 4Ω and 6Ω are connected in parallel. What is the equivalent resistance of the combination?
8. A charge of $2 \mu\text{C}$ is placed in an electric field of intensity 5 N/C. What is the force experienced by the charge?
9. A sound wave has a frequency of 500 Hz and a wavelength of 0.7 m. What is the speed of the sound wave?
10. What is the kinetic energy of an electron moving with a velocity of $2 \times 10^6 \text{ m/s}$? (Mass of electron = $9.1 \times 10^{-31} \text{ kg}$)
11. A body is projected up a smooth inclined plane (angle of inclination θ) with a velocity u . The body comes to rest after travelling a distance s on the plane. Find the expression for s .
12. Two wires of the same material have lengths in the ratio 1:2 and radii in the ratio 2:1. Compare their resistances.
13. A parallel plate capacitor has a capacitance C . If the distance between the plates is doubled and the area of the plates is halved, what will be the new capacitance?
14. Describe the working principle of a transformer.
15. What is the de Broglie wavelength of an electron moving with a velocity v ?
16. A long straight wire carries a current I . Find the magnetic field at a distance r from the wire.
17. Explain the phenomenon of total internal reflection with examples.
18. What is the working principle of a cyclotron?
19. Derive the expression for the equivalent capacitance of two capacitors connected in series.
20. What are the limitations of Bohr's model of the atom?

Chemistry

1. What is the molarity of a solution containing 40 g of NaOH in 1 liter of solution?
2. What is the pH of a solution with a hydrogen ion concentration of 10^{-5} M?
3. Balance the following chemical equation: $\text{KMnO}_4 + \text{HCl} \rightarrow \text{KCl} + \text{MnCl}_2 + \text{H}_2\text{O} + \text{Cl}_2$
4. What is the oxidation number of chromium in $\text{K}_2\text{Cr}_2\text{O}_7$?
5. What is the IUPAC name of the following compound: $\text{CH}_3\text{-CH}(\text{CH}_3)\text{-CH}_2\text{-CH}_3$
6. What is the mass of oxygen required to completely burn 10 g of methane (CH_4)?
7. What are the products formed when sodium bicarbonate (NaHCO_3) is heated?
8. What is the difference between a physical change and a chemical change? Give one example of each.
9. Write the IUPAC name of the following compound: $\text{CH}_3\text{-CO-CH}_2\text{-CH}_3$
10. What is the role of a catalyst in a chemical reaction?
11. What is the difference between an electrophile and a nucleophile? Give one example of each.
12. Explain the factors affecting the rate of a chemical reaction.
13. Write the balanced chemical equation for the reaction between potassium permanganate (KMnO_4) and ferrous sulfate (FeSO_4) in an acidic medium.
14. What are the different types of hybridisation exhibited by carbon atoms in organic compounds?
15. Explain the concept of electronegativity and its influence on the nature of chemical bonds.
16. Explain the concept of entropy and its role in determining the spontaneity of a reaction.
17. What are the different types of reactions involved in the extraction of metals from their ores?
18. Write the IUPAC name of the following compound: $\text{CH}_3\text{-CH}(\text{OH})\text{-CH}_2\text{-CHO}$
19. Explain the mechanism of the addition reaction of HBr to propene.
20. What are polymers? Give examples of some common polymers and their uses.

Mathematics

1. If $A = \{1, 2, 3\}$ and $B = \{2, 3, 4\}$, find $A \cup B$ and $A \cap B$.
2. Solve the following quadratic equation: $x^2 - 5x + 6 = 0$
3. Find the value of $\sin 30^\circ + \cos 60^\circ$.
4. Find the equation of the straight line passing through the points (1, 2) and (3, 4).
5. Differentiate the following function with respect to x: $y = x^2 + 2x + 1$
6. If $\log_2 x = 3$, what is the value of x?
7. Find the sum of the first 10 terms of the arithmetic progression 2, 4, 6, 8,...
8. Find the value of $\tan 45^\circ + \cot 45^\circ$.
9. Find the area of a triangle whose sides are 3 cm, 4 cm, and 5 cm.
10. Find the equation of the circle with centre (2, 3) and radius 5.
11. If $f(x) = x^2 - 4x + 3$, find the values of x for which f(x) is negative.

12. Find the equation of the ellipse whose foci are $(\pm 3, 0)$ and the length of the major axis is 8.
13. Evaluate the integral: $\int x \sin x \, dx$
14. Find the area of the region bounded by the curve $y = x^2$, the x-axis, and the lines $x = 1$ and $x = 2$.
15. Prove that the tangent at any point of a circle is perpendicular to the radius through that point.
16. Solve the differential equation: $dy/dx + y = e^{-x}$
17. Find the equation of the plane passing through the points $(1, 0, 0)$, $(0, 1, 0)$, and $(0, 0, 1)$.
18. Evaluate the limit: $\lim_{x \rightarrow 0} \sin x / x$
19. Find the maximum and minimum values of the function $f(x) = x^3 - 3x^2 + 1$.
20. Find the area of the region bounded by the curves $y = x^2$ and $y = \sqrt{x}$.