Physics

Question 1:

- A transformer works on the principle of:
    - (a) Self-induction
    - (b) Mutual induction
    - (c) Eddy currents
    - (d) Ohm's law
- Solution:
    - A transformer works on the principle of mutual induction, where a changing magnetic field in one coil induces an emf in another coil.
    - Therefore, the correct answer is (b) Mutual induction.

Question 2:

- The escape velocity from the surface of Earth is approximately:
    - (a) 11.2 km/s
    - (b) 8 km/s
    - (c) 3×10^8 m/s
    - (d) 9.8 m/s²
- Solution:
    - The escape velocity from Earth's surface is approximately 11.2 km/s.
    - Therefore, the correct answer is (a) 11.2 km/s.

Question 3:

- Which of the following electromagnetic waves has the highest frequency?
    - (a) Radio waves
    - (b) Microwaves
    - (c) X-rays
    - (d) Visible light
- Solution:
    - X-rays have the highest frequency among the given options.
    - Therefore, the correct answer is (c) X-rays.

Question 4:

- The specific heat capacity of water is:
    - (a) 4200 J/kg°C
    - (b) 2100 J/kg°C
    - (c) 1000 J/kg°C
    - (d) 840 J/kg°C

- Solution:
    - The specific heat capacity of water is approximately 4200 J/kg°C.
    - Therefore, the correct answer is (a) 4200 J/kg°C.

Question 5:

- What is the unit of surface tension?
    - (a) N/m
    - (b) N/m²
    - (c) J/m
    - (d) J/m²
- Solution:
    - Surface tension is force per unit length, so its unit is N/m.
    - Therefore, the correct answer is (a) N/m.

Question 6:

- The phenomenon of total internal reflection occurs when light travels from:
    - (a) Rarer to denser medium
    - (b) Denser to rarer medium
    - (c) Same medium
    - (d) Vacuum to any medium
- Solution:
    - Total internal reflection occurs when light travels from a denser medium to a rarer medium.
    - Therefore, the correct answer is (b) Denser to rarer medium.

Question 7:

- A particle moving with constant velocity has:
    - (a) Zero acceleration
    - (b) Non-zero acceleration
    - (c) Variable acceleration
    - (d) Uniformly decreasing acceleration
- Solution:
    - Constant velocity implies zero acceleration.
    - Therefore, the correct answer is (a) Zero acceleration.

Question 8:

- The magnetic field inside a long solenoid carrying current is:
    - (a) Zero
    - (b) Uniform
    - (c) Non-uniform

    - (d) Variable
- Solution:
    - The magnetic field inside a long solenoid carrying current is uniform.
    - Therefore, the correct answer is (b) Uniform.

Question 9:

- What is the value of the universal gravitational constant (G)?
    - (a) 6.67×10^{-11} Nm²/kg²
    - (b) 9.8 m/s²
    - (c) 3×10^{8} m/s
    - (d) 1.6×10^{-19} C
- Solution:
    - The value of G is approximately 6.67×10^{-11} Nm²/kg².
    - Therefore, the correct answer is (a) 6.67×10^{-11} Nm²/kg².

Question 10:

- What is the unit of power of a lens?
    - (a) Meter
    - (b) Diopter
    - (c) Watt
    - (d) Joule
- Solution:
    - The unit of the power of a lens is diopter.
    - Therefore, the correct answer is (b) Diopter.

Question 11:

- If the kinetic energy of a particle is doubled, its momentum becomes:
    - (a) 2 times
    - (b) √2 times
    - (c) 4 times
    - (d) Remains same
- Solution:
    - KE = $p^2/2m$, therefore $p = \sqrt{(2mKE)}$. If KE is doubled, p becomes √2 times.
    - Therefore, the correct answer is (b) √2 times.

Question 12:

- What is the dimensional formula of impulse?
    - (a) MLT^{-1}
    - (b) ML^2T^{-2}
    - (c) MLT^{-2}

    - (d) $ML^{-1}T^{-2}$
- Solution:
    - Impulse is force multiplied by time. Force is MLT^{-2} and time is T, therefore impulse is MLT^{-1}.
    - Therefore, the correct answer is (a) MLT^{-1}.

Question 13:

- What is the value of the speed of light in a vacuum?
    - (a) 3×10^8 m/s
    - (b) 11.2 km/s
    - (c) 9.8 m/s^2
    - (d) 6.67×10^{-11} Nm^2/kg^2
- Solution:
    - The speed of light in a vacuum is approximately 3×10^8 m/s.
    - Therefore, the correct answer is (a) 3×10^8 m/s.

Question 14:

- Which of the following is a scalar quantity?
    - (a) Velocity
    - (b) Force
    - (c) Momentum
    - (d) Work
- Solution:
    - Work is a scalar quantity.
    - Therefore, the correct answer is (d) Work.

Question 15:

- What is the SI unit of luminous intensity?
    - (a) Lumen
    - (b) Candela
    - (c) Lux
    - (d) Watt
- Solution:
    - The SI unit of luminous intensity is candela.
    - Therefore, the correct answer is (b) Candela.

Chemistry

Question 1:

- What is the IUPAC name of CH_3CH_2CHO?
    - (a) Propanone
    - (b) Propanal
    - (c) Propanoic acid
    - (d) Propane
- Solution:
    - CH_3CH_2CHO has a -CHO (aldehyde) functional group.
    - It has three carbon atoms, so the parent chain is propane.
    - The IUPAC name is propanal.
    - Therefore, the correct answer is (b) Propanal.

Question 2:

- Which of the following is a strong electrolyte?
    - (a) CH_3COOH
    - (b) NH_4OH
    - (c) NaCl
    - (d) H_2O
- Solution:
    - Strong electrolytes completely dissociate into ions in solution.
    - NaCl (sodium chloride) is a strong electrolyte.
    - Therefore, the correct answer is (c) NaCl.

Question 3:

- What is the product of the reaction between ethene (C_2H_4) and hydrogen (H_2) in the presence of a nickel catalyst?
    - (a) Ethyne
    - (b) Ethane
    - (c) Methanol
    - (d) Carbon dioxide
- Solution:
    - Ethene undergoes hydrogenation to form ethane.
    - $C_2H_4 + H_2 \rightarrow C_2H_6$ (ethane).
    - Therefore, the correct answer is (b) Ethane.

Question 4:

- Which of the following is an example of a thermosetting polymer?
    - (a) Polyethylene

    - (b) Polystyrene
    - (c) Bakelite
    - (d) PVC
- Solution:

    - Bakelite is a thermosetting polymer, meaning it hardens permanently upon heating.
    - Therefore, the correct answer is (c) Bakelite.

Question 5:

- What is the molarity of a solution containing 40 g of NaOH in 1 L of solution? (Molar mass of NaOH = 40 g/mol)

    - (a) 0.5 M
    - (b) 1 M
    - (c) 2 M
    - (d) 4 M
- Solution:

    - Molarity (M) = moles of solute/litres of solution.
    - Moles of NaOH = 40 g / 40 g/mol = 1 mol.
    - Molarity = 1 mol / 1 L = 1 M.
    - Therefore, the correct answer is (b) 1 M.

Question 6:

- Which of the following is responsible for the depletion of the ozone layer?

    - (a) CO_2
    - (b) CH_4
    - (c) CFCs
    - (d) SO_2
- Solution:

    - Chlorofluorocarbons (CFCs) are responsible for the depletion of the ozone layer.
    - Therefore, the correct answer is (c) CFCs.

Question 7:

- What is the process of separating components of a mixture based on their differences in boiling points?

    - (a) Filtration
    - (b) Chromatography
    - (c) Distillation
    - (d) Sublimation
- Solution:

    - Distillation is the process of separating components based on their differences in boiling points.
    - Therefore, the correct answer is (c) Distillation.

Question 8:

- What is the main ore of aluminium?
    - (a) Hematite
    - (b) Bauxite
    - (c) Magnetite
    - (d) Copper pyrite
- Solution:
    - Bauxite is the main ore of aluminium.
    - Therefore, the correct answer is (b) Bauxite.

Question 9:

- Which of the following is a reducing agent?
    - (a) $KMnO_4$
    - (b) $K_2Cr_2O_7$
    - (c) H_2
    - (d) O_2
- Solution:
    - Hydrogen (H_2) is a reducing agent, as it donates electrons.
    - Therefore, the correct answer is (c) H_2.

Question 10:

- What is the shape of the molecule with sp^3 hybridization?
    - (a) Linear
    - (b) Trigonal planar
    - (c) Tetrahedral
    - (d) Octahedral
- Solution:
    - sp^3 hybridization results in a tetrahedral shape.
    - Therefore, the correct answer is (c) Tetrahedral.

Mathematics

Question 1:

- If sin(x) = 1/2, what are the general solutions for x?

    - (a) nπ + (-1)^n (π/6), where n is an integer.
    - (b) 2nπ ± (π/6), where n is an integer.
    - (c) nπ ± (π/3), where n is an integer.
    - (d) 2nπ + (π/3), where n is an integer.
- Solution:
    - sin(x) = 1/2.
    - The principal value is x = π/6.
    - The general solution for sin(x) = sin(α) is x = nπ + (-1)^n α, where n is an integer.
    - Therefore, x = nπ + (-1)^n (π/6).
    - The correct answer is (a) nπ + (-1)^n (π/6), where n is an integer.

Question 2:

- What is the equation of a parabola with vertex (0, 0) and focus (2, 0)?
    - (a) $y^2 = 8x$
    - (b) $x^2 = 8y$
    - (c) $y^2 = 4x$
    - (d) $x^2 = 4y$
- Solution:
    - The focus is (2, 0), so the parabola opens to the right.
    - The equation of a parabola with vertex (0, 0) and focus (a, 0) is $y^2 = 4ax$.
    - Here, a = 2, so $y^2 = 4(2)x = 8x$.
    - Therefore, the correct answer is (a) $y^2 = 8x$.

Question 3:

- What is the value of ∫ e^(3x) dx?
    - (a) e^(3x) + C
    - (b) (1/3)e^(3x) + C
    - (c) 3e^(3x) + C
    - (d) e^(x) + C
- Solution:
    - ∫ e^(3x) dx = (1/3)e^(3x) + C.
    - Therefore, the correct answer is (b) (1/3)e^(3x) + C.

Question 4:

- What is the probability of getting a sum of 7 when two dice are thrown?
    - (a) 1/6
    - (b) 1/12
    - (c) 1/18
    - (d) 1/36
- Solution:

    - Total possible outcomes = 6 * 6 = 36.
    - Outcomes that give a sum of 7: (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1).
    - Number of favorable outcomes = 6.
    - Probability = 6/36 = 1/6.
    - Therefore, the correct answer is (a) 1/6.

Question 5:

- What is the value of $\lim_{x\to\infty} (1 + 1/x)^x$?
    - (a) 0
    - (b) 1
    - (c) e
    - (d) ∞
- Solution:
    - $\lim_{x\to\infty} (1 + 1/x)^x = e$.
    - Therefore, the correct answer is (c) e.

Question 6:

- What is the area of the triangle with vertices (1, 2), (3, 4), and (5, 1)?
    - (a) 3
    - (b) 4
    - (c) 5
    - (d) 6
- Solution:
    - Area = $(1/2) |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$
    - Area = $(1/2) |1(4 - 1) + 3(1 - 2) + 5(2 - 4)|$
    - Area = $(1/2) |3 - 3 - 10| = (1/2) |-10| = 5$.
    - Therefore, the correct answer is (c) 5.

Question 7:

- What is the value of $\tan(\pi/4)$?
    - (a) 0
    - (b) 1
    - (c) √3
    - (d) 1/√3
- Solution:
    - $\tan(\pi/4) = \tan(45°) = 1$.
    - Therefore, the correct answer is (b) 1.

Question 8:

- What is the value of the dot product of vectors a = 2i + 3j and b = i - 2j?
    - (a) -4

    - (b) -2
    - (c) 2
    - (d) 4
- Solution:

    - a · b = (2 * 1) + (3 * -2) = 2 - 6 = -4.
    - Therefore, the correct answer is (a) -4.

Question 9:

- What is the derivative of ln(x)?

    - (a) e^x
    - (b) 1/x
    - (c) x
    - (d) ln(x)
- Solution:

    - The derivative of ln(x) is 1/x.
    - Therefore, the correct answer is (b) 1/x.

Question 10:

- What is the value of cos(2π)?

    - (a) 0
    - (b) 1
    - (c) -1
    - (d) 1/2
- Solution:

    - cos(2π) = cos(360°) = 1.
    - Therefore, the correct answer is (b) 1.