VITEEE 2023 Question Paper with Solutions

Memory-Based Solved Paper (Physics, Chemistry, Mathematics & Aptitude)

> **Note:** VIT does not release official VITEEE question papers. This document compiles memory-based questions reported from VITEEE 2023 shifts with verified answers and step-by-step solutions.

Exam	Duration Mode	2023 Pattern (125 MCQs)	Marking Scheme (2023)
Online CBT	2 Hours 30 Minutes	Maths/Bio: 40 | Physics: 35 | Chem: 35 | Aptitude: 10 | English: 5	+1 for correct, 0 for incorrect

Section I: Physics

Q1. Light of wavelengths λ_A and λ_B falls on two identical metal plates A and B, respectively. The maximum kinetic energies of photoelectrons are K_A and K_B. Given $\lambda_A = 2\lambda_B$, which relation is true?

(A) $K_A < K_B/2$ (B) $K_A = K_B/2$ (C) $K_A > K_B/2$ (D) $K_A = 2K_B$

Q2. The potential energy U(x) of a particle executing simple harmonic motion about the equilibrium position x = a is given by:

(A) $U(x) = (k/2)(x - a)^2$ (B) $U(x) = k_1x + k_2x^2 + k_3x^3$

(C) $U(x) = Ae^{-bx}$ (D) U(x) = constant

Q3. What is the maximum speed of a car on a flat circular road turn of radius 30 m if the coefficient of static friction between the tyres and the road is 0.4? (Take $g = 9.8\ m/s^2$) (A) 10.84 m/s (B) 9.84 m/s (C) 8.84 m/s (D) 6.84 m/s

Q4. A swimmer aiming to reach the exact opposite point on the other bank of a river swims at 0.5 m/s at an angle of 120° with the direction of river flow. The speed of water in the stream is: (A) 1.0 m/s (B) 0.5 m/s (C) 0.25 m/s (D) 0.43 m/s

Q5. If m is the magnetic dipole moment of a loop and B is a uniform magnetic field, the torque τ acting on the loop is given by:

(A) $m \cdot B$ (B) $B \times m$ (C) $m \times B$ (D) $|m||B|$

Q6. A dielectric slab of constant K is inserted into an isolated charged parallel-plate capacitor so that it completely fills the gap. Which of the following statements is INCORRECT?

(A) The energy stored in the capacitor decreases K times.

(B) The decrease in stored energy is $\frac{1}{2}CV^2(1 - 1/K)$.

(C) The charge on the capacitor is not conserved.

(D) The potential difference between the plates decreases K times.

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Section II: Chemistry

Q7. Which of the following sets of quantum numbers is valid for an electron in a 4f orbital?

(A) n = 4, l = 3, m = +1, s = +½ (B) n = 4, l = 4, m = −4, s = −½

(C) n = 4, l = 3, m = +4, s = +½ (D) n = 3, l = 2, m = −2, s = +½

Q8. The bond dissociation energies of X_2, Y_2, and XY are in the ratio 1 : 0.5 : 1. If ΔH for the formation of XY is −200 kJ mol^{-1}, the bond dissociation energy of X_2 is:

(A) 200 kJ mol^{-1} (B) 100 kJ mol^{-1} (C) 400 kJ mol^{-1} (D) 800 kJ mol^{-1}

Q9. The product(s) formed when diborane (B_2H_6) is hydrolyzed with water are:

(A) B_2O_3 and H_3BO_3 (B) B_2O_3 only (C) H_3BO_3 and H_2 (D) H_3BO_3 only

Q10. The rate law for a reaction between A and B is Rate = $k[A]^m[B]^n$. On doubling [A] and halving [B], the ratio of the new rate to the initial rate is:

(A) 2^{m+n} (B) 2^{n-m} (C) 2^{m-n} (D) (m + n)

Q11. In a chemical reaction, the threshold energy is equal to:

(A) Activation energy + normal energy of reactants (B) Activation energy − normal energy of reactants (C) Normal energy of reactants − activation energy (D) Average kinetic energy of molecules of reactants

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Section III: Mathematics & Aptitude

Q12. If A is a 3 × 3 matrix such that det(A) = 5, then the value of det(2A) is: (A) 10 (B) 20 (C) 25 (D) 40

Q13. For |x| < 1, the derivative of $\sin^{-1}[2x / (1 + x^2)]$ with respect to x is:

(A) $2 / (1 + x^2)$ (B) $1 / (1 + x^2)$ (C) $-2 / (1 + x^2)$ (D) $2x / (1 + x^2)$

Q14. Two fair six-sided dice are thrown simultaneously. The probability of obtaining a sum of 9 is: (A) 1/6 (B) 1/9 (C) 1/12 (D) 5/36

Q15. Find the next term in the number series: 2, 6, 12, 20, 30, ___ (A) 36 (B) 40 (C) 42 (D) 44

Quick Answer Key

Q. No.	Ans	Q. No.	Ans	Q. No.	Ans

Q1	(A)	Q6	(C)	Q11	(A)
Q2	(A)	Q7	(A)	Q12	(D)
Q3	(A)	Q8	(D)	Q13	(A)

Q. No.	Ans	Q. No.	Ans	Q. No.	Ans
Q4	(C)	Q9	(C)	Q14	(B)
Q5	(C)	Q10	(C)	Q15	(C)

Detailed Solutions

1. **(A) $K_A < K_B/2$:** $K_A = hc/(2\lambda_B) - \phi$ and $K_B = hc/\lambda_B - \phi$. Dividing K_B by 2 gives $K_B/2 = hc/(2\lambda_B) - \phi/2 > K_A$.

2. **(A) $U(x) = (k/2)(x - a)^2$:** Restoring force $F = -k(x - a)$ integrates to quadratic potential energy $U(x) = \frac{1}{2}k(x - a)^2$.

3. **(A) 10.84 m/s:** $v_{max} = \sqrt{(\mu rg)} = \sqrt{(0.4 \times 30 \times 9.8)} = \sqrt{117.6} \approx 10.84$ m/s.

4. **(C) 0.25 m/s:** To cancel drift, $v_{stream} = v_{swim} \cos(180° - 120°) = 0.5 \times \cos 60° = 0.25$ m/s.

5. **(C) m × B:** Magnetic torque is the cross product $\tau = m \times B$.

6. **(C):** Because the capacitor is isolated (disconnected from any battery), the total charge Q on its plates remains strictly conserved.

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7. **(A) n = 4, l = 3, m = +1, s = +½:** For a 4f orbital, n = 4, l = 3, and m can take integer values from −3 to +3.

8. **(D) 800 kJ mol^{-1}:** Let $BDE(X_2) = x$. For $\frac{1}{2}X_2 + \frac{1}{2}Y_2 \rightarrow XY$, $\Delta H = \frac{1}{2}(x) + \frac{1}{2}(0.5x) - x = -0.25x = -200 \Rightarrow x = 800$ kJ mol^{-1}.

9. **(C) H_3BO_3 and H_2:** $B_2H_6 + 6H_2O \rightarrow 2H_3BO_3 + 6H_2$.

10. **(C) 2^{m-n}:** Ratio = $[k(2A)^m(B/2)^n] / [kA^mB^n] = 2^m \times 2^{-n} = 2^{m-n}$.

11. **(A):** Threshold energy is the minimum total energy required for effective collisions, equal to reactant energy plus activation energy.

12. **(D) 40:** For an n × n matrix, $\det(kA) = k^n \det(A)$. Here $\det(2A) = 2^3 \times 5 = 40$.

13. **(A) $2/(1 + x^2)$:** Putting $x = \tan\theta$ (for $|x| < 1$), $\sin^{-1}(\sin 2\theta) = 2\theta = 2\tan^{-1}x$, whose derivative is $2/(1 + x^2)$.

14. **(B) 1/9:** Favorable outcomes are (3,6), (4,5), (5,4), and (6,3), giving 4/36 = 1/9.

15. **(C) 42:** Pattern is $n(n + 1)$: 1×2 = 2, 2×3 = 6, 3×4 = 12, 4×5 = 20, 5×6 = 30, 6×7 = 42.