VITEEE Previous Year Paper 2021

Time Allowed :90 Minutes	**Maximum Marks :**80	**Total Questions :**80

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The question paper contains a total of 80 questions divided into four parts:
   Part I: Physics (Questions 1 to 25)
   Part II: Chemistry (Questions 26 to 50)
   Part III: Mathematics (Questions 51 to 75)
   Part IV: English & Logical Reasoning (Questions 76 to 80)
2. All questions are multiple-choice with four options, and only one of them is correct.
3. For each correct answer, the candidate will earn 1 mark.
4. There is no negative marking for incorrect answers.
5. The test duration is $1\frac{1}{2}$ hours.

Section - I (Physics)

1. The distance of the centres of moon and earth is D. The mass of earth is 81 times the mass of the moon. At what distance from the centre of the earth, the gravitational force will be zero?

(1) $\frac{D}{2}$
(2) $\frac{2D}{3}$
(3) $\frac{4D}{3}$
(4) $\frac{9D}{10}$

---

2. Two wires A and B are of the same material. Their lengths are in the ratio 1 : 2 and the diameter is in the ratio 2 : 1. If they are pulled by the same force, then increase in length will be in the ratio of

(1) 2 : 1
(2) 1 : 4
(3) 1 : 8
(4) 1 : 2

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3. If $x = at + bt^2$, where x is the distance travelled by the body in kilometers while t is the time in seconds, then the unit of b is

(1) km/s
(2) km/s^2
(3) km^2/s
(4) km^2/s^2

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4. A soap bubble of radius r_1 is placed on another soap bubble of radius r_2 ($r_1 < r_2$). The radius R of the soapy film separating the two bubbles is

(1) $r_2 + r_1$
(2) $\frac{r_2 - r_1}{2}$
(3) $\frac{r_1}{2}$
(4) $\sqrt{r_1^2 + r_2^2}$

---

5. A charge q is moving with a velocity v parallel to a magnetic field B. Force on the charge due to magnetic field is

(1) qvB
(2) $\frac{qB}{v}$
(3) zero
(4) Bv/q

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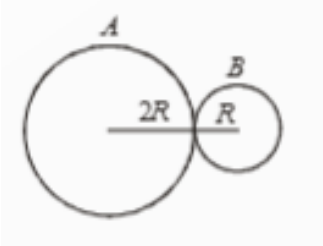
6. Two spheres A and B of masses m and $2m$ and radii R and $2R$ respectively are placed in contact as shown. The COM of the system lies



(1) inside A
(2) inside B
(3) at the point of contact
(4) None of these

7. Identify the correct statement.

(1) Static friction depends on the area of contact
(2) Kinetic friction depends on the area of contact
(3) Coefficient of static friction is more than the coefficient of kinetic friction
(4) Coefficient of kinetic friction is less than the coefficient of static friction

---

8. The distance travelled by a particle starting from rest and moving with an acceleration $3\,\mathrm{m/s^2}$ in the third second is:

(1) 10 m
(2) 20 m
(3) 30 m
(4) 40 m

---

9. Photocathode work function is 1 eV. Light of wavelength $\lambda = 3000\,\text{Å}$ falls on it. The photoelectron comes out with a maximum velocity of $1 \times 10^6\,\mathrm{m/s}$. What is the energy of the photon?

(1) 1.0 eV
(2) 1.5 eV
(3) 2.0 eV
(4) 3.0 eV

---

10. A steam engine operating between $100°C$ and $40°C$ has an efficiency of 25%. The heat absorbed by the engine is:

(1) 1.0×10^6 J
(2) 2.0×10^6 J
(3) 4.0×10^6 J
(4) 3.0×10^6 J

---

11. Two point charges $+q$ and $-q$ are placed at a distance d apart. The electric potential at the midpoint will be

(1) 0
(2) $\frac{q}{4\pi\epsilon_0 d}$
(3) $\frac{q}{2\pi\epsilon_0 d}$
(4) $\frac{q}{8\pi\epsilon_0 d}$

---

12. Two bodies of the same mass are projected with the same velocity at an angle 30° and 60° respectively. The ratio of their horizontal ranges will be:

(1) 1:1
(2) 1:2
(3) 1:3
(4) $2 : \sqrt{3}$

---

13. Two point charges $+3\,\mu C$ and $+8\,\mu C$ repel each other with a force of 40 N. If a charge of $-5\,\mu C$ is added to each of them, then the force between them will become:

(1) -10 N
(2) $+10$ N
(3) $+20$ N
(4) -20 N

---

14. A sphere rolls down an inclined plane of inclination θ. What is the acceleration as the sphere reaches the bottom?

(1) $\frac{5g}{7}\sin\theta$
(2) $\frac{3g}{5}\sin\theta$
(3) $\frac{7g}{5}\sin\theta$
(4) $\frac{5g}{3}\sin\theta$

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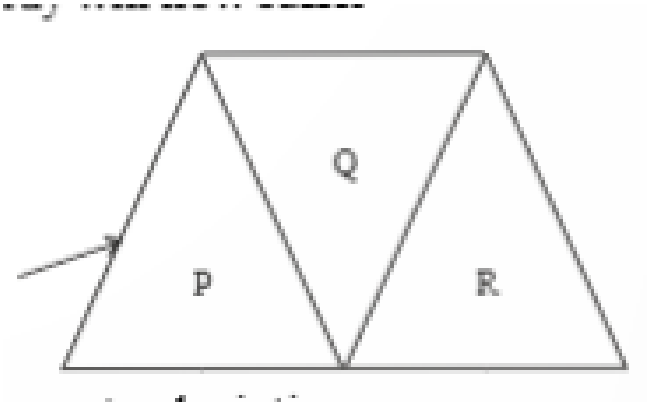
15. A given ray of light suffers minimum deviation in an equilateral prism P. Additional prisms Q and R of identical shape and same material such that P, Q, and R are now combined as shown in figure. The ray will now suffer



(1) greater deviation
(2) same deviation as before
(3) total internal reflection
(4) no deviation

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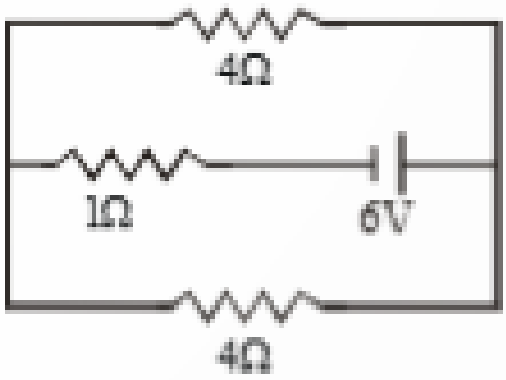
16. The current in the 120 Ω resistor shown in the circuit is



(1) 2 A
(2) 3 A
(3) 6 A
(4) 2.5 A

---

17. The root mean square velocity of hydrogen molecules at 300 K is 1930 meters/second. The velocity of oxygen molecules at 1200 K will be:

(1) 582 m/s
(2) 656 m/s

(3) 586 m/s
(4) 366 m/s

---

18. A magnetic field of 5 T is applied perpendicular to a coil with 5 turns. The induced emf in the coil is 10 V. The rate of change of magnetic flux is:

(1) 50 Wb/s
(2) 5 Wb/s
(3) 1 Wb/s
(4) 0.5 Wb/s

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19. A parallel plate capacitor with air between the plates has a capacitance of 3 F. Calculate the capacitance if the distance between the plates is reduced by half and the space between them is filled with a substance of dielectric constant k.

(1) $72\,\mu F$
(2) $81\,\mu F$
(3) $36\,\mu F$
(4) $6\,\mu F$

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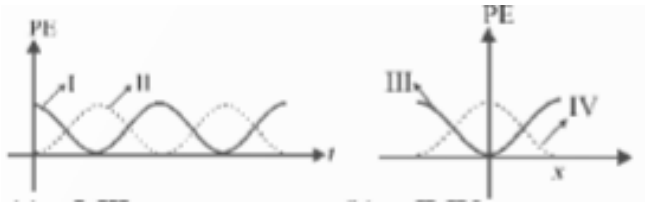
20. A body executing SHM has displacement $y = A\cos\omega t$. Identify the graph which represents the variation of potential energy (PE) as a function of time t and displacement.



(1) I
(2) II
(3) III
(4) IV

---

21. A radioactive sample contains 5×10^7 kg of each of two isotopes A and B with half-lives of 5 days and 8 days respectively. The fraction of A that decays in 3 days after a period of 3 days is:

(1) 0.2
(2) 0.4
(3) 0.3
(4) 0.6

---

22. A string of length 3 m and mass 0.035 kg is stretched with a tension of 50 N. The speed of the wave on the string is:

(1) 18.6 m/s
(2) 15.4 m/s
(3) 16.2 m/s
(4) 14.4 m/s

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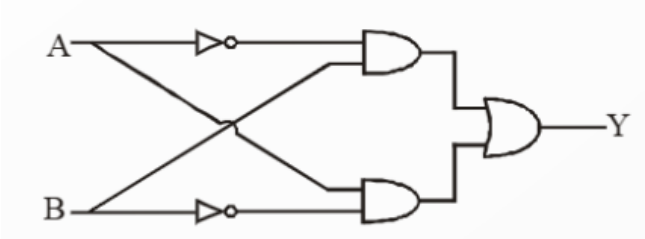
23. The following circuit represents



(1) OR gate
(2) AND gate
(3) NAND gate
(4) None of these

---

24. A particle of mass 10 kg is moving with a velocity of 5 m/s. The kinetic energy of the particle is:

(1) 125 J
(2) 250 J
(3) 500 J
(4) 1000 J

25. A source producing sound of frequency 170 Hz is approaching a stationary observer with a velocity of 17 m/s. The apparent change in the wavelength of sound heard by the observer is (speed of sound in air = 340 m/s):

(1) 0.1 m
(2) 0.2 m
(3) 0.4 m
(4) 0.5 m

Section - II (Chemistry)

26. Consider the following reactions:

$$NaCl + K_2Cr_2O_7 + H_2SO_4(\text{Conc.}) \rightarrow (A) + \text{Side products}$$

$$(B) + H_2SO_4(\text{dilute}) + H_2O_2 \rightarrow (C) + \text{Side products}$$

The sum of the total number of atoms in one molecule each of (A), (B) and (C) is _____.

(1) 18
(2) 15
(3) 21
(4) 20

27. Xenon hexafluoride on partial hydrolysis produces compounds 'X' and 'Y'. Compounds 'X', 'Y' and the oxidation state of Xe are respectively:

(1) $XeOF_4$ (+6) and XeO_3 (+6)
(2) XeO_2 (+4) and XeO_3 (+6)
(3) $XeOF_4$ (+6) and XeO_2F_2 (+6)
(4) XeO_2F_2 (+6) and XeO_2 (+4)

28. The edge length of unit cell of a metal having molecular weight 75 g/mol is 5 Å which crystallizes in cubic lattice. If the density is 2 g/cc, then find the radius of the metal atom. ($N_A = 6 \times 10^{23}$) Give the answer in pm.

(1) 217 pm
(2) 210 pm

(3) 220 pm
(4) 205 pm

---

29. Consider the following statements: I. Increase in concentration of reactant increases the rate of a zero order reaction. II. Rate constant k is equal to collision frequency if $E_a = 0$. III. Rate constant k is equal to collision frequency if $E_a = \infty$. IV. $\ln k$ vs T is a straight line. V. $1/T$ vs $\ln k$ is a straight line.
Correct statements are:

(1) I and IV
(2) II and V
(3) III and IV
(4) II and III

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30. To deposit 0.634 g of copper by electrolysis of aqueous cupric sulphate solution, the amount of electricity required (in coulombs) is:

(1) 1930
(2) 3960
(3) 4825
(4) 9650

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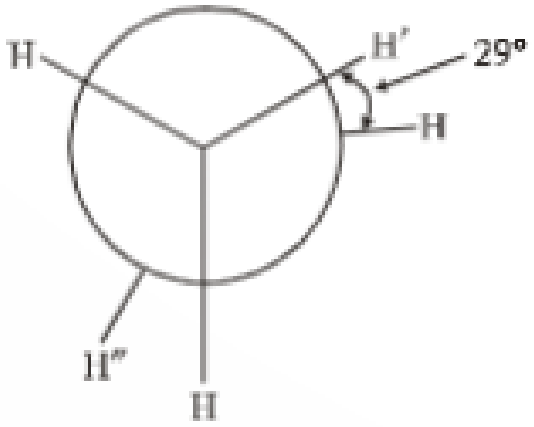
31. In the following skew conformation of ethane, the $H' - C - C - H''$ dihedral angle is:



(1) 58°
(2) 149°
(3) 151°
(4) 120°

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32. What is the product of the following reaction?
Hex-3-ynal + (i) $NaBH_4$, (ii) Pb_3, (iii) Mg/ether, (iv) $CO_2/H_2O \rightarrow$?

(a) 

(b) 

(c) 

(d) 

---

33. In the following sequence of reactions,

$$CH_3CH_2OH \xrightarrow{P_1,2} A \xrightarrow{\text{Mg/ether}} B \xrightarrow{\text{HCHO}} C \xrightarrow{H_2O} D$$

The compound D is:

(1) propanal
(2) butanal
(3) n-butyl alcohol
(4) n-propyl alcohol

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34. Which of the following reactions can produce aniline as the main product?

(1) $C_6H_5NO_2 + \text{Zn/KOH}$
(2) $C_6H_5NO_2 + \text{Zn/NHCl}$
(3) $C_6H_5NO_2 + LiAlH_4$
(4) $C_6H_5NO_2 + \text{ZnHCl}$

35. Secondary structure of protein refers to:

(1) mainly denatured proteins and structure of prosthetic groups
(2) three-dimensional structure, especially the bond between amino acid residues that are distinct from each other in the polypeptide chain

(3) linear sequence of amino acid residues in the polypeptide chain
(4) regular folding patterns of continuous portions of the polypeptide chain

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36. The increasing order for the values of e/m (charge/mass) is:

(1) e, p, n, α
(2) n, p, e, α
(3) n, p, α, e
(4) n, α, p, e

---

37. In which of the following pairs both the ions are coloured in aqueous solutions?

(1) Sc^{3+}, Ti^{3+}
(2) Ni^{2+}, Cu^{2+}
(3) Sc^{3+}, Co^{2+}
(4) Ni^{2+}, Ti^{3+}

---

38. The total number of possible isomers for square-planar $[Pt(Cl)(NO_2)(NO_3)(SCN)]^{2-}$ is:

(1) 16
(2) 12
(3) 8
(4) 24

---

39. For the reaction,

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g),$$

$$\Delta H = -57.2\,\text{kJ/mol} \quad \text{and} \quad K_c = 1.7 \times 10^{16}$$

Which of the following statement is INCORRECT?

(1) The equilibrium constant is large, suggestive of reaction going to completion and so no catalyst is required.
(2) The equilibrium will shift in forward direction as the pressure increases.
(3) The equilibrium constant decreases as the temperature increases.
(4) The addition of inert gas at constant volume will not affect the equilibrium constant.

40. The half-life of a reaction is inversely proportional to the square of the initial concentration of the reactant. Then the order of the reaction is:

(1) 0
(2) 1
(3) 2
(4) 3

---

41. A galvanic cell is set up from electrodes A and B Electrode A: $Cr_2O_7^{2-}/Cr^{3+}$, $E^\circ_{red} = +1.33\,V$ Electrode B: Fe^{3+}/Fe^{2+}, $E^\circ_{red} = +0.77\,V$ Which of the following statements is false?

(1) Standard e.m.f of the cell is 0.56 V
(2) Current will flow from electrode A to B in the external circuit
(3) A will act as cathode and have positive polarity
(4) None of these

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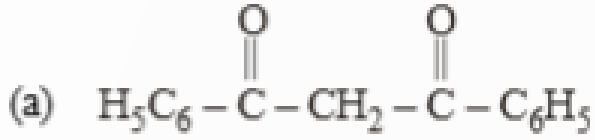
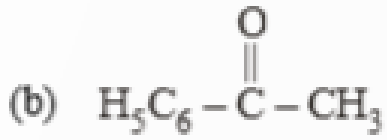
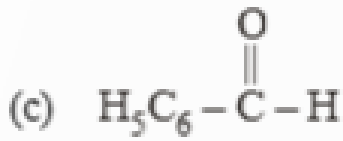
42. Keto-enol tautomerism is observed in:

(a) 

(b) 

(c) 

(d) Both (a) and (b)

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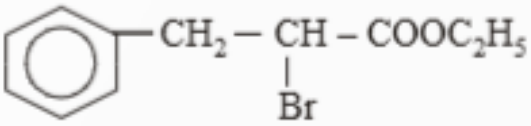
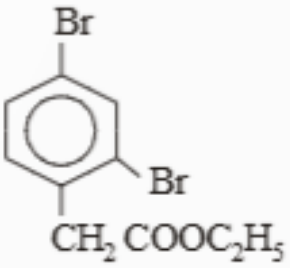
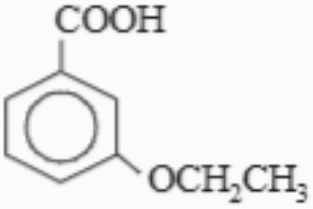
43. In a set of reactions, ethylbenzene yields a product D.

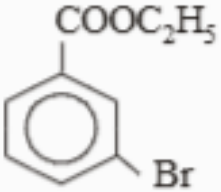
$$CH_3C_6H_5 \xrightarrow{KMnO_4} Br_2 \xrightarrow{FeCl_3} C_6H_5COOH \xrightarrow{H_2O} D$$

Identify D:

(a) 

(b) 

(c) 

(d) 

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44. What will be the final product in the following reaction sequence:

$$CH_3CH_2CN \xrightarrow{H^+/H_2O} A \xrightarrow{NH_3} B \xrightarrow{NaOBR} C$$

(1) $CH_3CH_2CONH_2$
(2) CH_3CH_2COBR
(3) $CH_3CH_2NH_2$
(4) $CH_3CH_2NH_2$

---

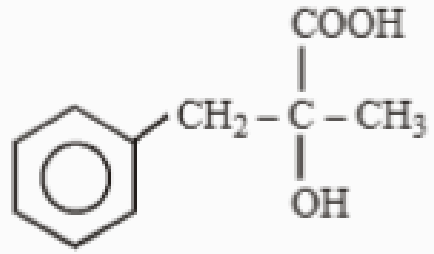
45. In a set of reactions, acetic acid yields a product D:

$$CH_3COOH \xrightarrow{SOCl_2} \text{Benzene} \xrightarrow{AlCl_3} (B)$$

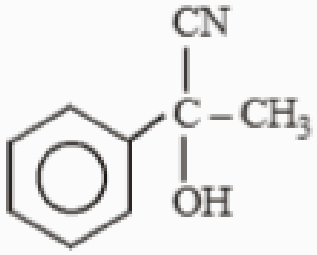
$$HCN \xrightarrow{(C)} HOH \xrightarrow{H_2O} (D)$$

The structure of D would be:

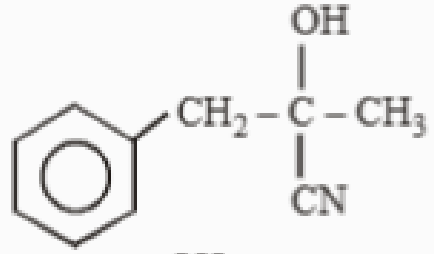
(a)



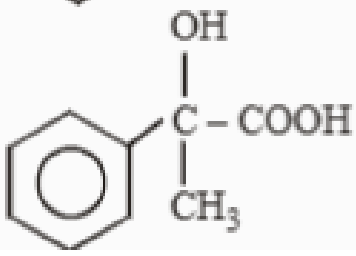
(b)



(c)



(d)



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46. In fructose, the possible optical isomers are:

(1) 12
(2) 16
(3) 8
(4) 4

---

47. The position of both, an electron and a helium atom is known within 1.0 nm. Further the momentum of the electron is known within $5.0 \times 10^{-26}\,\mathrm{kg\,ms^{-1}}$. The minimum uncertainty in the measurement of the momentum of the helium atom is:

(1) $50\,\mathrm{kg\,ms^{-1}}$
(2) $80\,\mathrm{kg\,ms^{-1}}$
(3) $8.0 \times 10^{-26}\,\mathrm{kg\,ms^{-1}}$

(4) $5.0 \times 10^{-26}\,\text{kg ms}^{-1}$

---

48. The value of $\log_{10} K$ for a reaction $A \rightleftharpoons B$ is (Given: $\Delta H^{\circ}_{298K} = -54.07\,\text{kJ mol}^{-1}$, $\Delta S^{\circ}_{298K} = 10\,\text{JK}^{-1}\,\text{mol}^{-1}$ and $R = 8.314\,\text{JK}^{-1}\,\text{mol}^{-1}$)

$$2.303 \times 8.314 \times 298 = 5705$$

$(a)5 \quad (b)10 \quad (c)95 \quad (d)100$

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49. If $\text{C}(s) + \text{O}_2(g) \rightleftharpoons \text{CO}_2(g)$, $\Delta H = R$ and

$$\text{CO}(g) + \frac{1}{2}\text{O}_2(g) \rightleftharpoons \text{CO}_2(g), \quad \Delta H = S$$

then heat of formation of CO is:

(1) R + S
(2) R - S
(3) R x S
(4) S - R

---

50. Which of the following compounds does not follow Markovnikov's law?

(1) $\text{CH}_3\text{CH}_2\text{CH}_3$
(2) CH_3CHCl_2
(3) $\text{CH}_3\text{CH}_2\text{C} = \text{CH}_2$
(4) None

Section - III (Mathematics)

51. The value of c in Rolle's Theorem for the function $f(x) = e^x \sin x, x \in [0, \pi]$ is:

(1) $\frac{\pi}{6}$
(2) $\frac{\pi}{4}$
(3) $\frac{\pi}{2}$
(4) $\frac{3\pi}{4}$

52. The equations $2x + 3y + 4 = 0$, $3x + 4y + 6 = 0$, and $4x + 5y + 8 = 0$ are:

(1) consistent with unique solution
(2) inconsistent
(3) consistent with infinitely many solutions
(4) None of the above

---

53. The shortest distance between the lines $x = y + 2$, $z = 6x - 6$ and $x + 1 = 2y = -12z$ is:

(1) $\frac{1}{2}$
(2) 2
(3) $\frac{3}{2}$
(4) 3

---

54. If the tangent at $P(1, 1)$ on $y^2 = x(2 - x)$ meets the curve again at Q, then Q is:

(1) (2, 2)
(2) (1, 2)
(3) $\left(\frac{9}{4}, \frac{3}{8}\right)$
(4) None of these

---

55. If $f(x) = \frac{x}{1+x^2} + \frac{x}{(1+x^2)^2} + \cdots$ to infinity, then at $x = 0, f(x)$

(1) has no limit
(2) is discontinuous
(3) is continuous but not differentiable
(4) is differentiable

---

56. Radius of the circle $(x + 5)^2 + (y - 3)^2 = 36$ is:

(1) 2
(2) 3
(3) 6

(4) 5

---

57. If $\mathbf{a} = 2i - 2j + k$ and $\mathbf{c} = -i + 2k$, then $\mathbf{a} \times \mathbf{c}$ is equal to:

(1) $2\sqrt{5}\mathbf{i} + 5\mathbf{j} + \sqrt{5}\mathbf{k}$
(2) $2\mathbf{i} - 2\mathbf{j} + \sqrt{5}\mathbf{k}$
(3) $5\mathbf{i} + \sqrt{5}\mathbf{j} + 2\mathbf{k}$
(4) $\sqrt{5}\mathbf{i} + 2\mathbf{j} + \mathbf{k}$

---

58. If $(-4, 5)$ is one vertex and $7x - y + 8 = 0$ is one diagonal of a square, then the equation of second diagonal is:

(1) $x + 3y = 21$
(2) $2x - 3y = 7$
(3) $x + 7y = 31$
(4) $2x + 3y = 21$

---

59. $P = Q$ can also be written as:

(1) $p \sim q$
(2) $q \sim p$
(3) $\sim q \sim p$
(4) None of these

---

60. Let

$$\int \frac{x^{1/2}}{\sqrt{1 - x^3}}\, dx = \frac{3}{3}\, g(x) + C$$

then

(1) $f(x) = \sqrt{x}$
(2) $f(x) = x^3$
(3) $g(x) = \sin^{-1} x$
(4) None of these

---

61. Which of the following is an infinite set?

(1) The set of human beings on the earth
(2) The set of water drops in a glass of water
(3) The set of trees in a forest
(4) The set of all primes

---

62. The domain of the function

$$\sqrt{2x - 5x^2 + 6} + \sqrt{2x + 8 - x^2}$$

is:

(1) $[2, 3]$
(2) $[-2, 1] \cup [3, 4]$
(3) $[-2, 1]$
(4) None of these

---

63. Area bounded by the curve $y = \log x$ and the coordinate axes is:

(1) 2
(2) 1
(3) 5
(4) $2\sqrt{2}$

---

64. The angle of intersection of the curve $y = x^2$, $dy = 7 - x^2$ at $(1, 1)$ is:

(1) $\frac{\pi}{2}$
(2) $\frac{\pi}{4}$
(3) $\frac{\pi}{3}$
(4) π

---

65. The angle formed by the positive Y-axis and the tangent to $y = x^2 + 4x - 17$ at $(2, -3)$ is:

(1) $\tan^{-1} 9$
(2) $\frac{\pi}{2} - \tan^{-1} 9$
(3) $\frac{\pi}{3}$

(4) $\tan^{-1} 9$

---

66. The value of $(1+i)^4$ is:

(1) 12
(2) 8
(3) 2
(4) 16

---

67. The relation R defined on the set $A = \{1, 2, 3, 4, 5\}$ by $R = \{(x, y) : |x^2 - y^2| < 16\}$ is given by:

(1) $\{(1, 1), (2, 1), (3, 1), (4, 1), (2, 3)\}$
(2) $\{(2, 1), (3, 2), (4, 2), (5, 4)\}$
(3) $\{(3, 3), (4, 5)\}$
(4) None of these

68.

$$\int \frac{2dx}{(e^x + e^{-x})^2} = ?$$

(1) $-e^{-x}$
(2) e^x
(3) $e^x + C$
(4) None of these

---

69. The value of $\tan^{-1}(1) + \tan^{-1}(0) + \tan^{-1}(2) + \tan^{-1}(3)$ is equal to:

(1) π
(2) $\frac{5\pi}{4}$
(3) $\frac{\pi}{2}$
(4) None of these

---

70. In a culture, the bacteria count is 1,00,000. The number is increased by 10

(1) $\frac{2\log 2}{\log 11}$
(2) $\frac{\log 2}{\log 11}$
(3) $\log 2$
(4) $\frac{2\log 2}{\log 11}$

---

71. What is the angle between the two straight lines

$$y = (2-\sqrt{3})x + 5 \quad \text{and} \quad y = (2+\sqrt{3})x - 7?$$

(1) 60°
(2) 30°
(3) 45°
(4) 15°

---

72. If the angle θ between the line

$$\frac{x+1}{2} = \frac{z-2}{2} = \frac{y+4}{\sqrt{n}}$$

and the plane $2x - y + z + 4 = 0$ is such that $\sin\theta = \frac{1}{3}$, then the value of n is:

(1) $\frac{5}{3}$
(2) $\frac{3}{5}$
(3) $\frac{3}{4}$
(4) $\frac{-5}{4}$

---

73. The distance of the point $(-5, -5, -10)$ from the point of intersection of the line

$$r = -2i - j + 2k + \lambda(3i + 4j + 2k)$$

and the plane $r \cdot (i - j + k) = 5$ is:

(1) 13
(2) 12
(3) 10
(4) 15

74.

$$\int_{\log\sqrt{n}}^{\log\sqrt{r}} 2x\sec^2\left(\frac{1}{3}\cdot 2x\right)\,dx$$

is equal to:

(1) $\sqrt{3}$
(2) $\frac{1}{\sqrt{3}}$
(3) $\frac{3\sqrt{3}}{2}$
(4) None of these

---

75. If $|x+3|+x>1$, then $x\in$:

(1) $(-5,-2)$
(2) $(-1,\infty)$
(3) $(-5,-2)\cup(-1,\infty)$
(4) None of these

Section - IV (English & Logical Reasoning)

Directions (76-78): Study the paragraph and answer the questions that follow.
A training calendar and schedule for Fire Agency Specialties Team (F.A.S.T.) membership is available in this office to all applicants for F.A.S.T. membership. Training will take place the third week of each month. Classes will be taught on Monday afternoons, Wednesday evenings, and Saturday afternoons.
So that the F.A.S.T. can maintain a high level of efficiency and preparedness for emergency response situations, its members must meet certain requirements.
First, in order for you to be considered for membership on F.A.S.T., your department must be a member of the F.A.S.T. organization, and you must have written permission from your fire chief or your department's highest ranking administrator.
Once active, you must meet further requirements to maintain active status. These include completion of technician-level training and certification in hazardous material (hazmat) operations. In addition, after becoming a member, you must also attend a minimum of 50% of all drills conducted by F.A.S.T. and go to at least one F.A.S.T. conference. You may qualify for alternative credit for drills by proving previous experience in actual hazmat emergency response.
If you fail to meet minimum requirements, you will be considered inactive, and the director of your team will be notified. You will be placed back on active status only after you complete the training necessary to meet the minimum requirements.

76. Potential F.A.S.T. members can attend less than half of F.A.S.T. drills if they:

(1) complete technician-level training requirements
(2) indicate prior real emergency experience.
(3) receive permission from their fire chief.
(4) enroll in three weekly training sessions.

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77. Which of the following is the main subject of the passage?

(1) preparing for hazmat certification
(2) the main goal of F.A.S.T.
(3) completing F.A.S.T. membership requirements
(4) learning about your department's F.A.S.T. membership

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78. Applicants must be available for training:

(1) three days each month.
(2) three days each week.
(3) every third month.
(4) for 50

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79. Jatin starting from a fixed point, goes 15 m towards North and then after turning to his right, he goes 15 m. Then, he goes 10 m, 15 m and 15 m after turning to his left each time. How far is he from his starting point?

(1) 15 m
(2) 5 m
(3) 10 m
(4) 20 m

---

80. Examine the following statements: 1. All members of Mohan's family are honest. 2. Some members of Mohan's family are not employed. 3. Some employed persons are not honest. 4. Some honest persons are not employed.
Which one of the following inferences can be drawn from the above statements?

(1) All members of Mohan's family are honest
(2) The employed members of Mohan's family are honest
(3) The honest members of Mohan's family are not employed

(4) The employed member of Mohan's family are not honest
