BITSAT 2013 Question Paper with Solution PDF

| **Time Allowed :**3 Hours | **Maximum Marks :**450 | **Total Questions :**150 |

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The question paper contains a total of 150 questions divided into four parts:
   Part I: Physics (Questions 1 to 40)
   Part II: Chemistry (Questions 41 to 80)
   Part III: Mathematics (Questions 81 to 125)
   Part IV: (A) English Proficiency (Questions 126 to 140)
   (B) Logical Reasoning (Questions 141 to 150)

2. All questions are multiple-choice with four options, and only one of them is correct.

3. Each correct answer is awarded 3 marks and -1 for each incorrect answer.

4. The duration of the paper is 3 hours.

Part I: Physics

Q1. The velocity and acceleration vectors of a particle undergoing circular motion are $\vec{v} = 2i + 4j$ m/s and $\vec{a} = 2i + 4j$ m/s^2 respectively at an instant of time. The radius of the circle is –

(1) 1 m
(2) 2 m
(3) 3 m
(4) 4 m

Q2. A man runs at a speed of 4 m/s to overtake a standing bus. When he is 6 m behind the door at $t = 0$, the bus moves forward and continuous with a constant acceleration of 1.2 m/s^2. The man reaches the door in time t. Then,

(1) $4t = 6 - 0.6t^2$
(2) $4t = 1.2t^2$
(3) $4t = 1.2t + 4t^2$
(4) $4t = 6 + 4t^2$

Q3. Wave pulse can travel along a tense string like a violin spring. A series of experiments showed that the wave velocity V of a pulse depends on the following quantities, the tension T of the string, the cross-section area A of the string and density ρ of the string. Obtain an expression for V in terms of T, A, and ρ using dimensional analysis.

(1) $V = \sqrt{\frac{T}{A\rho}}$

(2) $V = \sqrt{\frac{T}{\rho A}}$

(3) $V = \sqrt{\frac{AT}{\rho}}$

(4) None of these

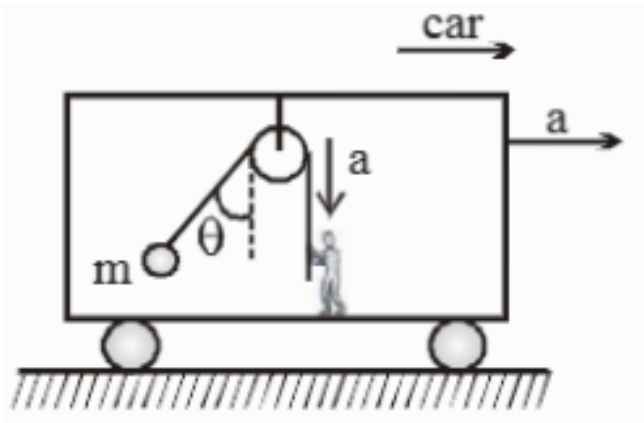
Q4. A body is projected, making an acute angle θ with the horizontal. If angle between velocity $\vec{v}$ and acceleration $\vec{g}$ is θ, then

(1) $\theta = 90°$
(2) $\theta = 0°$
(3) $90° < \theta < 180°$
(4) $\theta < 180°$

Q5. The minimum velocity (in m/s) with which a car driver must traverse a flat curve of radius 150 m and coefficient of friction 0.6 to avoid skidding is
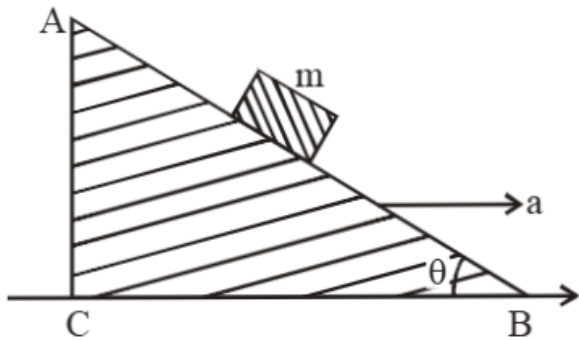
(1) 60
(2) 30
(3) 15
(4) 0

Q6. A bob is hanging over a pulley inside a car moving with constant acceleration a directed horizontally as shown. The second end of the string is in the hand of a person standing in the car. The car is moving with constant acceleration a horizontally as shown in figure. Other end of the string is pulled with constant acceleration a vertically. The tension in the string is equal to –

(1) $\frac{mg}{a^2}$

(2) $\frac{mg}{a}$

(3) $\frac{mg}{a+a^2}$

(4) $\frac{mg}{a+a^2}$

Q7. A block of mass m is placed on a smooth inclined wedge ABC of inclination θ as shown in the figure. The wedge is given an acceleration a towards the right. The relation between a and g for the block to remain stationary on the wedge is
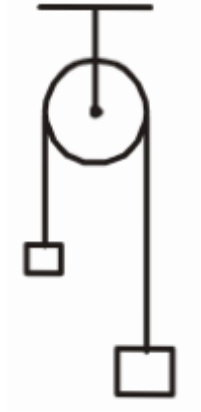

(1) $a = \frac{g}{\sec\theta}$

(2) $a = \frac{g}{\sin\theta}$

(3) $a = g\tan\theta$

(4) $a = g\cos\theta$

Q8. A 3.628 kg freight car moving along a horizontal rail road spur track at 7.2 km/hour strikes a bumper whose coil springs experiences a maximum compression of 30 cm in stopping the car. The elastic potential energy of the springs at the instant when they are compressed 15 cm is –

(1) 12.1×10^4 J

(2) 121×10^4 J

(3) 1.21×10^4 J
(4) 1.21×10^6 J

Q9. A light inextensible string that goes over a smooth fixed pulley as shown in the figure connects two blocks of masses 0.36 kg and 0.72 kg. Taking $g = 10\,\text{m/s}^2$, find the work done (in joules) by the string on the block of mass 0.36 kg during the first second after the system is released from rest.

(1) 4 J
(2) 8 J
(3) 6 J
(4) 10 J

Q10. Two rings of radius R and nR made of same material have the ratio of moment of inertia about an axis passing through the centre is 1 : 8. The value of n is –
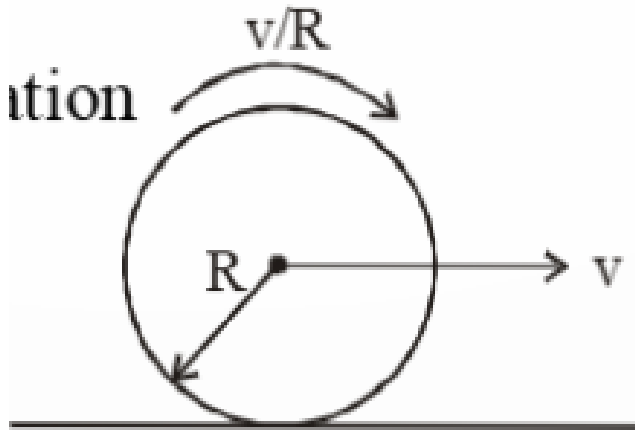
(1) 2
(2) $\sqrt{2}$
(3) 4
(4) $\frac{1}{2}$

Q11. A particle of mass m is projected with a velocity v making an angle of 30° with the horizontal. The magnitude of angular momentum of the projectile about the point of projection when the particle is at its maximum height h is –

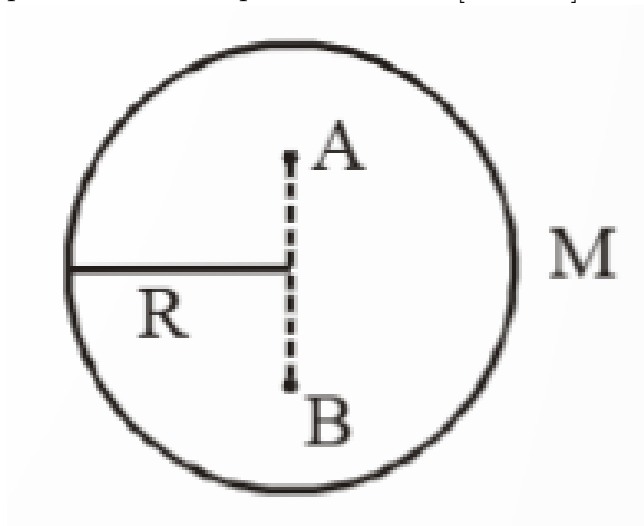(1) $\sqrt{3}\frac{mv^2}{g}$
(2) zero
(3) $\frac{mv^3}{2g}$

4

(4) $\sqrt{3}\frac{mv^3}{16g}$

Q12. A disc is performing pure rolling on a smooth stationary surface with constant angular velocity as shown in the figure. At any instant, for the lower most point of the disc –

(1) velocity is v, acceleration is zero
(2) velocity is zero, acceleration is zero
(3) velocity is v, acceleration is $\frac{v^2}{R}$
(4) velocity is zero, acceleration is $\frac{v^2}{R}$

Q13. There is a shell of mass M and density of the shell is uniform. The work done to take a point mass from point A to B is $[AB = r]$

(1) $\frac{GMm}{r}$
(2) $\frac{GMm}{R}$
(3) $-\frac{GMm}{r}$

(4) zero

Q14. A cube is subjected to a uniform volume compression. If the side of the cube decreases by 2%, the bulk strain is –
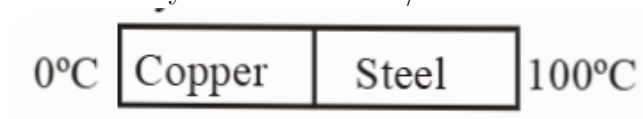
(1) 0.02
(2) 0.03
(3) 0.04
(4) 0.06

Q15. A ball whose density is $0.4 \times 10^3 \, \text{kg/m}^3$ falls into water from a height of 9 cm. To what depth does the ball sink?

(1) 2 cm
(2) 6 cm
(3) 4.5 cm
(4) 2.25 cm

Q16. Figure shows a copper rod joined to a steel rod. The rods have equal length and equal cross-sectional area. The free end of the copper rod is kept at 0°C and that of steel rod is kept at 100°C. Find the temperature of the junction of the rod.
Conductivity of copper $= 390 \, \text{W/m°C}$
Conductivity of steel $= 46 \, \text{W/m°C}$

(1) 18.01°C
(2) 26°C
(3) 10.6°C
(4) 20°C

Q17. If the radius of a star is R and it acts as a black body, what would be the temperature of the star, in which the rate of energy production is Q?

(1) $\frac{Q}{4\pi R^2 \sigma}$

(2) $\frac{Q}{4\pi R^2}$

(3) $(4\pi R^2 Q)^{1/4}$

(4) $(Q/4\pi R^2 \sigma)^{1/4}$

Q18. A thermodynamic system is changed from state (P_1, V_1) to (P_2, V_2) by two different processes, the quantity which will remain same will be –

(1) ΔQ

(2) ΔW

(3) $\Delta Q + \Delta W$

(4) $\Delta Q - \Delta W$

Q19. A Carnot's heat engine works between the temperatures 427°C and 27°C. What amount of heat should it consume per second to deliver mechanical work at the rate of 1.0 kW?

(1) 0.417 kcal/s

(2) 1.3 kcal/s

(3) 18.1 kcal/s

(4) 0.212 kcal/s

Q20. A vessel containing 1 more of O_2 gas (molar mass 32) at temperature T. The pressure of the gas is p. An identical vessel containing one mole of He gas (molar mass 4) at temperature 2T has a pressure of –

(1) $\frac{p}{8}$

(2) p

(3) $2p$

(4) $8p$

Q21. The temperature of an ideal gas is increased from 27°C to 127°C, then the percentage increase in v_{rms} is

(1) 37%

(2) 11%

(3) 33%
(4) 15.5%

Q22. Two gases occupy two containers A and B. The gas in A, of volume 0.10 m³, exerts a pressure of 1.40 MPa and that in B of volume 0.15 m³ exerts a pressure of 0.7 MPa. The two containers are united by a tube of negligible volume and the gases are allowed to intermingle. Then if the temperature remains constant, the final pressure in the container will be (in MPa)

(1) 0.70
(2) 0.98
(3) 1.40
(4) 2.10

Q23. An instantaneous displacement of a simple harmonic oscillator is $x = A\cos(\omega t + \pi/4)$. Its speed will be maximum at time

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

Q24. Two waves of wavelengths 99 cm and 100 cm both travelling with velocity 396 m/s are made to interfere. The number of beats produced by them is

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

Q25. If the equation of transverse wave is $y = x_0 \cos\left(2\pi\left(nt - \frac{x}{\lambda}\right)\right)$, the maximum velocity of the particle is twice of wave velocity, if k is –

(1) $\pi/2x_0$
(2) πx_0
(3) πx_0
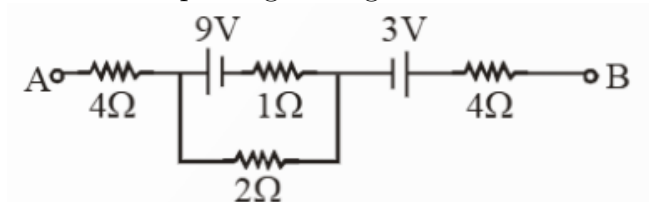
8

(4) πx_0

Q27. Two identical capacitors, have the same capacitance C. One of them is charged to potential V_1 and the other to V_2. The negative ends of the capacitors are connected together. When the positive ends are also connected, the decrease in energy of the combined system is –

(1) $\frac{1}{4}C(V_1 - V_2)^2$
(2) $\frac{1}{2}C(V_1 + V_2)^2$
(3) $\frac{1}{4}C(V_1 + V_2)^2$
(4) $\frac{1}{4}C(V_1 - V_2)^2$

Q28. What should be the characteristic of fuse wire?

(1) High melting point, high specific resistance.
(2) Low melting point, low specific resistance.
(3) High melting point, low specific resistance.
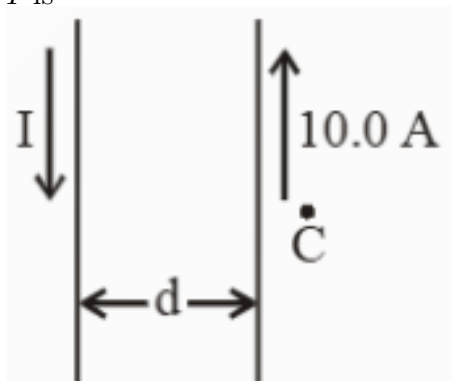(4) Low melting point, high specific resistance.

Q29. In the circuit shown in figure, the potential difference between points A and B is 16 V. The current passing through 2Ω resistance will be

(1) 2.5 A
(2) 3.5 A
(3) 4.0 A
(4) zero

Q30. Two parallel conductors carry current in opposite directions as shown in figure. One conductor carries a current of 10.0 A. Point C is a distance $\frac{d}{2}$ to the right of the 10.0 A current. If $d = 18\,\mathrm{cm}$ and I is adjusted so that the magnetic field at C is zero, the value of the current

I is

(1) 10.0 A
(2) 30.0 A
(3) 8.0 A
(4) 18.0 A

Q31. A uniform electric field and uniform magnetic field are acting along the same direction in a certain region. If an electron is projected in the region such that its velocity is pointed along the direction of fields, then the electron

(1) will turn towards the right direction of motion.
(2) speed will decrease.
(3) speed will increase.
(4) will turn towards the left direction of motion.

Q32. Eddy currents are produced when

(1) a metal is kept in varying magnetic field.
(2) a metal is kept in steady magnetic field.
(3) a circular coil is placed in a magnetic field.
(4) through a circular coil, current is passed.

Q33. Two coaxial solenoids are made by winding thin insulated wire over a pipe of cross-sectional area $A = 10\,\text{cm}^2$ and length 20 cm. If one of the solenoids has 300 turns and the other 400 turns, their mutual inductance is

(1) $2.4\pi \times 10^{-5}\,\text{H}$
(2) $2.4 \times 10^{-7}\,\text{H}$

(3) $4.8\pi \times 10^{-4}\,\text{H}$
(4) $4.8\pi \times 10^{-5}\,\text{H}$

Q34. The ratio of secondary and primary turns of step-up transformer is $4 : 1$. If a current of 4 A is applied to the primary, the induced current in secondary will be
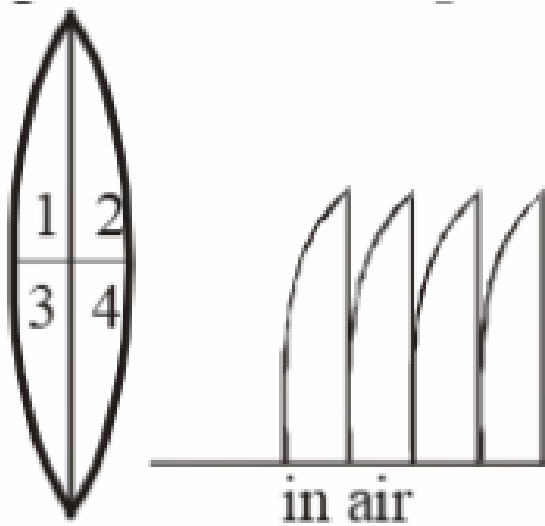
(1) 8 A
(2) 2 A
(3) 1 A
(4) 0.5 A

Q35. Which of the following electromagnetic radiations has the smallest wavelength?

(1) Ultraviolet rays
(2) X-rays
(3) γ-rays
(4) Microwaves

Q36. When light is refracted, which of the following does not change?

(1) Wavelength
(2) Frequency
(3) Velocity
(4) Amplitude

Q37. The given lens is broken into four parts and rearranged as shown. If the initial focal length is f, then after rearrangement the equivalent focal length is –
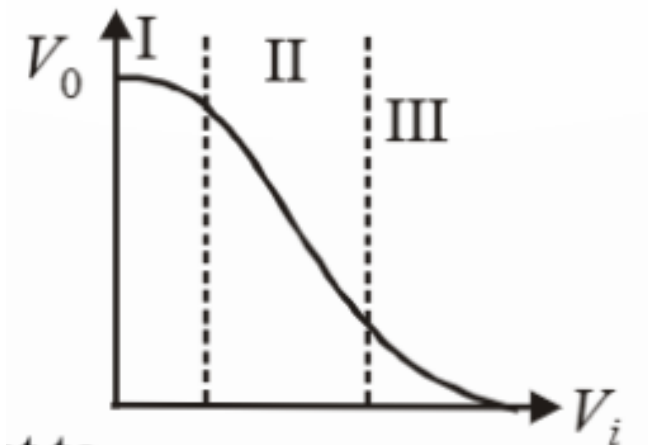
in air

(1) f

(2) $\frac{f}{2}$

(3) $\frac{f}{4}$

(4) $4f$

Q38. In Young's double slit experiment 10th order maximum is obtained at the point of observation in the interference pattern for $\lambda = 7000\,\text{Å}$. If the source is replaced by another one of wavelength $5000\,\text{Å}$ then the order of maximum at the same point will be –
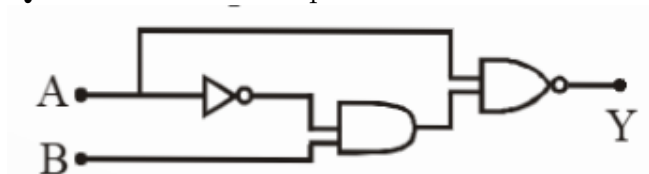
(1) 12th

(2) 14th

(3) 16th

(4) 18th

Q39. Transfer characteristics (output voltage V_o vs input voltage V_i) for a base biased transistor in CE configuration is as shown in the figure. For using transistor as a switch, it is used

(1) in region (III)
(2) both in region (I) and (III)
(3) in region (II)
(4) in region (I)

Q40. The circuit is equivalent to

(1) AND gate
(2) OR gate
(3) Not gate
(4) None of these

Part II: Chemistry

Q41. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0 M HNO_3? The concentrated acid is 70

(1) 90.0 g conc. HNO_3
(2) 70.0 g conc. HNO_3
(3) 54.0 g conc. HNO_3
(4) 45.0 g conc. HNO_3

Q42. The Bohr orbit radius for the hydrogen atom $(n = 1)$ is approximately 0.530 Å. The radius for the first excited state $(n = 2)$ orbit is (in Å)

(1) 0.13
(2) 1.06
(3) 4.77
(4) 2.12

Q43. The screening effect of d-electrons is

(1) Equal to p-electrons
(2) Much more than p-electrons
(3) Same as f-electrons
(4) Less than p-electrons

Q44. When the first ionisation energies are plotted against atomic number, the peaks are occupied by

(1) Alkali metals
(2) Rare gases
(3) Halogens
(4) Transition elements

Q45. The ions O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show:

(1) A decrease from O^{2-} to F^- and then increase from Na^+ to Al^{3+}
(2) A significant increase from O^{2-} to F^-
(3) A significant decrease from O^{2-} to Al^{3+}
(4) An increase from O^{2-} to F^- and then decrease from Na^+ to Al^{3+}

Q46. Using MOT, which of the following pairs denote paramagnetic species?

(1) B_2 and C_2
(2) B_2 and O_2
(3) N_2 and C_2
(4) O_2 and O_2^2

Q47. Increasing order of rms velocities of H_2, O_2, N_2 and HBr is

(1) $H_2 \rightarrow O_2 \rightarrow N_2 \rightarrow HBr$
(2) $H_2 \rightarrow N_2 \rightarrow O_2 \rightarrow HBr$
(3) $H_2 \rightarrow O_2 \rightarrow HBr \rightarrow N_2$
(4) $HBr \rightarrow N_2 \rightarrow H_2 \rightarrow O_2$

Q48. For the dissociation reaction, $H_2 \rightarrow H + H$, $\Delta H = 162\,\text{Kcal}$, heat of atomisation of H is

(1) 81 Kcal
(2) 162 Kcal
(3) 162 Kcal
(4) 218 Kcal

Q49. The enthalpy of combustion of 2 moles of benzene at 27°C differs from the value determined in bomb calorimeter by

(1) $-2.4941\,\text{kJ}$
(2) $+2.4941\,\text{kJ}$
(3) $-7.483\,\text{kJ}$
(4) $+7.483\,\text{kJ}$

Q50. If 1.0 mole of I_2 is introduced into a 1.0 litre flask at 1000 K, at equilibrium $(K_c = 10^{-6})$, which one is correct?

(1) $[I_2(g)] > [I(g)]$
(2) $[I_2(g)] < [I(g)]$
(3) $[I_2(g)] = [I(g)]$
(4) $[I_2(g)] = \frac{1}{2}[I(g)]$

Q51. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$, K_c is

(1) RT
(2) RT^{-1}
(3) $(RT)^{1/2}$
(4) $(RT)^{-1/2}$

Q52. The oxidation state of sulphur in $Na_2S_4O_6$ is
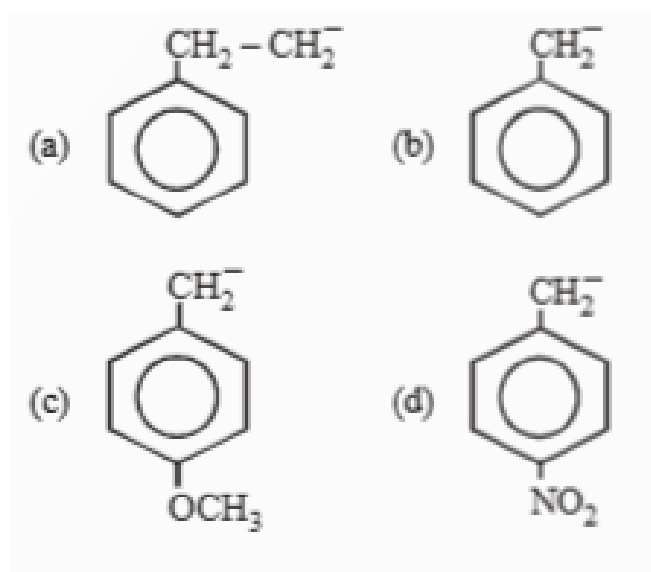
(1) $+6$
(2) $+5$
(3) $\frac{5}{2}$

(4) -2

Q53. When same amount of zinc is treated separately with excess of sulphuric acid and excess of sodium hydroxide solution, the ratio of volumes of hydrogen evolved is:

(1) 1:1
(2) 1:2
(3) 2:1
(4) 9:4

Q54. The alkali metals form salt-like hydrides by the direct synthesis at elevated temperature. The thermal stability of these hydrides decreases in which of the following orders?

(1) $CsH > RbH > KH > LiH$
(2) $KH > NaH > LiH > RbH$
(3) $NaH > LiH > RbH > CsH$
(4) $LiH > NaH > RbH > CsH$

Q55. The most stable carbocation among the following is

Q56. Among the following four structures I to IV, it is true that

(1) only I and II are chiral compounds.
(2) only III and IV are chiral compounds.
(3) all four are chiral compounds.
(4) only I is a chiral compound.

Q57. The number of enantiomers of the compound $CH_3CHBrCHBrCOOH$ is

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

Q58. Which one of the following reactions is expected to readily give a hydrocarbon product in good yields?

(1) $RCOOK \xrightarrow{\text{Electrolytic}} Br_2$
(2) $RCOOK \xrightarrow{Br}$
(3) $CH_3CH_3 \xrightarrow{Cl}$
(4) $CH_3CCl \xrightarrow{C_2OH}$

Q59. What will be the main product when acetylene reacts with hypochlorous acid?

(1) Trichloroacetaldehyde
(2) Acetaldehyde
(3) Dichloroacetaldehyde
(4) Chloroacetaldehyde

Q60. The greenhouse effect is because of the

(1) presence of gases, which in general are strong infrared absorbers, in the atmosphere.
(2) presence of CO_2 only in the atmosphere.
(3) presence of O_3 and CH_4 in the atmosphere.

(4) N_2O and chlorofluorohydrocarbons in the atmosphere.

Q61. Due to Frenkel defect, the density of ionic solids

(1) decreases
(2) increases
(3) does not change
(4) changes

Q62. Equal weights of NaCl and KCl are dissolved separately in equal volumes of solutions. Molarity of the two solutions will be:

(1) Equal
(2) That of NaCl will be less than that of KCl
(3) That of NaCl will be more than that of KCl
(4) That of NaCl will be about half of that of KCl

Q63. A current of 2.0 A passed for 5 hours through a molten metal salt deposits 22.2 g of metal (At wt. = 177). The oxidation state of the metal in the salt is

(1) +1
(2) +2
(3) +3
(4) +4

Q64. The electrolytic cells, one containing acidified ferrous chloride and another acidified ferric chloride are connected in series. The ratio of iron deposited at cathodes in the two cells when electricity is passed through the cells will be:

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

Q65. Velocity constant of a reaction at 290 K was found to be 3.2×10^{-3}. At 300 K it will be:

(1) 1.28×10^{-3}
(2) 9.6×10^{-3}
(3) 6.4×10^{-3}
(4) 3.2×10^{-4}

Q66. At high pressure, the entire surface gets covered by a monomolecular layer of the gas follows

(1) three-halved order
(2) second-order
(3) first-order
(4) zero-order

Q67. Which of the following is incorrect with respect to property indicated?

(1) E.N.$F > Cl > Br$
(2) E.A. : $O > F > Br$
(3) Oxidizing power: $F_2 > Cl_2 > Br_2$
(4) Bond energy: $F_2 > Cl_2 > Br_2$

Q68. Strong reducing behaviour of H_3PO_4 is due to

(1) presence of one $-OH$ group and two P-H bonds
(2) high electron gain enthalpy of phosphorus
(3) high oxidation state of phosphorus
(4) presence of two $-OH$ groups and one P-H bond

Q69. The pair in which both species have same magnetic moment (spin only value) is:

(1) $[Cr(H_2O)_6]^{2+}$, $[CoCl_4]^{2-}$
(2) $[Cr(H_2O)_6]^{3+}$, $[Fe(H_2O)_6]^{2+}$
(3) $[Mn(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{2+}$
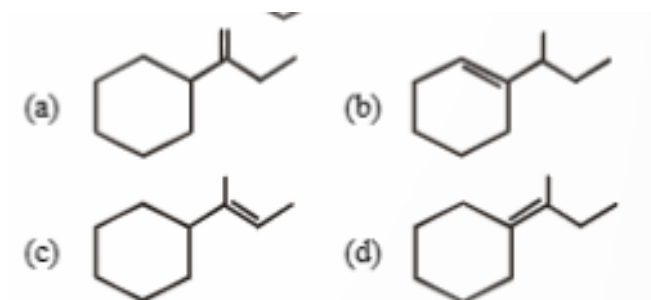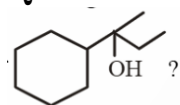(4) $[CoCl_4]^{2-}$, $[Fe(H_2O)_6]^{2+}$

Q70. Which of the following is less acidic among the given halogen compounds?

(1) CHF_3
(2) $CHCl_3$
(3) CH_3Cl
(4) $CHBr_3$

Q71. In an S_N2 substitution reaction of the type $R-Br+Cl^- \xrightarrow{DMF} R-Cl+Br^-$, which one of the following has the highest relative rate?

(1) $CH_3CH_2CH_2Br$
(2) $CH_3CH_2CH_2Br$
(3) $CH_3CH_2CH_2Br$
(4) CH_3CH_2Br

Q72. Which of the following is not the product of dehydration of OH?

Q73. What will be the correct structural formula of the product for the following reaction?

Q74. Nucleophilic addition reaction will be most favoured in

(1) $(CH_3)_2C=O$
(2) $CH_3CH=CHO$
(3) CH_3CHO
(4) $CH_3CH_2C=CH_2$

Q75. Identify the product C in the series

(1) CH_3COOH
(2) $CH_3CH_2C=CH_2$
(3) CH_3CH_2CHO
(4) CH_3CHO

Q76. Insulin production and its action in the human body are responsible for the level of diabetes. This compound belongs to which of the following categories?

(1) An enzyme
(2) A hormone
(3) A co-enzyme
(4) An antibiotic

Q77. Which statement is incorrect about peptide bond?

(1) C-N bond length in proteins is longer than usual C-N bond length.
(2) Spectroscopic analysis shows planar structure of C-NH bond.
(3) C-N bond length in proteins is smaller than usual C-N bond length.
(4) None of these

Q78. A mixture of chlorides of copper, cadmium, chromium, iron, and aluminium was dissolved in water acidified with HCl and hydrogen sulphide gas was passed for sufficient time. It was filtered, boiled and a few drops of nitric acid were added while boiling. To this solution ammonium chloride and sodium hydroxide were added and filtered. The filtrate shall give test for.

(1) Sodium and iron
(2) Sodium and aluminium
(3) Aluminium and iron
(4) None of these

Q79. Volume of 3%solution of sodium carbonate necessary to neutralise a litre of 0.1 N sulphuric acid is

(1) 176.66 ml
(2) 156.6 ml
(3) 116.0 ml
(4) 196.1 ml

Q80. Volume of 3%solution of sodium carbonate necessary to neutralise a litre of 0.1 N sulphuric acid is

(1) 176.66 ml
(2) 156.6 ml
(3) 116.0 ml
(4) 196.1 ml

Part III: Mathematics

Q81. A class has 175 students. The following data shows the number of students obtaining one or more subjects. Mathematics 100, Physics 70, Chemistry 40; Mathematics and Physics 30, Mathematics and Chemistry 28, Physics and Chemistry 18. How many students have offered Mathematics alone?

(1) 35
(2) 48
(3) 60
(4) 29

Q82. If $\cos\theta + \sin\theta = x\cos\theta$ and $\sin\theta = y\cos\theta$, then $x^2 + y^2 =$

(1) 1
(2) 2
(3) 3
(4) None of these

Q83. If $\cos 76° = \cos(90° - \theta)$, then the general value of θ is

(1) $76°$
(2) $90° - 76°$
(3) $76°$ and $180° - 76°$
(4) $180° - 76°$

Q84. If the real part of $\frac{z+1}{z-1} = 4$, then the locus of the point representing z in the complex plane is

(1) a straight line parallel to x-axis
(2) a straight line equally inclined to axes
(3) a circle with radius 2
(4) a circle with radius $\frac{1}{2}$

Q85. If α and β are the roots of $x^2 - x + 1 = 0$, then the equation whose roots are α^{100} and β^{100} is

(1) $x^2 - x + 1 = 0$
(2) $x^2 + x + 1 = 0$
(3) $x^2 - x - 1 = 0$
(4) $x^2 + x - 1 = 0$

Q86. The set of all real x satisfying the inequality

$$\frac{3 - |x|}{4 - |x|} \geq 0$$

is

(1) $[-3, 3] \cup (-4, 4)$
(2) $(-4, 4)$
(3) $[-3, 3] \cup (4, \infty)$
(4) $(-3, 3] \cup (-4, \infty)$

Q87. If x satisfies $|3x - 2| + |3x - 4| \geq |3x - 6|$, then

(1) $0 \leq x \leq \frac{8}{3}$
(2) $x \geq \frac{8}{3}$
(3) $x \leq 0$ or $x \geq \frac{8}{3}$
(4) $x \geq 2$ only

Q88. In how many ways can 5 boys and 5 girls be seated at a round table so that no two girls may be together?

(1) $4!$
(2) $4! \times 5!$
(3) $5!$
(4) $5! \times 4!$

Q89. A box contains two white balls, three black balls and four red balls. In how many ways can three balls be drawn from the box if at least one black ball is to be included in the draw?

(1) 84
(2) 60

(3) 129

(4) 114

Q90. The coefficient of the middle term in the expansion of $(2 + 3x)^4$ is

(1) 216

(2) 200

(3) 180

(4) 2160

Q91. If $C_0, C_1, C_2, \ldots$ denote the binomial coefficients in the expansion of $(1 + x)^n$, then the value of

$$C_0 + (C_0 + C_1) + (C_0 + C_1 + C_2) + \cdots + (C_0 + C_1 + C_2 + \cdots + C_n)$$

is

(1) n^2

(2) $(n - 1)2^n$

(3) $(n + 1)2^n$

(4) $n2^n$

Q92. The sum of the series

$$1 + 2^2 + 3^2 + 4^2 + \cdots + 100^2$$

is

(1) $100^2 + 100$

(2) $99 \times 2^{100} - 1$

(3) $99 \times 2^{100} + 1$

(4) 99×2^{100}

Q93. The quadratic equation whose roots are the x and y intercepts of the line passing through $(1, 1)$ and making a triangle of area A with the co-ordinate axes is

(1) $x^2 + Ax + 2A = 0$
(2) $x^2 - Ax + 2A = 0$
(3) $x^2 - Ax - 2A = 0$
(4) None of these

Q94. If $4a^2 + b^2 + 2c^2 + 4ab - 6ac - 3bc = 0$, the family of lines $ax + by + c = 0$ is concurrent at one or the other of the two points-

(1) $(-1, -1)$, $(2, -1)$
(2) $(-1, 1)$, $(-2, -1)$
(3) $(-1, 2)$, $(-2, 1)$
(4) $(-1, -1)$, $(1, -1)$

Q95. A pair of tangents are drawn from the origin to the circle $x^2 + y^2 + 20(x + y) + 20 = 0$, then the equation of the pair of tangent are

(1) $x^2 + y^2 - 5xy = 0$
(2) $x^2 + y^2 + 2xy = 0$
(3) $x^2 + y^2 - 2xy = 0$
(4) $2x^2 + 2y^2 + 5xy = 0$

Q96. An ellipse has OB as semi-minor axis, F and F' its foci and the angle $\angle$FBF' is a right angle. Then the eccentricity of the ellipse is

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

Q97. If the line $2x - 3y = k$ touches the parabola $y^2 = 6x$, then find the value of k.

(1) $-15/4$
(2) $-7/4$
(3) $-2/4$

(4) $-1/4$

Q98. S and T are the foci of an ellipse and B is an end of the minor axis. If $\triangle$STB is an equilateral triangle, then the eccentricity of the ellipse is

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

Q99. Let $f(x) = (x^5 - 1)(x^3 + 1)$, $g(x) = (x^2 - 1)(x^2 - x + 1)$ and let $h(x)$ be such that $f(x) = g(x)h(x)$. Then

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

Q100. In the truth table for the statement $(p \wedge q) \to (q \vee \neg p)$, the last column has the truth value in the following order is

(1) TFFF
(2) FTTT
(3) FTTF
(4) TFTT

Q101. If the value of mode and mean is 60 and 66 respectively, then the value of median is

(1) 70
(2) 64
(3) 60
(4) 90

Q102. Find the variance of the data given below

Size of item: $3.5, 4.5, 5.5, 6.5, 7.5, 8.5, 9.5$ Frequency: $3, 7, 22, 60, 85, 32, 8$

(1) 1.29
(2) 1.32
(3) 1.36
(4) None of these

Q103. Let R be the relation on the set $\mathbb{R}$ of all real numbers, defined by aRb if $|a - b| \leq 1$. Then, R is

(1) reflexive and symmetric only
(2) reflexive and transitive only
(3) equivalence
(4) None of the above

Q104. The greatest and least values of $(\sin(x))^2 + (\cos(x))^2$ are respectively

(1) $\frac{\pi}{2}$ and 0
(2) $\frac{\pi}{4}$ and $-\frac{\pi}{2}$
(3) $\frac{5\pi}{2}$ and $\frac{\pi}{8}$
(4) $\frac{\pi}{2}$ and $-\frac{\pi}{4}$

Q105. The value of

$$\frac{1}{2} \cos^{-1}\left(\cos\left(\frac{\pi}{3} - \frac{\sqrt{63}}{8} \right) \right)$$

is

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

Q106. The determinant

$$\begin{vmatrix} 1 & x & x^2 \\ 1 & x^3 & x^4 \\ 1 & x^5 & x^6 \end{vmatrix}$$

vanishes for

(1) 3 values of x
(2) 1 value of x
(3) 2 values of x
(4) No value of x

Q107. If the lines $\ell_1 : \ell m + mn + n = 0$, $\ell_2 : mn + m + n = 0$ are concurrent then

(1) $\ell = m = n = 0$
(2) $\ell = m = n$
(3) $m \neq n$
(4) $\ell = m \neq n$

Q108. If $y = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots + \infty$, then

(1) x
(2) 1
(3) y
(4) None of these

Q109. If $f(x) = \begin{cases} \frac{x^2+3x-10}{x^2+2x-15}, & x \neq -5 \\ a, & x = -5 \end{cases}$ is continuous at $x = -5$, then the value of a will be

(1) $\frac{3}{2}$
(2) $\frac{7}{8}$
(3) $\frac{2}{3}$
(4) $\frac{3}{2}$

Q110. The equation of all lines having slope 2 which are tangent to the curve $y = \frac{1}{x-3}$, is

29

(1) $y = 2$
(2) $y = 2x$
(3) $y = 2x + 3$
(4) None of these

Q111. The function $f(x) = (x(x-2))^2$ is increasing in the set

(1) $(-\infty, 0) \cup (2, \infty)$
(2) $(-\infty, 1) \cup (2, \infty)$
(3) $(0, 1) \cup (2, \infty)$
(4) $(1, 2)$

Q112. If $a^2x^4 + b^2y^4 = c^4$, then the maximum value of xy is

(1) $\frac{c}{\sqrt{ab}}$
(2) $\frac{c^2}{\sqrt{ab}}$
(3) $\frac{c^2}{2ab}$
(4) $\frac{c^2}{\sqrt{2ab}}$

Q113.

$$\int \frac{1}{(x^2 + 1)^{\frac{3}{4}}} \, dx$$

is equal to

(1) $\sec^{-1}\left(\frac{x^2+1}{\sqrt{2x}}\right) + c$
(2) $\frac{1}{\sqrt{2x}} \sec^{-1}\left(\frac{1}{\sqrt{2}}\right) + c$
(3) $\frac{1}{\sqrt{2x}} \sec^{-1}\left(\frac{1}{\sqrt{2}}\right) + c$
(4) None of these

Q114. Evaluate

$$\int_0^{\frac{\pi}{2}} \frac{\sin x}{1 + \cos^2 x} \, dx$$

30

is

(1) π^2

(2) $\frac{\pi}{4}$

(3) $\frac{\pi^3}{3}$

(4) $\frac{\pi}{2}$

Q115. The area intercepted by the curves $y = \cos x$, $x \in [0, \pi]$ and $y = \cos 2x$, $x \in [0, \pi]$, is

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

(2) $\frac{3\sqrt{3}}{2}$

(3) $\frac{3\pi}{4}$

(4) $\frac{3\sqrt{3}}{4}$

Q116. The general solution of the differential equation

$$\frac{dy}{dx} + \sin(x + y) = \sin(x - y)$$

is

(1) $\log \tan \frac{y}{2} + \sin x = C$

(2) $\log \tan \frac{y}{2} + \log \sin x = C$

(3) $\tan \frac{y}{2} + \log \sin x = C$

(4) None of these

Q117. The solution to the differential equation

$$\frac{dy}{dx} = \frac{y f'(x) - y^2}{f(x)}$$

where $f(x)$ is a given function is

(1) $f(x) = x + c$

(2) $f(x) = cx + y$

(3) $f(x) = cx + y$

(4) $y f(x) = cx$

Q118. If $\mathbf{a}, \mathbf{b}, \mathbf{c}$ are three unit vectors such that

$$\mathbf{a} + \mathbf{b} + \mathbf{c} = \mathbf{0}, \quad \mathbf{a} \cdot \mathbf{b} = \mathbf{b} \cdot \mathbf{c} = \mathbf{c} \cdot \mathbf{a}$$

then the value of $\mathbf{a} \cdot \mathbf{a}$ is

(1) -3
(2) -2
(3) 3/2
(4) 0

Q119. If vectors $2i + j + k$, $2j - 3k$, and $3i + j + 5k$ are coplanar, then the value of a is

(1) 2
(2) -2
(3) 4
(4) -4

Q120. The coordinates of the point where the line through the points $A(3, 4, 1)$ and $B(5, 1, 6)$ crosses the XY-plane are

(1) $\left(\frac{13}{5}, 0, 0\right)$
(2) $\left(\frac{13}{5}, 5, 0\right)$
(3) $\left(\frac{13}{5}, 23, 0\right)$
(4) $\left(\frac{13}{5}, 0, 5\right)$

Q121. Find the angle between the two planes $2x + y - 2z = 5$ and $3x - 6y - 2z = 7$.

(1) $\cos^{-1}\left(\frac{4}{21}\right)$
(2) $\cos^{-1}\left(\frac{2}{11}\right)$
(3) $\cos^{-1}\left(\frac{2}{21}\right)$
(4) $\cos^{-1}\left(\frac{1}{11}\right)$

Q122. For $k = 1, 2, 3$, the box B_k contains red balls and $(k + 1)$ white balls. Let $P(B_1) = \frac{1}{2}, P(B_2) = \frac{1}{3}, P(B_3) = \frac{1}{6}$. A box is selected at random and a ball is drawn from it. If a red ball is drawn, then the probability that it came from box B_2 is

(1) $\frac{35}{78}$

(2) $\frac{14}{39}$

(3) $\frac{10}{63}$

(4) $\frac{13}{78}$

Q123. The probability of India winning a test match against West Indies is $\frac{1}{2}$. Assuming independence from match to match, the probability that in a 5 match series India's second win occurs at the third test is

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

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

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

(4) $\frac{1}{6}$

Q124. An object is observed from the points A, B and C lying in a horizontal straight line which passes directly underneath the object. The angular elevation at A is θ, at B is 2θ, and at C is 3θ. If AB = a, BC = b, and the height of the object is h, then the height of the object is

(1) $\frac{a}{2}(b-a)$

(2) $\frac{a}{2b}(b-a)$

(3) $\frac{b}{2a}(b-a)$

(4) $\frac{2a}{b}(b-a)$

Q125. A shopkeeper wants to purchase two articles A and B of cost price 4 and 3 respectively. He thought that he may earn 30 paise by selling article A and 10 paise by selling article B. He has not to purchase total articles worth more than 24. If he purchases the number of articles of A and B, x and y respectively, then linear constraints are

(1) $x \geq 0, y \geq 0, 4x + 3y \leq 24$

(2) $x \geq 0, y \geq 0, 3x + 10y \leq 24$

(3) $x \geq 0, y \geq 0, 4x + 3y \leq 24$

(4) $x \geq 0, y \geq 0, 30x + 40y \geq 24$

Part IV: English

Q126. Out of the four alternatives, choose the one which expresses the correct meaning of the word "SAGACIOUS".

(1) Shameless
(2) Wise
(3) Powerless
(4) Foolish

Q127. Out of the four alternatives, choose the one which expresses the correct meaning of the word "REMEDIAL".

(1) Corrective
(2) Proficient
(3) Damaging
(4) Optional

Q128. Out of the four alternatives, choose the one which expresses the correct meaning of the word "RETICENT".

(1) Confident
(2) Sad
(3) Truthful
(4) Secretive

Q129. Choose the word opposite in meaning to the given word "FIDELITY".

(1) Faith
(2) Allegiance
(3) Devotedness
(4) Treachery

Q130. Choose the word opposite in meaning to the given word "INFRINGABLE".

(1) Complicated
(2) Weird
(3) Breakable

(4) Software

Q131. Choose the word opposite in meaning to the given word "PROGENY".

(1) Kid
(2) Parent
(3) Friend
(4) Enemy

Q132. It was not possible to drag any conclusion so he left the case.

(1) Fetch
(2) Find
(3) Draw
(4) No improvement

Q133. I am looking after my pen which is missing.

(1) Looking for
(2) Looking in
(3) Looking back
(4) No improvement

Q134. "Mind your language!" he shouted.

(1) change
(2) inspect
(3) hold
(4) No improvement

Q135. I ..... to go there when I was a student.

(1) liked
(2) used

(3) prefer
(4) denied

Q136. She was angry ..... me.

(1) at
(2) about
(3) with
(4) in

Q137. You should not laugh ..... the poor.

(1) on
(2) at
(3) with
(4) over

Q138. 1. He is a famous doctor. 2. Once I had to consult with him. 3. I never believed him. 4. He suggested me a proper remedy. 5. I become completely fine. 6. Now I also admit this fact.

(1) PQRS
(2) QPRS
(3) QRPS
(4) RQPS

Q139. We don't know the plan of Ram. He cares for his friends. He is a complete person. We want some help and advice. As we are in trouble. We hope he will do his best for us.
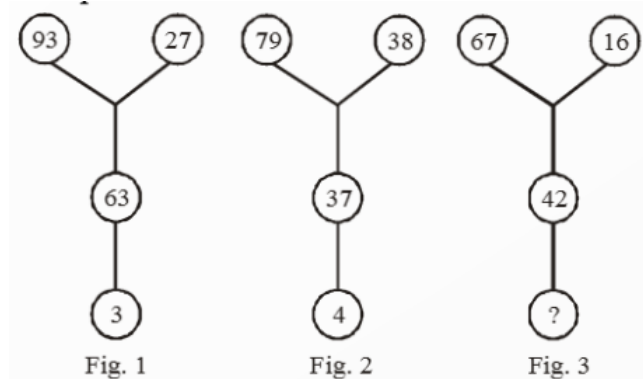
(1) PRSQ
(2) QPRS
(3) PQRS
(4) RQPS

Q140. It is not my problem. All residents of this society are careless. I am unable to convince anyone. They don't want to do some good. Every one seems to be unwise here. We all have to suffer one day.

(1) PRSQ
(2) PQRS
(3) QRPS
(4) PSRQ

Q141. In a certain code language "DOME" is written as "8943" and "MEAL" is written as "4321". What group of letters can be formed for the code "38249"?
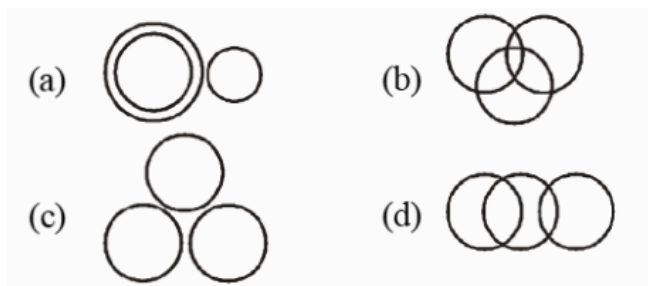
(1) EODAM
(2) MEDOA
(3) EMDAO
(4) EDAMO

Q142. Find the missing number from the given response.

Fig. 1   Fig. 2   Fig. 3

(1) 5
(2) 6
(3) 7
(4) 8

Q143. Which of the following correctly represents the relationship among illiterates, poor people, and unemployed?

(1) Circle within a circle
(2) Overlapping circles
(3) Circle within overlapping circles
(4) None of these

Q144. Sushma walks 20m towards north. Then she turns right and walks 30m. Now, she turns right and walks 35m. Now turning left, she walks 15m. Again, she turns left and moves 15m. Finally, she turns left and walks 15m. In which direction and how far is she from her original position?

(1) 15m East
(2) 30m East
(3) 15m West
(4) 45m West

Q145. In a classroom, there are 5 rows and 5 children A, B, C, D and E are seated one behind the other in 5 separate rows as follows. - A is sitting behind C but in front of B. - C is sitting behind E and D is sitting in front of E. The order in which they are sitting from the first row to the last is

(1) DECAB
(2) BACED
(3) ACDBE
(4) ABDEC

Q146. Which of the following will fill the series?

$$2, 9, 28, 2, 126$$

(1) 64
(2) 65

(3) 72
(4) 56

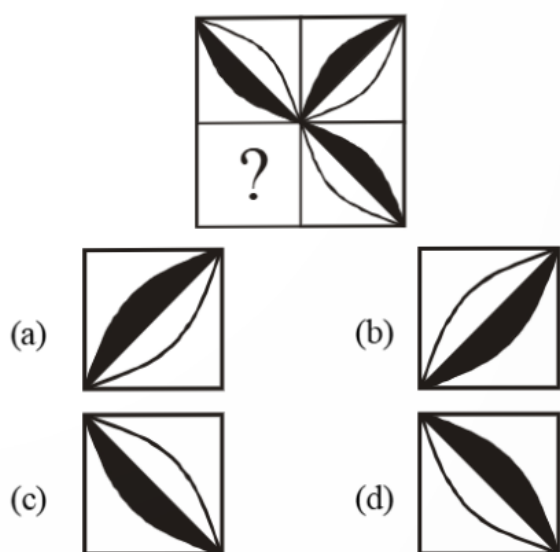**Q147.** Two signs in the equations have been interchanged, find out the two signs to make the equation correct.

$$3 - 5 + 8 + 2 - 10 = 13$$

(1) + and −
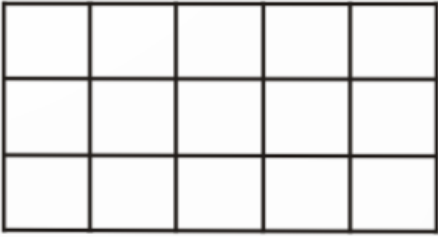(2) × and ÷
(3) = and −
(4) + and ÷

Q148. Assertion: [A] India is a democratic country. Reason: [R] India has a constitution of its own. Choose the correct alternative from the given options.

(1) Both (A) and (R) are true and (R) is correct explanation of (A).
(2) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(3) (A) is true (R) is false.
(4) (A) is false (R) is true.

Q149. Which one of the following figures completes the original figure?

Q150. How many squares are there in the following figure?

(1) 24
(2) 25
(3) 26
(4) 27