

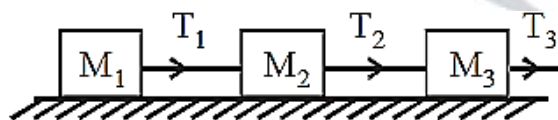
PART-I PHYSICS

- A passenger in a open car travelling at 30 m/s throws a ball out over the bonnet. Relative to the car the initial velocity of the ball is 20 m/s at 60° to the horizontal. The angle of projection of the ball with respect to the horizontal road will be
 (a) $\tan^{-1}\left(\frac{2}{3}\right)$ (b) $\tan^{-1}\left(\frac{\sqrt{3}}{4}\right)$
 (c) $\tan^{-1}\left(\frac{4}{\sqrt{3}}\right)$ (d) $\tan^{-1}\left(\frac{3}{4}\right)$
- A particle is moving in a straight line with initial velocity and uniform acceleration a . If the sum of the distance travelled in t^{th} and $(t + 1)^{\text{th}}$ seconds is 100 cm, then its velocity after t seconds, in cm/s, is
 (a) 80 (b) 50
 (c) 20 (d) 30
- The two vectors $\vec{A}$ and $\vec{B}$ are drawn from a common point and $\vec{C} = \vec{A} + \vec{B}$, then angle between $\vec{A}$ and $\vec{B}$ is -
 (1) 90° if $C^2 = A^2 + B^2$
 (2) greater than 90° if $C^2 < A^2 + B^2$
 (3) greater than 90° if $C^2 > A^2 + B^2$
 (4) less than 90° if $C^2 > A^2 + B^2$

Correct options are -

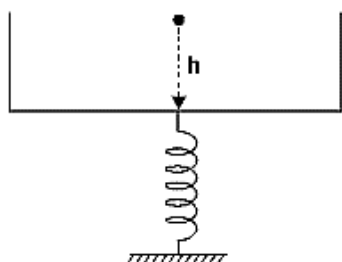
- (a) 1,2 (b) 1,2,3,4
 (c) 2,3,4 (d) 1,2,4

- If $T = 2\pi \sqrt{\frac{ML^3}{3Yq}}$ then find the dimensions of q . Where T is the time period of bar of mass M , length L and Young modulus Y .
 (a) $[L]$ (b) $[L^2]$
 (c) $[L^4]$ (d) $[L^3]$
- An object experiences a net force and accelerates from rest to its final position in 16 s. How long would the object take to reach the same final position from rest if the object's mass was four times larger
 (a) 64 s (b) 32 s
 (c) 16 s (d) 8 s
- Three blocks of masses m_1 , m_2 and m_3 are connected by massless strings, as shown, on a frictionless table. They are pulled with a force $T_3 = 40$ N. If $m_1 = 10$ kg, $m_2 = 6$ kg and $m_3 = 4$ kg, the tension T_2 will be



- (a) 20 N (b) 40 N
 (c) 10 N (d) 32 N

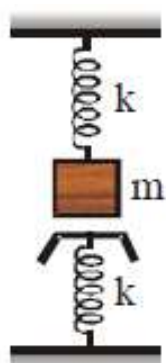
- A massless platform is kept on a light elastic spring as shown in fig. When a sand particle of mass 0.1 kg is dropped on the pan from a height of 0.24 m, the particle strikes the pan and spring is compressed by 0.01 m. From what height should the particle be dropped to cause a compression of 0.04 m.



- (a) 3.96 m (b) 0.396 m
(c) 4 m (d) 0.4 m

8. A constant torque of 31.4 N-m is exerted on a pivoted wheel. If angular acceleration of wheel is $4\pi \text{ rad/s}^2$, then the moment of inertia of the wheel is
(a) 2.5 kg m^2 (b) 3.5 kg m^2
(c) 4.5 kg m^2 (d) 5.5 kg m^2
9. A man of mass m starts falling towards a planet of mass M and radius R . As he reaches near to the surface, he realizes that he will pass through a small hole in the planet. As he enters the hole, he sees that the planet is really made of two pieces a spherical shell of negligible thickness of mass $2M/3$ and a point mass $M/3$ at the centre. Change in the force of gravity experienced by the man is
(a) $\frac{2GMm}{3R^2}$ (b) 0
(c) $\frac{1GMm}{3R^2}$ (d) $\frac{4GMm}{3R^2}$
10. Geo-stationary satellite is one which
(a) remains stationary at a fixed height from the earth's surface
(b) revolves like other satellites but in the opposite direction of earth's rotation
(c) revolves round the earth at a suitable height with same angular velocity and in the same direction as earth does about its own axis
(d) None of these
11. Two wires are made of the same material and have the same volume. However, wire 1 has cross sectional area A and wire 2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force F , how much force is needed to stretch wire 2 by the same amount?
(a) $4F$ (b) $6F$
(c) $9F$ (d) F
12. An iron rod of length 2 m and cross-sectional area of 50 mm^2 stretched by 0.5 mm , when a mass of 250 kg is hung from its lower end. Young's modulus of iron rod is
(a) $19.6 \times 10^{20} \text{ N/m}^2$ (b) $19.6 \times 10^{18} \text{ N/m}^2$
(c) $19.6 \times 10^{10} \text{ N/m}^2$ (d) $19.6 \times 10^{15} \text{ N/m}^2$
13. Viscosity is the property of a liquid due to which it:
(a) occupies minimum surface area
(b) opposes relative motion between its adjacent layers
(c) becomes spherical in shape
(d) tends to regain its deformed position
14. The radiation emitted by a perfectly black body is proportional to
(a) temperature on ideal gas scale
(b) fourth root of temperature on ideal gas scale
(c) fourth power of temperature on ideal gas scale
(d) square of temperature on ideal gas scale
15. A copper sphere cools from 62°C to 50°C in 10 minutes and to 42°C in the next 10 minutes. Calculate the temperature of the surroundings.
(a) 18.01°C (b) 26°C
(c) 10.6°C (d) 20°C

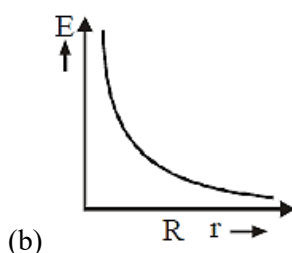
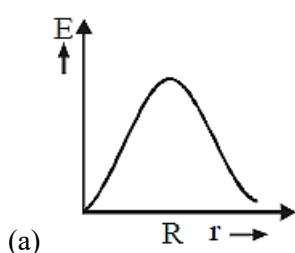
16. An air bubble of volume v_0 is released by a fish at a depth h in a lake. The bubble rises to the surface. Assume constant temperature and standard atmospheric pressure above the lake. The volume of the bubble just before touching the surface will be (density of water is ρ)
- (a) v_0 (b) $v_0(\rho gh/p)$
 (c) $\frac{v_0}{(1+\frac{\rho gh}{p})}$ (d) $v_0(1 + \frac{\rho gh}{p})$
17. The molecules of a given mass of gas have a root mean square velocity of 200 m s^{-1} at 27°C and $1.0 \times 10^5 \text{ N m}^{-2}$ pressure. When the temperature is 127°C and the pressure $0.5 \times 10^5 \text{ N m}^{-2}$, the root mean square velocity in ms^{-1} , is
- (a) $\frac{400}{\sqrt{3}}$ (b) $100\sqrt{2}$
 (c) $\frac{100\sqrt{2}}{3}$ (d) $\frac{100}{3}$
18. Which of the following expressions corresponds to simple harmonic motion along a straight line, where x is the displacement and a, b, c are positive constants?
- (a) $a + bx - cx^2$ (b) bx^2
 (c) $a - bx + cx^2$ (d) $-bx$
19. A mass m is suspended from a spring of force constant k and just touches another identical spring fixed to the floor as shown in the figure. The time period of small oscillations is

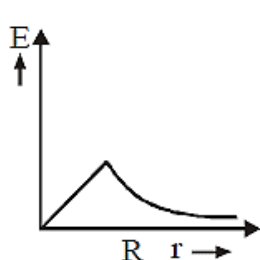


- (a) $2\pi\sqrt{\frac{m}{k}}$ (b) $\pi\sqrt{\frac{m}{k}} + \pi\sqrt{\frac{m}{k/2}}$
 (c) $\pi\sqrt{\frac{m}{3k/2}}$ (d) $\pi\sqrt{\frac{m}{k}} + \pi\sqrt{\frac{m}{2k}}$

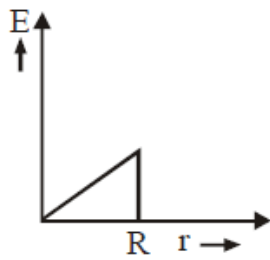
20. The fundamental frequency of an open organ pipe is 300 Hz. The first overtone of this pipe has same frequency as first overtone of a closed organ pipe. If speed of sound is 330 m/s, then the length of closed organ pipe is
- (a) 41 cm (b) 37 cm
 (c) 31 cm (d) 80 cm

21. In a uniformly charged sphere of total charge Q and radius R , the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be





(c)



(d)

22. A charge Q_1 exerts some force on a second charge Q_2 . If a 3rd charge Q_3 is brought near, then the force of Q_1 exerted on Q_2 –

- (a) will increase
- (b) will decrease
- (c) will remain unchanged
- (d) will increase if Q_3 is of the same sign as Q_1 and will decrease if Q_3 is of opposite sign.

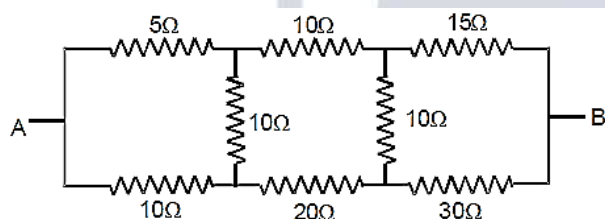
23. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. The potential at a distance of 2 cm from the centre of the sphere is

- (a) zero
- (b) 10 V
- (c) 4 V
- (d) $10/3$ V

24. If the potential of a capacitor having capacity $6\mu\text{F}$ is increased from 10 V to 20 V, then increase in its energy will be

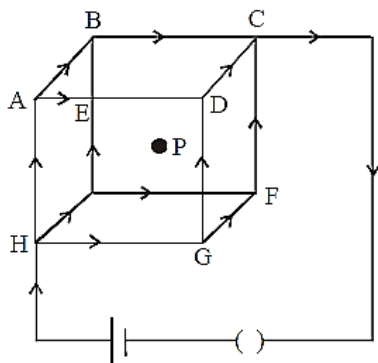
- (a) 4×10^{-4} J
- (b) 4×10^{-6} J
- (c) 9×10^{-4} J
- (d) 12×10^{-6} J

25. Calculate the effective resistance between A and B in following network.



- (a) 5Ω
- (b) 10Ω
- (c) 20Ω
- (d) 30Ω

26. A steady current is set up in a cubic network composed of wires of equal resistance and length d as shown in figure. What is the magnetic field at the centre P due to the cubic network



- (a) $\frac{\mu_0 2I}{4\pi d}$
- (b) $\frac{\mu_0 2I}{4\pi \sqrt{2} d}$
- (c) 0
- (d) $\frac{\mu_0 \theta \pi I}{4\pi d}$

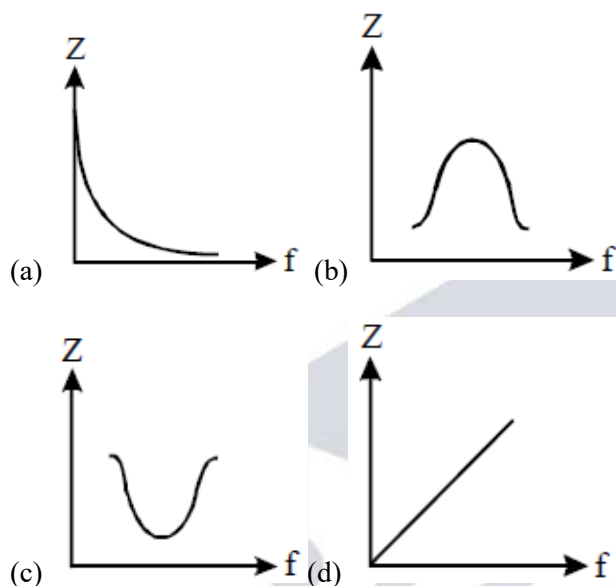
27. If $\vec{M}$ is magnetic moment and $\vec{B}$ is the magnetic field, then the torque is given by

- (a) $\vec{M} \cdot \vec{B}$ (b) $\frac{|\vec{M}|}{|\vec{B}|}$
 (c) $\vec{M} \times \vec{B}$ (d) $|\vec{M}||\vec{B}|$

28. A metal rod of length 1 m is rotated about one of its ends in a plane right angles to a field of inductance $2.5 \times 10^{-3} \text{ Wb/m}^2$. If it makes 1800 revolutions /min. Calculate induced e.m.f. between its ends.

- (a) 2.471 V (b) 3.171 V
 (c) 0.471 V (d) 1.771 V

29. Which one of the following curves represents the variation of impedance (Z) with frequency f in series LCR circuit?



30. An electromagnetic wave passes through space and its equation is given by $E = E_0 \sin(\omega t - kx)$ where E is electric field. Energy density of electromagnetic wave in space is

- (a) $\frac{1}{2} \epsilon_0 E_0^2$ (b) $\frac{1}{4} \epsilon_0 E_0^2$
 (c) $\epsilon_0 E_0^2$ (d) $2\epsilon_0 E_0^2$

31. A thin convergent glass lens ($\mu_g = 1.5$) has a power of +5.0D. When this lens is immersed in a liquid of refractive index μ , it acts as a divergent lens of focal length 100 cm. The value of μ must be

- (a) 4/3 (b) 5/3
 (c) 5/4 (d) 6/5

32. A vessel of depth 2 d cm. is half filled with a liquid of refractive index μ_1 and the upper half with a liquid of refractive index μ_2 . The apparent depth of the vessel seen perpendicularly is -

- (a) $d \left(\frac{\mu_1 \mu_2}{\mu_1 + \mu_2} \right)$ (b) $d \left(\frac{1}{\mu_1} + \frac{1}{\mu_2} \right)$
 (c) $2d \left(\frac{1}{\mu_1} + \frac{1}{\mu_2} \right)$ (d) $2d \left(\frac{1}{\mu_1 \mu_2} \right)$

33. If the distance between the first maxima and fifth minima of a double slit pattern is 7 mm and the slits are separated by 0.15 mm with the screen 50 cm. from the slits, then the wavelength of the light used is:

- (a) 200 nm (b) 100 nm
 (c) 800 nm (d) 600 nm

34. If the energy of a photon is 10eV, then its momentum is

- (a) $5.33 \times 10^{-23} \text{ kg m/s}$ (b) $5.33 \times 10^{-25} \text{ kg m/s}$
 (c) $5.33 \times 10^{-29} \text{ kg m/s}$ (d) $5.33 \times 10^{-27} \text{ kg m/s}$

35. The energies of energy levels A, B and C for a given atom are in the sequence $E_A < E_B < E_C$. If the radiations of wavelengths λ_1, λ_2 and λ_3 are emitted due to the atomic transitions C to B, B to A and C to A respectively then which of the following relations is correct?
- (a) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (b) $\lambda_3 = \lambda_1^2 + \lambda_2$
 (c) $\lambda_3 = \lambda_1 + \lambda_2$ (d) $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$
36. Which one is correct about fission?
- (a) Approx. 0.1% mass converts into energy.
 (b) Most of energy of fission is in the form of heat.
 (c) In a fission of U^{235} about 200eV energy is released.
 (d) On an average, one neutron is released per fission of U^{235} .
37. The output of an OR gate is connected to both the inputs of a NAND gate. The combination will serve as a:
- (a) NOT gate (b) NOR gate
 (c) AND gate (d) OR gate
38. In a semiconductor diode, the barrier potential offers opposition to
- (a) holes in P-region only
 (b) free electrons in N-region only
 (c) majority carriers in both regions
 (d) majority as well as minority carriers in both regions
39. An electron, in a hydrogen-like atom, is in an excited state. It has a total energy of -3.4eV . The kinetic energy and the de-Broglie wavelength of the electron are respectively
- (a) $+3.4\text{eV}, 0.66 \times 10^{-9}\text{ m}$
 (b) $-3.4\text{eV}, 1.99 \times 10^{-9}\text{ m}$
 (c) $2.8\text{eV}, 2.38 \times 10^{-10}\text{ m}$
 (d) $1.1\text{eV}, 1.28 \times 10^{-9}\text{ m}$
40. Light of wavelength 180 nm ejects photoelectron from a plate of a metal whose work function is 2eV. If a uniform magnetic field of $5 \times 10^{-5}\text{ T}$ is applied parallel to plate, what would be the radius of the path followed by electrons ejected normally from the plate with maximum energy?
- (a) 1.239 m (b) 0.149 m
 (c) 3.182 m (d) 2.33 m

PART-II CHEMISTRY

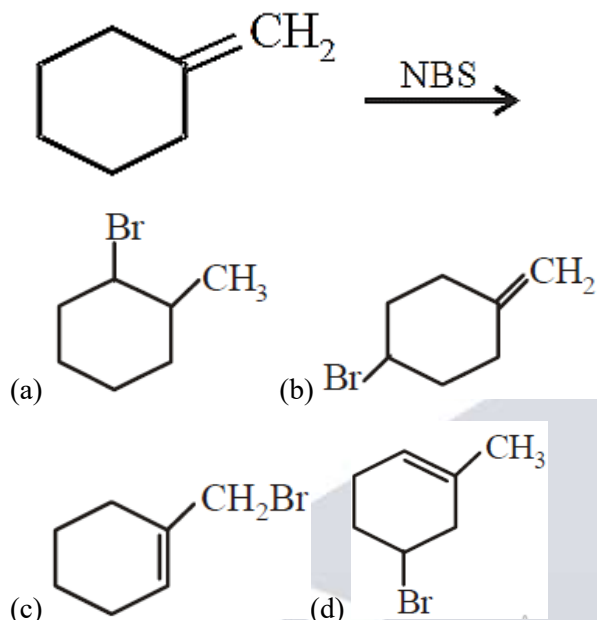
41. The product of atomic weight and specific heat of any element is a constant, approximately 6.4. This is known as:
- (a) Dalton's law (b) Avogadro's law
 (c) Newton's law (d) Dulong Pettit law
42. 1.520 g of hydroxide of a metal on ignition gave 0.995 g of oxide. The equivalent weight of metal is :
- (a) 1.52 (b) 0.995
 (c) 190 (d) 9
43. The correct order of radii is
- (a) $N < Be < B$ (b) $F^- < O^{2-} < N^{3-}$
 (c) $Na < Li < K$ (d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$
44. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in
- (a) forming covalent halides
 (b) forming polymeric hydrides
 (c) exhibiting maximum covalency in compounds
 (d) exhibiting amphoteric nature in their oxides
45. Among Al_2O_3, SiO_2, P_2O_3 and SO_2 the correct order of acid strength is:
- (a) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$

- (b) $\text{SiO}_2 < \text{SO}_2 < \text{Al}_2\text{O}_3 < \text{P}_2\text{O}_3$
 (c) $\text{SO}_2 < \text{P}_2\text{O}_3 < \text{SiO}_2 < \text{Al}_2\text{O}_3$
 (d) $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{P}_2\text{O}_3 < \text{SO}_2$
46. A σ bonded molecule MX_3 is T-shaped. The number of non bonded pair of electrons is
 (a) 0
 (b) 2
 (c) 1
 (d) can be predicted only if atomic number is known
47. The correct bond order in the following species is:
 (a) $\text{O}_2^{2+} < \text{O}_2^- < \text{O}_2^+$ (b) $\text{O}_2^+ < \text{O}_2^- < \text{O}_2^{2+}$
 (c) $\text{O}_2^- < \text{O}_2^+ < \text{O}_2^{2+}$ (d) $\text{O}_2^{2+} < \text{O}_2^+ < \text{O}_2^-$
48. What is the free energy change, ΔG , when 1.0 mole of water at 100°C and 1 atm pressure is converted into steam at 100°C and 1 atm. pressure?
 (a) 540cal (b) -9800cal
 (c) 9800cal (d) 0cal
49. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because
 (a) presence of HCl decreases the sulphide ion concentration.
 (b) solubility product of group II sulphides is more than that of group IV sulphides.
 (c) presence of HCl increases the sulphide ion concentration.
 (d) sulphides of group IV cations are unstable in HCl.
50. The pH of a solution is increased from 3 to 6 ; its H^+ ion concentration will be
 (a) reduced to half
 (b) doubled
 (c) reduced by 1000 times
 (d) increased by 1000 times
51. A gas X at 1 atm is bubbled through a solution containing a mixture of 1M Y^- and 1M Z^- at 25°C . If the reduction potential is $\text{Z} > \text{Y} > \text{X}$, then
 (a) Y will oxidise X and not Z
 (b) Y will oxidise Z and not X
 (c) Y will oxidise both X and Z
 (d) Y will reduce both X and Z
52. When a crystal of caustic soda is exposed to air, a liquid layer is deposited because:
 (a) Crystal loses water
 (b) Crystal absorbs moisture and CO_2
 (c) Crystal melts
 (d) Crystal sublimates
53. Which of the following compound is not chiral?
 (a) $\text{DCH}_2\text{CH}_2\text{CH}_2\text{Cl}$ (b) $\text{CH}_3\text{CHDCH}_2\text{Cl}$
 (c) $\text{CH}_3\text{CHClCH}_2\text{D}$ (d) $\text{CH}_3\text{CH}_2\text{CHDCl}$
54. $\text{C}_6\text{H}_5\text{C} \equiv \text{N}$ and $\text{C}_6\text{H}_5\text{N} \rightleftharpoons \text{C}$ exhibit which type of isomerism?
 (a) Position (b) Functional
 (c) Demotropism (d) Position isomerism
55. The correct nucleophilicity order is
 (a) $\text{CH}_3^- < \text{NH}_2^- < \text{HO}^- < \text{F}^-$
 (b) $\text{CH}_3^- \approx \text{NH}_2^- > \text{HO}^- \approx \text{F}^-$
 (c) $\text{CH}_3^- > \text{NH}_2^- > \text{HO}^- > \text{F}^-$
 (d) $\text{NH}_2^- > \text{F}^- > \text{HO}^- > \text{CH}_3^-$

56. In the anion HCOO^- the two carbon-oxygen bonds are found to be of equal length. What is the reason for it?

- (a) The $\text{C} = \text{O}$ bond is weaker than the $\text{C} - \text{O}$ bond.
- (b) The anion HCOO^- has two resonating structures.
- (c) The anion is obtained by removal of a proton from the acid molecule.
- (d) Electronic orbitals of carbon atom are hybridised.

57. What will be the product in the following reaction?



58. The fraction of total volume occupied by the atoms present in a simple cube is

- (a) $\frac{\pi}{3\sqrt{2}}$
- (b) $\frac{\pi}{4\sqrt{2}}$
- (c) $\frac{\pi}{4}$
- (d) $\frac{\pi}{6}$

59. 1.00 g of a non-electrolyte solute (molar mass 250 g mol^{-1}) was dissolved in 51.2 g of benzene. If the freezing point depression constant, K_f of benzene is $5.12 \text{ K kg mol}^{-1}$, the freezing point of benzene will be lowered by

- (a) 0.3 K
- (b) 0.5 K
- (c) 0.4 K
- (d) 0.2

60. The number of coulombs required for the deposition of 108 g of silver is

- (a) 96500
- (b) 48250
- (c) 193000
- (d) 10000

61. During the kinetic study of the reaction,

$2\text{A} + \text{B} \rightarrow \text{C} + \text{D}$, following results were obtained:

Run	$[\text{A}] / \text{mol L}^{-1}$	$[\text{B}] / \text{mol L}^{-1}$	Initial rate of formation of $\text{D} / \text{mol L m}^{-1} \text{ min}^{-1}$
I	0.1	0.1	6.0×10^{-1}
II	0.3	0.2	7.2×10^{-1}

III	0.3	0.4	28.8×10^{-1}
IV	0.4	0.1	24.0×10^{-1}

Based on the above data which one of the following is correct?

- (a) rate = $k[A]^2[B]$ (b) rate = $k[A][B]$
 (c) rate = $k[A]^2[B]^2$ (d) rate = $k[A][B]^2$

62. Position of non-polar and polar part in micelle is

- (a) polar at outer surface and non-polar at inner surface.
 (b) polar at inner surface and non-polar at outer surface.
 (c) distributed all over the surface.
 (d) present in the surface only.

63. For adsorption of a gas on a solid, the plot of $\log x/m$ vs $\log P$ is linear with slope equal to (n being whole number)

- (a) k (b) $\log k$
 (c) n (d) $\frac{1}{n}$

64. Calcination is used in metallurgy for removal of?

- (a) Water and sulphide (b) Water and CO_2
 (c) CO_2 and H_2S (d) H_2O and H_2S

65. Phosphine is not obtained by the reaction

- (a) White P is heated with NaOH
 (b) Red P is heated with NaOH
 (c) Ca_3P_2 reacts with water
 (d) Phosphorus trioxide is boiled with water

66. Which of the following halides is not oxidized by MnO_2

- (a) F^- (b) Cl^-
 (c) Br^- (d) I^-

67. Which of the following exhibit only +3 oxidation state?

- (a) U (b) Th
 (c) Ac (d) Pa

68. Which of the following pairs has the same size?

- (a) Fe^{2+} , Ni^{2+} (b) Zr^{4+} , Ti^{4+}
 (c) Zr^{4+} , Hf^{4+} (d) Zn^{2+} , Hf^{4+}

69. Which of the following is not considered as an organometallic compound?

- (a) cis-platin (b) Ferrocene
 (c) Zeise's salt (d) Grignard reagent

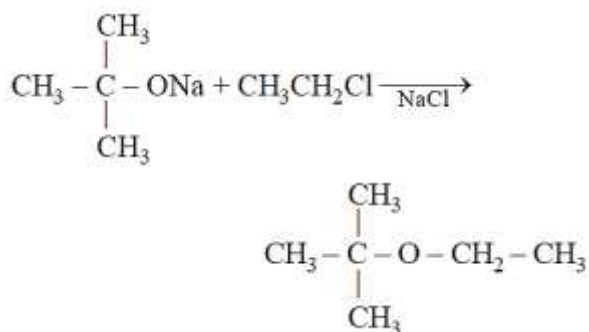
70. The most stable ion is

- (a) $[Fe(OH)_3]^{3-}$ (b) $[FeCl_6]^{3-}$
 (c) $[Fe(CN)_6]^{3-}$ (d) $[Fe(H_2O)_6]^{3+}$

71. A is an optically inactive alkyl chloride which on reaction with aqueous KOH gives B. B on heating with Cu at $300^\circ C$ gives an alkene C, what are A and C

- (a) CH_3CH_2Cl , $CH_2 = CH_2$
 (b) Me_3CCl , $MeCH = CH.Me$
 (c) Me_3CCl , $Me_2C = CH_2$
 (d) $Me_2CH.CH_2Cl$, $Me_2C = CH_2$

72. The reaction



is called:

- (a) Williamson continuous etherification process
- (b) Etard reaction
- (c) Gatterman - Koch reaction
- (d) Williamson Synthesis

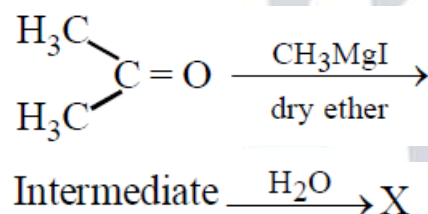
73. Which of the following esters cannot undergo Claisen self- condensation?

- (a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOC}_2\text{H}_5$
- (b) $\text{C}_6\text{H}_5 - \text{COOC}_2\text{H}_5$
- (c) $\text{C}_6\text{H}_{11}\text{CH}_2\text{COOC}_2\text{H}_5$
- (d) $\text{C}_6\text{H}_5\text{CH}_2\text{COOC}_2\text{H}_5$

74. Schotten-Baumann reaction is a reaction of phenols with

- (a) benzoyl chloride and sodium hydroxide.
- (b) acetyl chloride and sodium hydroxide.
- (c) salicylic acid and conc. H_2SO_4 .
- (d) acetyl chloride and conc H_2SO_4 .

75. Identify X,



- (a) CH_3OH
- (b) Ethyl alcohol
- (c) Methyl cyanide
- (d) tert-Butyl alcohol

76. The reagent (s) which can be used to distinguish acetophenone from benzophenone is (are)

- (a) 2,4-dinitrophenylhydrazine
- (b) aqueous solution of NaHSO_3
- (c) benedict reagent
- (d) I_2 and NaOH .

77. Aniline reacts with nitrous acid to produce

- (a) phenol
- (b) nitrobenzene
- (c) chlorobenzene
- (d) benzene diazonium chloride

78. The structural feature which distinguishes proline from natural α -amino acids?

- (a) Proline is optically inactive.
- (b) Proline contains aromatic group.

- (c) Proline is a dicarboxylic acid.
(d) Proline is a secondary amine.

79. Which of the following cannot give iodometric titration?

- (a) Fe^{3+} (b) Cu^{2+}
(c) Pb^{2+} (d) Ag^{2+}

80. Acetaldehyde and acetone can be distinguished by:

- (a) Iodoform test (b) Nitroprusside test
(c) Fehlings solution test (d) C & P test

PART-III MATHEMATICS

81. If $f(x)$ is a function that is odd and even simultaneously, then $f(3) - f(2)$ is equal to

- (a) 1 (b) -1
(c) 0 (d) None of these

82. If, $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, then find the value of $A + B$

- (a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{4}$ (d) $\frac{-\pi}{4}$

83. If $\sin \theta = -\frac{1}{2}$ and $\tan \theta = 1/\sqrt{3}$, then $\theta =$

- (a) $2n\pi + \pi/6$ (b) $2n\pi + 11\pi/6$
(c) $2n\pi + 7\pi/6$ (d) $2n\pi + \pi/4$

84. $\frac{\cos \theta}{1 - \tan \theta} + \frac{\sin \theta}{1 - \cot \theta}$ is equal to

- (a) $\sin \theta - \cos \theta$ (b) $\sin \theta + \cos \theta$
(c) $\tan \theta + \cot \theta$ (d) $\tan \theta - \cot \theta$

85. For $n \in \mathbb{N}$, $x^{n+1} + (x+1)^{2n-1}$ is divisible by

- (a) x (b) $x+1$
(c) $x^2 + x + 1$ (d) $x^2 - x + 1$

86. If α, β are the roots of the equation $ax^2 + bx + c = 0$, then the roots of the equation $ax^2 + bx(x+1) + c(x+1)^2 = 0$ are

- (a) $\alpha - 1, \beta - 1$ (b) $\alpha + 1, \beta + 1$
(c) $\frac{\alpha}{\alpha-1}, \frac{\beta}{\beta-1}$ (d) $\frac{\alpha}{1-\alpha}, \frac{\beta}{1-\beta}$

87. If $a > 0, a \in \mathbb{R}, z = a + 2i$ and $z|z| - az + 1 = 0$ then

- (a) z is always a positive real number
(b) z is always a negative real number
(c) z is purely imaginary number
(d) such a complex z does not exist

88. Which of the following is not a vertex of the positive region bounded by the inequalities $2x + 3y \leq 6, 5x + 3y \leq 15$ and $x, y \geq 0$

- (a) (0,2) (b) (0,0)
(c) (3,0) (d) None of these

89. If ${}^{20}C_r = {}^{20}C_{r-10}$ then ${}^{18}C_r$ is equal to

- (a) 4896 (b) 816
(c) 1632 (d) None of these

90. The term independent of x in the expansion of $\left(9x - \frac{1}{3\sqrt{x}}\right)^{18}$, $x > 0$, is a times the corresponding binomial coefficient. Then a is

- (a) 3 (b) $1/3$
(c) $-1/3$ (d) None of these

91. In the binomial $(2^{1/3} + 3^{-1/3})^n$, if the ratio of the seventh term from the beginning of the expansion to the seventh term from its end is $1/6$, then n equal to
 (a) 6 (b) 9
 (c) 12 (d) 15
92. If p^{th} , q^{th} and r^{th} terms of H.P. are u, v, w respectively, then find the value of the expression $(q - r)vw + (r - p)wu + (p - q)uv$.
 (a) 2 (b) 0
 (c) 4 (d) 8
93. If the sum of the first $2n$ terms of $2, 5, 8, \dots$ is equal to the sum of the first n terms of $57, 59, 61, \dots$, then n is equal to
 (a) 10 (b) 12
 (c) 11 (d) 13
94. The distance of the point $(-1, 1)$ from the line $12(x + 6) = 5(y - 2)$ is
 (a) 2 (b) 3
 (c) 4 (d) 5
95. The family of straight lines $(2a + 3b)x + (a - b)y + 2a - 4b = 0$ is concurrent at the point
 (a) $(\frac{2}{5}, \frac{-14}{5})$ (b) $(\frac{-2}{5}, \frac{-14}{5})$
 (c) $(\frac{-2}{5}, \frac{14}{5})$ (d) $(\frac{2}{5}, \frac{14}{5})$
96. The length of the latus-rectum of the parabola whose focus is $(\frac{u^2}{2g} \sin 2\alpha, -\frac{u^2}{2g} \cos 2\alpha)$ and directrix is $y = \frac{u^2}{2g}$, is
 (a) $\frac{u^2}{g} \cos^2 \alpha$ (b) $\frac{u^2}{g} \cos 2\alpha$
 (c) $\frac{2u^2}{g} \cos^2 2\alpha$ (d) $\frac{2u^2}{g} \cos^2 \alpha$
97. The equation of the ellipse with focus at $(\pm 5, 0)$ and $x = \frac{36}{5}$ as one directrix is
 (a) $\frac{x^2}{36} + \frac{y^2}{25} = 1$ (b) $\frac{x^2}{36} + \frac{y^2}{11} = 1$
 (c) $\frac{x^2}{25} + \frac{y^2}{11} = 1$ (d) None of these
98. For what value of k the circles $x^2 + y^2 + 5x + 3y + 7 = 0$ and $x^2 + y^2 - 8x + 6y + k = 0$ cuts orthogonally
 (a) 16 (b) -18
 (c) -13 (d) -10
99. If the lines $3x - 4y + 4 = 0$ and $6x - 8y - 7 = 0$ are tangents to a circle, then the radius of the circle is
 (a) $3/2$ (b) $3/4$
 (c) $1/10$ (d) $1/20$
100. Evaluate $\lim_{x \rightarrow \infty} \frac{\sqrt{1 + \sin 3x} - 1}{\ln(1 + \tan 2x)}$;
 (a) $1/2$ (b) $3/2$
 (c) $3/4$ (d) $1/4$
101. Negation of "Paris in France and London is in England" is
 (a) Paris is in England and London is in France
 (b) Paris is not in France or London is not in England
 (c) Paris is in England or London is in France
 (d) None of these
102. Find the A.M. of the first ten odd numbers.
 (a) 10 (b) 20
 (c) 15 (d) 25

103. If A and B are mutually exclusive events and if $P(B) = \frac{1}{3}$, $P(A \cup B) = \frac{13}{21}$, then $P(A)$ is equal to
 (a) $\frac{1}{7}$ (b) $\frac{4}{7}$
 (c) $\frac{2}{7}$ (d) $\frac{5}{7}$
104. A die is loaded such that the probability of throwing the number i is proportional to its reciprocal. The probability that 3 appears in a single throw is-
 (a) $\frac{3}{22}$ (b) $\frac{3}{11}$
 (c) $\frac{9}{22}$ (d) None of these
105. If $f(x) = \begin{cases} x; & \text{when } x \text{ is rational} \\ 1-x; & \text{when } x \text{ is irrational} \end{cases}$, then $f(f(x))$ is given as
 (a) 1 (b) x
 (c) $1+x$ (d) None of these
106. If $f(x) = \frac{1-x}{1+x}$ the domain of $f^{-1}(x)$ is
 (a) $\mathbb{R}$ (b) $\mathbb{R} - \{-1\}$
 (c) $(-\infty, -1)$ (d) $(-1, \infty)$
107. The value of $\sin\left(4\tan^{-1}\frac{1}{3}\right) - \cos\left(2\tan^{-1}\frac{1}{7}\right)$ is
 (a) $\frac{3}{7}$ (b) $\frac{7}{8}$
 (c) $\frac{8}{21}$ (d) None of these
108. The matrix $A^2 + 4A - 5I$, where I is identity matrix and $A = \begin{bmatrix} 1 & 2 \\ 4 & -3 \end{bmatrix}$, equals :
 (a) $4 \begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$ (b) $4 \begin{bmatrix} 0 & -1 \\ 2 & 2 \end{bmatrix}$
 (c) $32 \begin{bmatrix} 2 & 1 \\ 2 & 0 \end{bmatrix}$ (d) $32 \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$
109. If $A = \begin{bmatrix} 2 & 0 & 0 \\ 2 & 2 & 0 \\ 2 & 2 & 2 \end{bmatrix}$, then $\text{adj}(\text{adj } A)$ is equal to -
 (a) $8 \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ (b) $16 \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$
 (c) $64 \begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ (d) None of these
110. If $y = x^{x^2}$, then $\frac{dy}{dx}$ is equal to
 (a) $(2\ln x)$ (b) $(2\ln x + 1)$
 (c) $(\ln \ln x + 1)x^{x^2}$ (d) None of these
111. The function $f(x) = (x-1)\sqrt{|\ln x|}$ is at $x = 1$
 (a) discontinuous
 (b) continuous but not differentiable
 (c) differentiable with $f'(1) = 0$
 (d) differentiable with $f'(1) \neq 0$
112. The function $f(x) = \sin x - kx - c$, where k and c are constants, decreases always when
 (a) $k > 1$ (b) $k \geq 1$
 (c) $k < 1$ (d) $k \leq 1$
113. The minimum value of $f(x) = \sin^4 x + \cos^4 x$ in the interval $\left(0, \frac{\pi}{2}\right)$ is
 (a) $\frac{1}{2}$ (b) 2
 (c) $\sqrt{2}$ (d) 1

114. The curve $y - e^{xy} + x = 0$ has a vertical tangent at

- (a) (1,1) (b) (0,1)
(c) (1,0) (d) no point

115. The function $f(x) = 2x^3 - 3x^2 - 12x + 4$, has

- (a) two points of local maximum
(b) two points of local minimum
(c) one maxima and one minima
(d) nomaxima or minima

116. Evaluate $\int \frac{x^2}{x^2-1} dx$

- (a) $x - \frac{1}{2} \log \left(\frac{x-1}{x+1} \right) + c$
(b) $x + \frac{1}{2} \log \left(\frac{x+1}{x-1} \right) + c$
(c) $x + \frac{1}{2} \log \left(\frac{x-1}{x+1} \right) + c$
(d) None of these

117. Find the value of $\int_0^{4\pi} |\sin x| dx$

- (a) 8 (b) 6
(c) 4 (d) 2

118. Let $I_1 = \int_1^2 \frac{1}{\sqrt{1+x^2}} dx$ and $I_2 = \int_1^2 \frac{1}{x} dx$, then

- (a) $I_1 > I_2$ (b) $I_2 > I_1$
(c) $I_1 = I_2$ (d) None of these

119. What is the area bounded by $y = \tan x$, $y = 0$ and $x = \frac{\pi}{4}$?

- (a) $\ln 2$ sq. units (b) $\frac{\ln 2}{2}$ sq. units
(c) $2 \ln 2$ sq. units (d) None of these

120. The degree of the differential equation $\left(\frac{d^3 y}{dx^3} \right)^{2/3} + 4 - 3 \frac{d^2 y}{dx^2} + 5 \frac{dy}{dx} = 0$ is

- (a) 1 (b) 2
(c) 3 (d) None of these

121. Two vectors $\vec{A}$ and $\vec{B}$ are such that $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$. The angle between the two vectors will be-

- (a) 60° (b) 90°
(c) 180° (d) 0°

122. Gives the line $L: \frac{x-1}{3} = \frac{y+1}{2} = \frac{z-3}{-1}$ and the plane $\pi: x - 2y - z = 0$. Of the following assertions, the only one that is always true is

- (a) L is $\perp$ to π (b) L lies in π
(c) L is not parallel to π (d) None of these

123. A ladder rests against a wall so that its top touches the roof of the house. If the ladder makes an angle of 60° with the horizontal and height of the house be $6\sqrt{3}$ meters, then the length of the ladder in meters is

- (a) $12\sqrt{3}$ (b) 12
(c) $12/\sqrt{3}$ (d) None of these

124. In an equilateral triangle, the in radius, circumradius and one of the ex-radii are in the ratio

- (a) 2:3:5 (b) 1:2:3
(c) 3:7:9 (d) 3:7:8

125. For the constraints of a L.P. Problem given by $x_1 + 2x_2 \leq 2000$, $x_1 + x_2 \leq 1500$ and $x_2 \leq 600$ and $x_1, x_2 \geq 0$, which one of the following points does not lie in the positive bounded region

- (a) (1000,0) (b) (0,500)
(c) (2,0) (d) (2000,0)

PART-IV: ENGLISH

DIRECTIONS (126 & 127): In the following questions, two sentences are given. There may be an error in the sentence(s). Mark as your correct answer.

126. Although he was innocent, baseless accusations were leveled at him.

II. Despite of repeated representations from the people, the authorities have failed to take any action.

- (a) if there is an error only in the first sentence;
- (b) if there is an error only in the second sentence;
- (c) if there are errors in both sentences; and
- (d) if there is no error in either of the sentences.

127. I. I deem it as a privilege to address the gathering.

II. Perfection can be achieved with practice.

- (a) if there is an error only in the first sentence;
- (b) if there is an error only in the second sentence;
- (c) if there are errors in both sentences; and
- (d) if there is no error in either of the sentences.

DIRECTIONS (Qs. 128 - 130): For each of the following questions, select the option which is CLOSEST in meaning to the capitalized word.

128. TURBULENCE

- (a) Treachery
- (b) Triumph
- (c) Commotion
- (d) Overflow

129. DEFER

- (a) Discourage
- (b) Minimize
- (c) Postpone
- (d) Estimate

130. ADAGE

- (a) Proverb
- (b) Youth
- (c) Supplement
- (d) Hardness

DIRECTIONS (Qs. 131 - 133): Choose the word, which is most OPPOSITE in meaning as the word given in bold.

131. FRAGRANCE

- (a) Aroma
- (b) Perfume
- (c) Smell
- (d) Stink

132. PECULIAR

- (a) Characteristic
- (b) Special
- (c) Specific
- (d) Universal

133. ETERNAL

- (a) Momentary
- (b) Continual
- (c) Everlasting
- (d) Endless

DIRECTIONS (Qs. 134 & 135): Pick out the most effective word from the given words to fill in the blanks to make the sentence meaningfully complete in the contest of the sentence.

134. _____ to popular belief that red meat makes human aggressive, scientist have found that it actually has a calming effect.

- (a) Sticking
- (b) Similarly
- (c) Opposite
- (d) Contrary

135. From its _____ opening sequence, it is clear that we are in the grip of a delicious new voice, a voice of breathtaking.

- (a) Imagination (b) Evocative
(c) Mesmerizing (d) Resonance

DIRECTIONS (Qs. 136-140): In the following passages, the first and the last parts of the sentence are numbered 1 and 6. The rest of the sentence is split into four parts and named, P, Q, R and S. These four parts are not given in their proper order. Read the parts and find out which of the four combinations is correct. Then find the correct answer.

136. 1. making ourselves

P. our language

Q. part of growing into

R Masters of

S. is an important

6. full manhood or womanhood

(a) PSRQ (b) SQPR

(c) RPSQ (d) PRSQ

137. (1) The very first battle they fought

(P) and they had to fall back

(Q) cross the border

(R) was lost

(S) letting the enemy

(6) an enter the country

(a) RQSP (b) RPSQ

(c) QRPS (d) QPRS

138. (1) A nation

(P) the material assets it possesses

(Q) is not made by

(R)and collective determination

(S) but by the will

(6) of the people

(a) PQRS (b) OPSR

(c) RSPQ (d) SRPQ

139. (1) When the Governor

(P) the bell had rung

(Q) justice should be immediately

(R) he ordered that

(S) found out why

(6) done to the horse

(a) RSPQ (b) PQSR

(c) SPRQ (d) SQRP

140. (1) When you ponder over

(P) that the only hope

(Q) you will realize

(R) of world peace lies

(S) the question deeply

(6) in the United Nations

- (a) QRSP (b) SPQR
(c) SQPR (d) RSPQ

DIRECTION (Q. 141& 142): In the following question, a series is given with one term missing. Choose the correct alternative from the given ones that will complete the series:

141. One of the, numbers does not fit into the series. Find the wrong number.

15, 20, 45, 145, 565, 2830

- (a) 20 (b) 45
(c) 145 (d) 565

142. VWX, BCD, HIJ, ?

- (a) NOQ (b) NOP
(c) MNO (d) OPQ

143. In a code language, if TARGET is coded as 201187520, then the word WILLIUM will be coded as

- (a) 239121292113 (b) 239121291213
(c) 239122191213 (d) 239121292213

144. Sanjay is taller than Suresh but shorter than Rakesh. Rakesh is taller than Harish but shorter than Binit. Who among is the tallest?

- (a) Suresh (b) Sanjay
(c) Binit (d) Rakesh

145. In a row of 62 persons. Rahul is 36th from left side of the row and Nitesh is 29th from the right side of the row. Find out the number of persons sitting between them?

- (a) 1 (b) 2
(c) 3 (d) 4

146. The missing number in the given figure is



- (a) 13 (b) 15
(c) 17 (d) 19

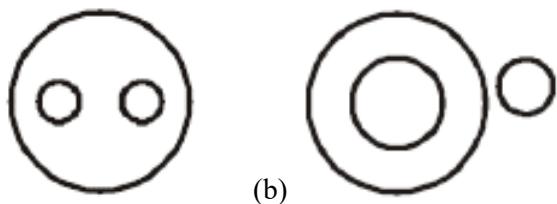
147. Select the combination of number so that the letters arranged will form a meaningful word.

H N R C A B
1 2 3 4 5 6

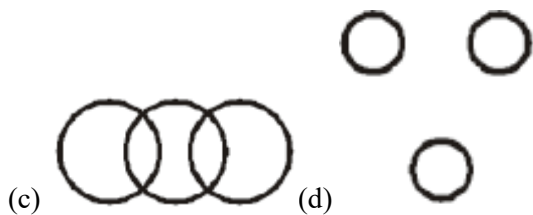
- (a) 2,5,3,4,1,6 (b) 3,5,6,4,1,2
(c) 4,1,5,6,2,3 (d) 6,3,5,2,4,1

148. Which of the given Venn diagrams out of (a), (b), (c) or (d) correctly represents the relationship among the following classes?

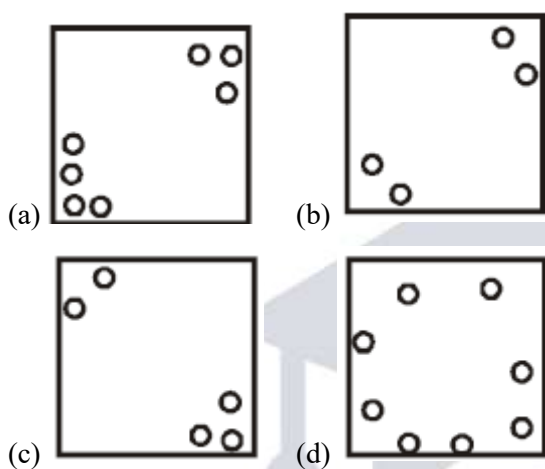
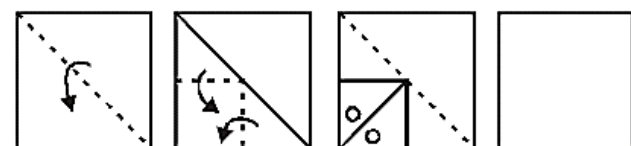
Rose, Flower, Lotus



- (a) (b)



149. A piece of paper is folded and a cut is made as shown below. From the given responses indicate how it will appear when opened?



150. Which answer figure will complete the question figure?
Question figure

