

**PREVIOUS PAPERS SOLVED**

# UGC-CSIR

**PAPER - I (Section B)**

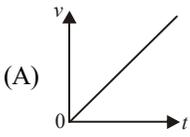
**ACCORDING TO NEW PATTERN**

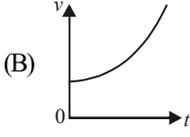
# Chemical Sciences

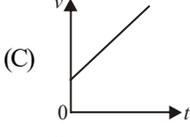
## Solved Paper

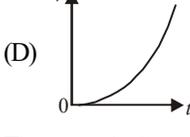
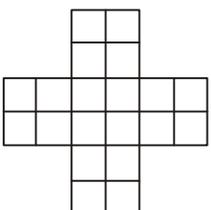
# CSIR JRF (NET) CHEMICAL SCIENCES, DECEMBER 2015

### PART-'A'

1. A shopkeeper purchases a product for ₹100 and sells it making a profit 10%. The customer resells it to the same shopkeeper incurring a loss of 10%. In these dealings the shopkeeper makes—  
 (A) no profit, no loss (B) ₹ 11  
 (C) ₹ 1 (D) ₹ 20
2. A vessel is partially filled with water. More water is added to it at a rate directly proportional to time  $\left[ \text{i.e., } \frac{dv}{dt} \propto t \right]$ . Which of the following graphs depicts correctly the variation of total volume  $V$  of water with time  $t$ ?
- (A) 

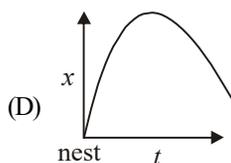
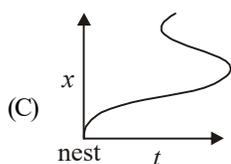
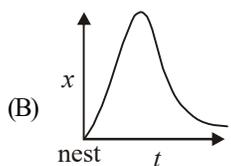
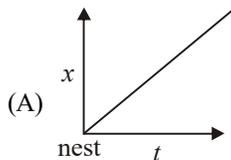
(B) 

(C) 

(D) 
3. The triangle formed by the lines  $y = x$ ,  $y = 1 - x$  and  $x = 0$  in a two dimensional plane is ( $x$  and  $y$  axes have the same scale )  
 (A) isosceles and right-angled  
 (B) isosceles but not right-angled  
 (C) right-angled but not isosceles  
 (D) neither isosceles nor right-angled
4. **Statement A** : The following statement is true.  
**Statement B** : The preceding statement is false.  
 (A) Statement A and B are always true  
 (B) Statement A and B can be true if there is at least one statement between A and B  
 (C) Statements A and B can be true if there are at least two statements between A and B  
 (D) Statements A and B can never be true, independently
5. 
- The number of squares in the above figure is  
 (A) 30  
 (B) 29  
 (C) 25  
 (D) 20
6. A person walks downhill at 10 km/h, uphill at 6 km/h and on the plane at 7.5 km/h. If the person takes 3 hours to go from a place A to another place B, and 1 hour on the way back, the distance between A and B is  
 (A) 15 km  
 (B) 23.5 km  
 (C) 16 km  
 (D) Given data is insufficient to calculate the distance

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7. A bird leaves its nest and flies away. Its distance  $x$  from the nest is plotted as a function of time  $t$ . Which of the following plots cannot be right ?



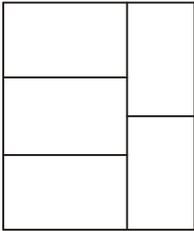
8. A car is moving at 60 km/h. The instantaneous velocity of the upper most points of its wheels is—  
 (A) 60 km/h forward  
 (B) 120 km/h forward  
 (C) 60 km/h backward  
 (D) 120 km/h backward
9. A living cell has a protoplasm which is water based and demarcated by a lipid bilayer membrane. If a cell is pierced up to  $\frac{1}{5}$  th of its diameter with a very sharp needle, after taking the needle out—  
 (A) no effect will be observed  
 (B) protoplasm will leak out from the hole made by the needle for a few minutes until the cell heals the wound  
 (C) protoplasm will keep on leaking out till the cell is dead  
 (D) the cell will burst like a balloon

10. If  $D + I + M = 1501$   
 $C + I + V + I + L = 157$   
 $L + I + V + I + D = 557$   
 $C + I + I + C = 207$

What is  $V + I + M$  ?

- (A) Cannot be found (B) 1009  
 (C) 1006 (D) 509
11. Density of a rice grain is 1.5 g/cc and bulk density of rice heap is 0.80 g/cc. If a 1 litre container is completely filled with rice, what will be the approximate volume of pore space in the container ?  
 (A) 350 cc (B) 465 cc  
 (C) 550 cc (D) 665 cc
12. Four circles of unit radius each are drawn such that each one touches two others and their centres lie on the vertices of a square. The area of the region enclosed between the circles is—  
 (A)  $\pi - 1$  (B)  $\pi - 2$   
 (C)  $3 - \pi$  (D)  $4 - \pi$
13. A turtle starts swimming from a point A located on the circumference of a circular pond. After swimming for 4 meters in a straight line it hits point B on the circumference and swims for 3 meters in a straight line and arrives at point D diametrically opposite to point A. How far is point D from A ?  
 (A) 3m (B) 4m  
 (C) 7m (D) 5m
14. A film projector and microscope give equal magnification. But a film projector is not used to see living cells because—  
 (A) a living cell cannot be placed in a film projector  
 (B) the viewer's eye is close to a microscope whereas it is far away from the projector's screen  
 (C) a microscope produces a virtual image whereas a projector produces a real image  
 (D) a microscope produces has greater resolving power than a projector
15. In each of the following groups of words is a hidden number, based on which you should arrange them in descending order. Pick the correct answer—

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- (E) Papers I Xeroxed (F) Wi-Fi veteran  
(G) Yourself ourselves (H) Breaks even  
(A) H, F, G, H (B) E, G, F, H  
(C) H, F, G, E (D) H, E, F, G
16. Five congruent rectangles are drawn inside a big rectangle of perimeter 165 as shown. What is the perimeter of one of the five rectangles ?
- 
- (A) 37 (B) 75  
(C) 15 (D) 165
17. At one instant, the hour hand and the minute hand of a clock are one over the other in between the markings for 5 and 6 on the dial. At this instant, the tip of the minute hand—  
(A) is closer to the marking for 6  
(B) is equidistant from the markings for 5 and 6  
(C) is closer to marking for 5  
(D) is equidistant from the markings for 11 and 12
18. A cubical cardboard box made of 1 cm thick cardboard has outer side of 29 cm. A tight-fitting cubical box of the same thickness is placed inside it, then another one inside it and so on. How many cubical boxes will be there in the entire set?  
(A) 29  
(B) 28  
(C) 15  
(D) 14
19. There are two buckets A and B. Initially A has 2 litres of water and B is empty. At every hour 1 litre of water is transferred from A to B following by returning  $\frac{1}{2}$  litre back to A from B half an hour later. The earliest A will get empty is in—  
(A) 5 h (B) 4 h  
(C) 3 h (D) 2 h
20. Secondary colours are made by a mixture of three primary colours, Red, Green and Blue, in different proportions; each of the primary colours comes in 8 possible levels. Grey corresponds to equal proportions of Red, Green and Blue. How many shades of grey exist in this scheme ?  
(A)  $8^3$  (B) 8  
(C)  $3^8$  (D)  $8 \times 3$

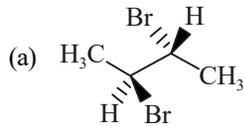


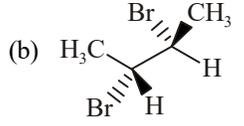
## PART-'B'

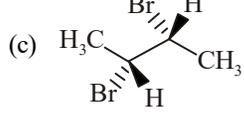


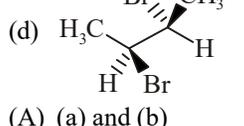
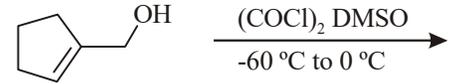
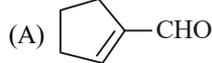
21. The biological functions of cytochrome  $P_{450}$  and myoglobin are, respectively—  
(A) oxidation of alkene and  $O_2$  storage  
(B)  $O_2$  transport and  $O_2$  storage  
(C)  $O_2$  storage and electron carrier  
(D) electron carrier and  $O_2$  transport
22. Deoxy-hemocyanin is—  
(A) heme protein and paramagnetic  
(B) colorless and diamagnetic  
(C)  $O_2$  transporter and paramagnetic  
(D) blue colored and diamagnetic
23. The oxidizing power of  $[CrO_4]^{2-}$ ,  $[MnO_4]^{2-}$  and  $[FeO_4]^{2-}$  follows the order—  
(A)  $[CrO_4]^{2-} < [MnO_4]^{2-} < [FeO_4]^{2-}$   
(B)  $[FeO_4]^{2-} < [MnO_4]^{2-} < [CrO_4]^{2-}$   
(C)  $[MnO_4]^{2-} < [FeO_4]^{2-} < [CrO_4]^{2-}$   
(D)  $[CrO_4]^{2-} < [FeO_4]^{2-} < [MnO_4]^{2-}$
24. Using crystal field theory, identify from the following complex ions that shows same  $\mu_{\text{eff}}$  (spin only) values—  
(A)  $[CoF_6]^{3-}$ , (B)  $[IrCl_6]^{3-}$ , (C)  $[Fe(H_2O)_6]^{2+}$ ,  
(A) A and B (B) B and C  
(C) A and C (D) A, B, and C
25. The W-W bond order in  $[W(\eta^5-C_5H_5)(\mu-Cl)(CO)_2]_2$  is—  
(A) three (B) two  
(C) one (D) zero
26. The correct statement for Mn-O bond lengths in  $[Mn(H_2O)_6]^{2+}$  is—  
(A) All bonds are equal  
(B) Four bonds are longer than two others  
(C) Two bonds are longer than four others  
(D) They are shorter than the Mn-O bond in  $[MnO_4]^-$

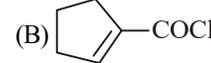
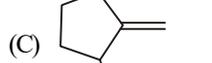
## 4 Chemical Sciences

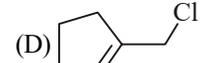
27. For the reaction of  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)(\text{CH}_3)(\text{CO})_2]$  with  $\text{PMe}_3$ , the main intermediate is—  
 (A)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)(\text{CH}_3)(\text{CO})_2(\text{PMe}_3)]$   
 (B)  $[\text{Fe}(\eta^5\text{-C}_5\text{H}_5)(\text{COCH}_3)(\text{CO})]$   
 (C)  $[\text{Fe}(\eta^3\text{-C}_5\text{H}_5)(\text{CH}_3)(\text{CO})_2]$   
 (D)  $[\text{Fe}(\eta^3\text{-C}_5\text{H}_5)(\text{COCH}_3)(\text{CO})(\text{PMe}_3)]$
28. Identify the complex ions in sequential order when ferroin is used as an indicator in the titration of iron(II) with potassium dichromate. (phen = 1,10-phenanthroline)—  
 (A)  $[\text{Fe}(\text{phen})_3]^{2+}$  and  $[\text{Fe}(\text{phen})_3]^{3+}$   
 (B)  $[\text{Fe}(\text{phen})_3]^{3+}$  and  $[\text{Fe}(\text{phen})_3]^{2+}$   
 (C)  $[\text{Fe}(\text{CN})_6]^{4-}$  and  $[\text{Fe}(\text{CN})_6]^{3-}$   
 (D)  $[\text{Fe}(\text{CN})_6]^{3-}$  and  $[\text{Fe}(\text{CN})_6]^{4-}$
29. The structures of  $\text{XeF}_2$  and  $\text{XeO}_2\text{F}_2$  respectively are—  
 (A) bent, tetrahedral  
 (B) linear, square planar  
 (C) linear, see-saw  
 (D) bent, see-saw
30. Spin motion of which of the following gives magnetic moment—  
 (a) Electron;  
 (b) Proton;  
 (c) Neutron  
 Correct answer is  
 (A) (a) and (b) (B) (b) and (c)  
 (C) (a) and (c) (D) (a), (b) and (c)
31. Correct statement for coulometry is—  
 (A) it is based on Faraday's law of electrolysis  
 (B) it is a type of voltammetry  
 (C) it is based on Ohm's law  
 (D) it uses ion selective electrode
32. The order of increasing Brønsted acidity for boron hydrides is—  
 (A)  $\text{B}_5\text{H}_9 < \text{B}_6\text{H}_{10} < \text{B}_{10}\text{H}_{14}$   
 (B)  $\text{B}_{10}\text{H}_{14} < \text{B}_5\text{H}_9 < \text{B}_6\text{H}_{10}$   
 (C)  $\text{B}_6\text{H}_{10} < \text{B}_{10}\text{H}_{14} < \text{B}_5\text{H}_9$   
 (D)  $\text{B}_{10}\text{H}_{14} < \text{B}_6\text{H}_{10} < \text{B}_5\text{H}_9$
33. Among the following, species expected to show fluxional behaviour are—  
 (a)  $[\text{NiCl}_4]^{2-}$  (tetrahedral),  
 (b)  $\text{IF}_7$  (pentagonal bipyramidal),  
 (c)  $[\text{CoF}_6]^{3-}$  (octahedral),  
 (d)  $\text{Fe}(\text{CO})_5$  (trigonal bipyramidal)  
 (A) (b) and (c) (B) (b) and (d)  
 (C) (c) and (d) (D) (a) and (d)
34. The ring size and the number of linked tetrahedra present in  $[\text{Si}_6\text{O}_{18}]^{12-}$  are, respectively,—  
 (A) 6 and 6 (B) 12 and 6  
 (C) 12 and 12 (D) 6 and 12
35. The molecule  $\text{C}_3\text{O}_2$  has a linear structure. This compound has—  
 (A) 4  $\sigma$  and 4  $\pi$  bonds  
 (B) 3  $\sigma$  and 2  $\pi$  bonds  
 (C) 2  $\sigma$  and 3  $\pi$  bonds  
 (D) 3  $\sigma$  and 4  $\pi$  bonds
36. The metallic radii are abnormally high for which of the following pairs?  
 (A) Eu, Yb (B) Sm, Tm  
 (C) Gd, Lu (D) Nd, Ho
37. Identify two enantiomers among the following compounds.
- (a) 

(b) 

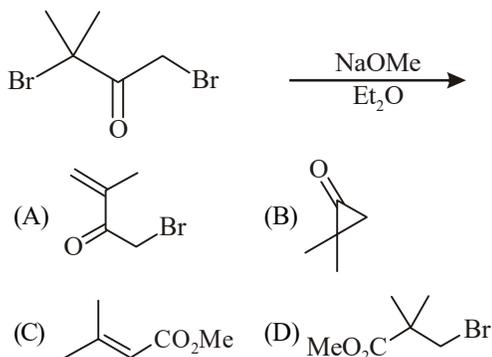
(c) 

(d) 
- (A) (a) and (b) (B) (a) and (c)  
 (C) (b) and (d) (D) (c) and (d)
38. The major product formed in the following reaction is—
- 
- (A) 

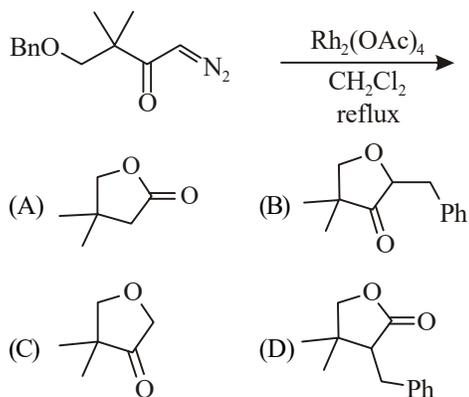
(B) 
- (C) 

(D) 

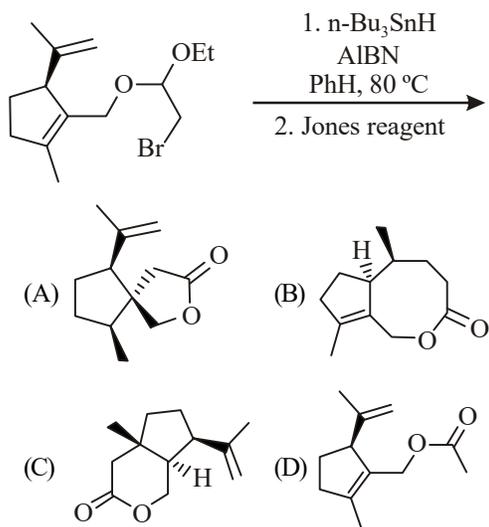
39. The major product formed in the following reaction is—



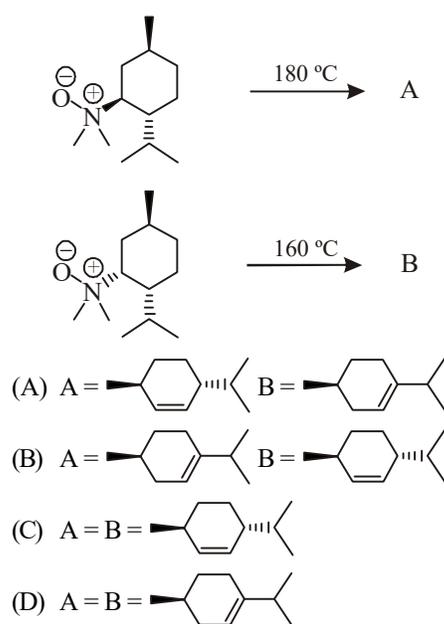
40. The major product formed in the following reaction is—



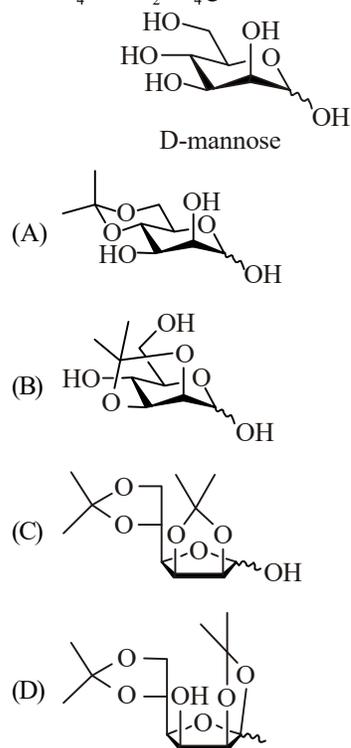
41. The major product formed in the following reaction is—



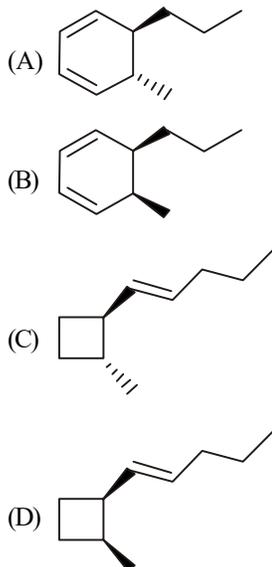
42. The major products A and B in the following reactions are—



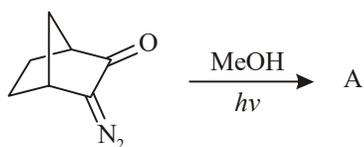
43. D-Mannose upon refluxing in acetone with  $\text{CuSO}_4$  and  $\text{H}_2\text{SO}_4$  gives—

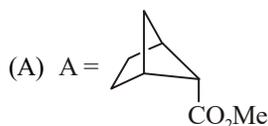
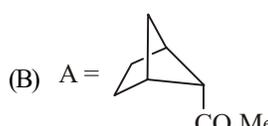
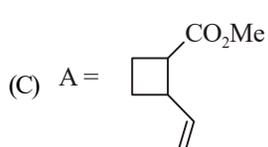
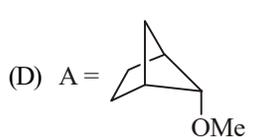


44. The major product formed by photochemical reaction of (2E,4Z,6E)-decatriene is—



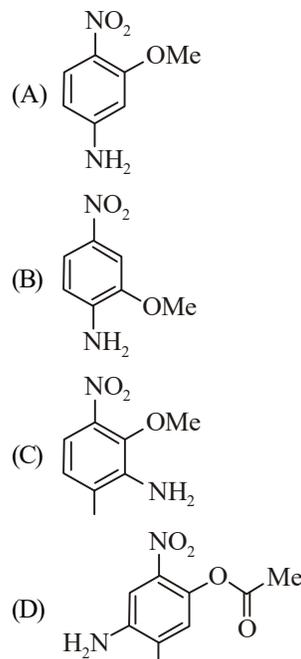
45. The correct statement about the following reaction is that—



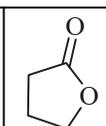
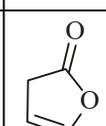
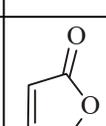
- (A) A =  and the reaction proceeds through carbene intermediate
- (B) A =  and the reaction proceeds through nitrene intermediate
- (C) A =  and the reaction proceeds through Norrish type II path
- (D) A =  and the reaction proceeds through Norrish type II path

46. The structure of the compound that matches the  $^1\text{H NMR}$  data given below is—

$^1\text{H NMR}$  ( $\text{DMSO-d}_6$ ):  $\delta$  7.75 (dd,  $J=8.8, 2.4$  Hz, 1H), 7.58 (d,  $J=2.4$  Hz, 1H), 6.70 (d,  $J=8.8$  Hz, 1H), 6.50 (broad s, 2H), 3.80 (s, 3H).



47. Correctly matched structure and carbonyl stretching frequency set is—

Column A		Column B	
P.		X.	$1750\text{ cm}^{-1}$
Q.		Y.	$1770\text{ cm}^{-1}$
R.		Z.	$1800\text{ cm}^{-1}$

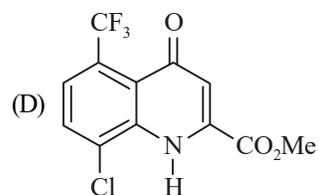
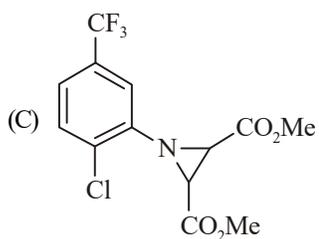
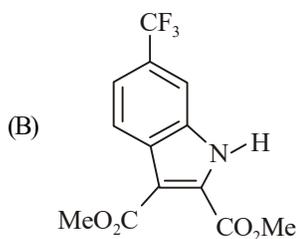
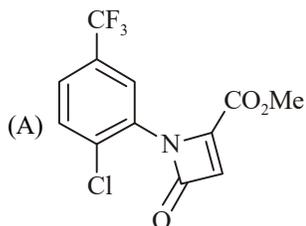
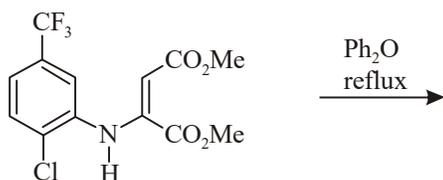
- (A) P-Y, Q-Z, R-X (B) P-Y, Q-X, R-Z  
(C) P-Z, Q-Y, R-X (D) P-X, Q-Z, R-Y

48. The number of chemical shift **non-equivalent** protons expected in  $^1\text{H}$  NMR spectrum of  $\alpha$ -pinene is—

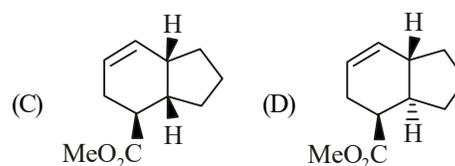
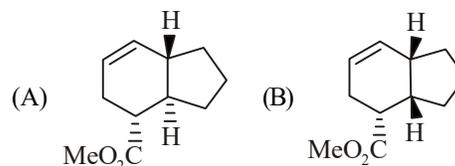
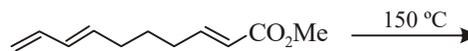


$\alpha$ -pinene

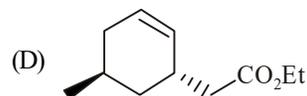
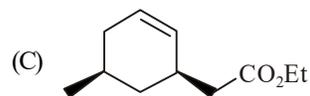
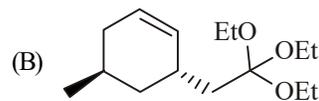
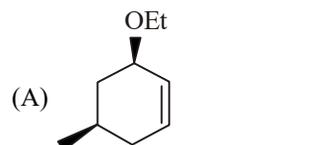
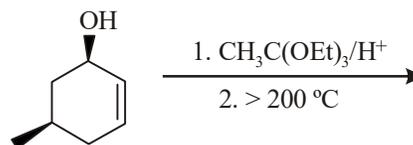
- (A) 7 (B) 8  
(C) 9 (D) 10
49. In the mass spectrum of 1,2-dichloroethane, approximate ratio of peaks at  $m/z$  values 98, 100, 102 will be—
- (A) 3:1:1 (B) 9:6:1  
(C) 1:1:2 (D) 1:2:1
50. The major product formed in the following reaction is—



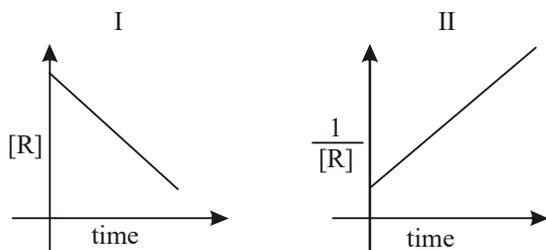
51. The major product formed in the following reaction is—



52. The major product formed in the following reaction is—



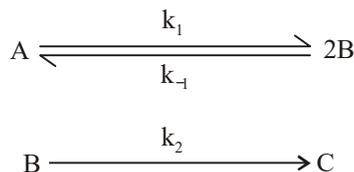
53. The concentration of a reactant R varies with time for two different reactant as shown in the following plots:



The orders of these two reactions I and II, respectively, are

- (A) zero and one (B) one and zero  
(C) zero and two (D) two and zero
54. For a simple cubic crystal lattice, the angle between the [2 0 1] plane and the  $xy$  plane is—  
(A) less than  $30^\circ$   
(B) between  $30^\circ$  and  $45^\circ$   
(C) between  $45^\circ$  and  $60^\circ$   
(D) greater than  $60^\circ$

55. For the following reaction,



is given by—

- (A)  $k_1[A] - k_{-1}[B]^2 - 2k_2[B]$   
(B)  $2k_1[A] - 2k_{-1}[B]^2 - 2k_2[B]$   
(C)  $\frac{1}{2}k_1[A] - \frac{1}{2}k_{-1}[B]^2 - 2k_2[B]$   
(D)  $2k_1[A] - 2k_{-1}[B]^{1/2} - 2k_2[B]$
56. If the reduced mass of a diatomic molecule is doubled without changing its force constant, the vibrational frequency of the molecule will be—  
(A)  $\sqrt{2}$  times the original frequency  
(B)  $\frac{1}{\sqrt{2}}$  times the original frequency  
(C) twice the original frequency  
(D) unchanged

57. The standard deviation of speed ( $\sigma_c$ ) for Maxwell's distribution satisfies the relation—

- (A)  $\sigma_c \propto T$  (B)  $\sigma_c \propto \sqrt{T}$   
(C)  $\sigma_c \propto 1/T$  (D)  $\sigma_c \propto 1/\sqrt{T}$

58. The value of  $\Delta U - \Delta H$  for the reaction  $\text{Fe}_2\text{O}_3(\text{S}) + 3\text{C}(\text{s}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}(\text{g})$  is—

- (A)  $-3RT$  (B)  $+3RT$   
(C)  $+RT$  (D)  $-RT$

59. If the pressure  $p$  (system) is greater than the  $p$  (surroundings), then—

- (A) work is done on the system by the surroundings  
(B) work is done on the surroundings by the system  
(C) work done on the system by the surroundings is equal to the work done on the surroundings by the system  
(D) internal energy of the system increases

60. Two different non-zero operators  $\hat{A}$  and  $\hat{B}$  ( $\hat{A} \neq \hat{B}$ ) satisfy the relation  $(\hat{A} + \hat{B})$

$$(\hat{A} - \hat{B}) = \hat{A}^2 - \hat{B}^2, \text{ when—}$$

- (A)  $\hat{A}\hat{B} = \hat{A}^2$  and  $\hat{A}\hat{B} = \hat{B}^2$   
(B)  $\hat{A}\hat{B} + \hat{B}\hat{A} = 0$   
(C)  $\hat{A}$  and  $\hat{B}$  are arbitrary  
(D)  $\hat{A}\hat{B} - \hat{B}\hat{A} = 0$

61. The degeneracy of an excited state of a particle in 3-dimensional cubic box with energy 3 times its ground state energy is—

- (A) 3 (B) 2  
(C) 1 (D) 4

62.  $\Delta H$  of a reaction is equal to slope of the plot of—

- (A)  $\Delta G$  versus  $(1/R)$   
(B)  $\Delta G$  versus  $T$   
(C)  $\Delta G/T$  versus  $T$   
(D)  $(\Delta G/T)$  versus  $(1/T)$

63. The correct form for a simple Langmuir isotherm is—

- (A)  $\theta = Kp$   
(B)  $\theta = (Kp)^{1/2}$   
(C)  $\theta = Kp/(1 + Kp)$   
(D)  $\theta = (1 + Kp)/Kp$

64. In Kohlrausch law

$$\Lambda_m = \Lambda_m^\circ - \mathcal{K}\sqrt{c}, \Lambda_m^\circ \text{ and } \mathcal{K} \text{ ****}$$

- (A) depend only on stoichiometry  
 (B) depend only on specific identity of the electrolyte  
 (C) are independent of specific identity of the electrolyte  
 (D) are mainly dependent on specific identity of the electrolyte and stoichiometry, respectively

65. The correct expression for the product

$(\bar{M}_n) \cdot (\bar{M}_w)$  [ $\bar{M}_n$  and  $\bar{M}_w$  are the number-average and weight average molar masses, respectively, of a polymer] is—

- (A)  $N^{-1} \sum_i N_i M_i$   
 (B)  $N^{-1} \sum_i N_i M_i^2$   
 (C)  $N / \sum N_i M_i$   
 (D)  $N / \sum N_i M_i^2$

66. The concentration of a  $\text{MgSO}_4$  solution having the same ionic strength as that of a 0.1M  $\text{Na}_2\text{SO}_4$  solution is—

- (A) 0.05 M  
 (B) 0.067 M  
 (C) 0.075 M  
 (D) 0.133 M

67. hybrid orbitals are of the form  $C_1 2s + C_2 p_z$  ( $2s$  and  $2p_z$  are normalised individually). The coefficients of the orma- lized form of the above  $sp$  hybrid orbitals are—

- (A)  $C_1 = \frac{1}{\sqrt{2}}, C_2 = \pm \frac{1}{\sqrt{2}}$   
 (B)  $C_1 = \frac{1}{2}, C_2 = \pm \frac{1}{2}$   
 (C)  $C_1 = \frac{1}{\sqrt{2}}, C_2 = \pm \frac{1}{2}$   
 (D)  $C_1 = \frac{1}{2}, C_2 = \pm \frac{1}{\sqrt{2}}$

68. The correct statement among the following is—

- (A)  $\text{N}_2$  has higher bond order than  $\text{N}_2^+$  and hence has larger bond length compared to  $\text{N}_2^+$   
 (B)  $\text{N}_2^+$  has higher bond order than  $\text{N}_2$  and hence has larger bond length compared to  $\text{N}_2$   
 (C)  $\text{N}_2$  has higher bond order than  $\text{N}_2^+$  and hence has higher dissociation energy compared to  $\text{N}_2^+$   
 (D)  $\text{N}_2$  has lower bond order than  $\text{N}_2^+$  and hence has lower dissociation energy compared to  $\text{N}_2^+$

69. The formation constant for the complexation of  $\text{M}^+$  ( $\text{M} = \text{Li}, \text{Na}, \text{K}$  and  $\text{Cs}$ ) with cryptand, C222 follows the order—

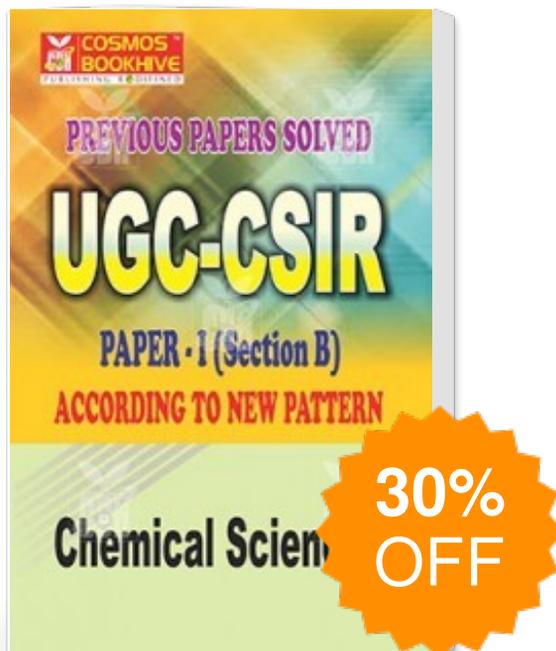
- (A)  $\text{Li}^+ < \text{Cs}^+ < \text{Na}^+ < \text{K}^+$   
 (B)  $\text{Li}^+ < \text{Na}^+ < \text{K}^+ < \text{Cs}^+$   
 (C)  $\text{K}^+ < \text{Cs}^+ < \text{Li}^+ < \text{Na}^+$   
 (D)  $\text{Cs}^+ < \text{K}^+ < \text{Li}^+ < \text{Na}^+$

70. The correct match for compounds in column A with the description in column B is—

	Column A	Column B
P.		X. Oil of Wintergreen
Q.		Y. Aspirin
R.		Z. Ibuprofen

- (A) P-Y, Q-Z, R-X  
 (B) P-Z, Q-X, R-Y  
 (C) P-Z, Q-Y, R-X  
 (D) P-X, Q-Z, R-Y

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