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Prelims Paper II (Chemistry)

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**Combined Geo-Scientist (P) Examination 2020**  
**Paper-II (Chemistry)**

1.

Consider the following statements regarding radial and total angular function of H-atom:

1. The radial function  $R(r)$  depends on the quantum number  $n$  and  $l$
2. The total angular function depends only on the direction and is independent of the distance from the nucleus ( $r$ )

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

2.

Which one of the following is the correct electronic configuration of gold (ground state)?

- (a)  $[\text{Xe}] 6s^2 4f^{14} 5d^9$
- (b)  $[\text{Xe}] 6s^1 4f^{14} 5d^{10}$
- (c)  $[\text{Xe}] 6s^2 4f^{13} 5d^{10}$
- (d)  $[\text{Xe}] 6s^2 4f^{14} 5d^{10}$

3.

Which one of the following is the correct order of increasing acidic nature of oxides?

- (a)  $\text{SiO}_2 < \text{Al}_2\text{O}_3 < \text{SO}_3 < \text{Cl}_2\text{O}_7$
- (b)  $\text{SiO}_2 < \text{SO}_3 < \text{Al}_2\text{O}_3 < \text{Cl}_2\text{O}_7$
- (c)  $\text{Al}_2\text{O}_3 < \text{SiO}_2 < \text{SO}_3 < \text{Cl}_2\text{O}_7$
- (d)  $\text{Cl}_2\text{O}_7 < \text{SiO}_2 < \text{SO}_3 < \text{Al}_2\text{O}_3$

4.

Which one of the following is the correct outermost electronic configuration of representative elements?

- (a)  $(n-1)d^{1-10} ns^{0-2}$
- (b)  $ns^{1-2} \text{ to } ns^2 np^{1-6}$
- (c)  $(n-2)f^{1-14} (n-1)d^{0-1} ns^2$
- (d)  $ns^0$

5.

The name of the element given by IUPAC with atomic number 118 is:

- (a) Nihonium
- (b) Moscovium
- (c) Oganesson
- (d) Tennessine

6.

Which one of the following statements regarding actinoid metals is NOT correct?

- (a) The actinoid metals are usually silvery in appearance
- (b) Ionization enthalpies of the early actinoids are higher than that of the early lanthanoids
- (c) The actinoids are highly reactive metals
- (d) The actinoid metals in general show +3 oxidation state

7.

Which one of the following is the correct order of ionic radius?

- (a)  $\text{F}^- > \text{O}^{2-} > \text{Na}^+$
- (b)  $\text{Na}^+ > \text{F}^- > \text{O}^{2-}$
- (c)  $\text{H}^- > \text{H} > \text{H}^+$
- (d)  $\text{Al}^{3+} > \text{Mg}^{2+} > \text{N}^{3-}$

8.

Which one among the following elements has the highest second ionization potential?

- (a) B
- (b) Be
- (c) Mg
- (d) Al

9.

Consider the following statements regarding magnetism of two complexes:

1.  $[\text{CoF}_6]^{3-}$  is a paramagnetic and high spin complex
2.  $[\text{Co}(\text{NH}_3)_6]^{3+}$  is a diamagnetic and low spin complex

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

10.

Consider the following statements in respect of alkali metal halides:

1. The low solubility of LiF in water is due to its high lattice enthalpy
2. The low solubility of CsI in water is due to smaller hydration enthalpy of its two ions

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only
- (c) Both 1 and 2
- (d) Neither 1 nor 2

11.

When the radius ratio in an ionic crystal lies between 0.732 – 0.999, the coordination number will be:

- (a) 3
- (b) 4
- (c) 6
- (d) 8

12.

Which one of the following is the correct order of thermal stabilities of metal carbonates?

- (a)  $\text{BaCO}_3 > \text{CaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$
- (b)  $\text{BaCO}_3 > \text{MgCO}_3 > \text{CaCO}_3 > \text{BeCO}_3$
- (c)  $\text{CaCO}_3 > \text{BaCO}_3 > \text{MgCO}_3 > \text{BeCO}_3$
- (d)  $\text{BaCO}_3 > \text{BeCO}_3 > \text{MgCO}_3 > \text{CaCO}_3$

13.

Which one of the following is the correct order of increasing covalent character of halides of  $\text{Al}^{3+}$ ?

- (a)  $\text{AlF}_3 < \text{AlCl}_3 < \text{AlBr}_3 < \text{AlI}_3$
- (b)  $\text{AlI}_3 < \text{AlBr}_3 < \text{AlCl}_3 < \text{AlF}_3$
- (c)  $\text{AlF}_3 < \text{AlBr}_3 < \text{AlCl}_3 < \text{AlI}_3$
- (d)  $\text{AlCl}_3 < \text{AlF}_3 < \text{AlBr}_3 < \text{AlI}_3$

14.

The appearance of colour in solid alkali metal halides is generally due to:

- (a) Schottky defect
- (b) Frenkel defect
- (c) Interstitial Position
- (d) F-Centres

15.

Match List-I with List-II and select the correct answer using the code given below the lists:

List-I (Molecule/ion)	List-II (Shape)
A. $\text{H}_2\text{O}$	1. Linear
B. $\text{BF}_3$	2. Angular
C. $\text{I}_3^-$	3. Trigonal planar
D. $\text{SF}_4$	4. See-saw

**Code:**

	A	B	C	D
(a)	4	1	3	2
(b)	2	3	1	4
(c)	2	1	3	4
(d)	4	3	1	2

16.

In which of the following molecules/ions, all the bond lengths are NOT equal?

- (a)  $\text{BF}_3$
- (b)  $\text{BF}_4^-$
- (c)  $\text{XeF}_4$
- (d)  $\text{SF}_4$

17.

Which one of the following exhibits highest bond order?

- (a)  $\text{O}_2$
- (b)  $\text{O}_2^-$
- (c)  $\text{O}_2^{2-}$
- (d)  $\text{O}_2^+$

18.

How many resonating structures are possible for  $\text{NO}_3^-$  ion?

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

19.

Consider the following statements for the complex  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ :

1. It is an outer orbital octahedral complex
2. Hybridization of Ni is  $sp^3d^2$
3. It is a paramagnetic complex
4. It is a diamagnetic complex

Which of the statements given above are correct?

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

20.

Sodium nitroprusside when added to an alkaline solution of sulphide ion gives red coloured solution. The red colouration is due to the formation of:

- (a)  $\text{Na}_4[\text{Fe}(\text{CN})_5(\text{NOS})]$
- (b)  $\text{Na}_2[\text{Fe}(\text{CN})_5(\text{NO})]$
- (c)  $\text{Na}_4[\text{FeCl}_5(\text{NOS})]$
- (d)  $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]\text{SO}_4$

21.

The complex ions  $[\text{NiCl}_4]^{2-}$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are:

- (a) Both square planar
- (b) Both diamagnetic
- (c) Both paramagnetic
- (d) Paramagnetic and diamagnetic respectively

22.

Consider the following complexes:

1.  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
2.  $[\text{Fe}(\text{CN})_6]^{3-}$
3.  $[\text{Fe}(\text{CN})_6]^{4-}$
4.  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

Which one of the following is the correct order of number of unpaired electrons in the above complexes?

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

23.

The denticity of ligands glycinate, iminodiacetic acid and nitrilotriacetic acid are:

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

24.

Which one of the following is the IUPAC name of the complex  $\text{K}_3[\text{Fe}(\text{CN})_6]$ ?

- (a) Potassium hexacyanoferrate(II)
- (b) Potassium hexacyanoferrate(III)
- (c) Tris potassium hexacyanoiron(III)
- (d) Potassium hexacyanoiron(III)

25.

Which one of the following complexes will NOT show geometrical isomerism?

- (a)  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$
- (b)  $[\text{Co}(\text{en})_2\text{Cl}_2]\text{Cl}$
- (c)  $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
- (d)  $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$

26.

Which one of the following complexes exhibits optical isomerism?

- (a) *cis*-[PtCl<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>]
- (b) *trans*-[PtCl<sub>2</sub>(NH<sub>3</sub>)<sub>2</sub>]
- (c) *trans*-[Co(en)<sub>2</sub>Cl<sub>2</sub>]<sup>+</sup>
- (d) [Co(EDTA)]<sup>-</sup>

27.

Consider the following complex ions:

1. [Co(en)<sub>3</sub>]<sup>3+</sup>
2. *cis*-[Co(en)<sub>2</sub>Cl<sub>2</sub>]<sup>+</sup>
3. *trans*-[Co(en)<sub>2</sub>Cl<sub>2</sub>]<sup>+</sup>

Which of the complex ion(s) given above show(s) optical activity?

- (a) 1 only
- (b) 1 and 2
- (c) 1 and 3
- (d) 2 and 3

28.

A solution is obtained by mixing 10 ml of 0.2 N KOH solution with 30 ml of 0.1 N CH<sub>3</sub>COOH.

The pH of the solution would be:

(Given: pK<sub>a</sub> of CH<sub>3</sub>COOH = 4.75; log 2 = 0.30)

- (a) 5.301
- (b) 5.05
- (c) 4.699
- (d) 4.398

29.

What will be the hydrogen ion concentration of a solution obtained by mixing 500 ml of 0.20 M acetic acid and 500 ml of 0.30 M sodium acetate?

(Dissociation constant of acetic acid =  $1.75 \times 10^{-5}$ )

- (a)  $2.75 \times 10^{-5}$  mol.dm<sup>-3</sup>
- (b)  $1.17 \times 10^{-5}$  mol.dm<sup>-3</sup>
- (c)  $3.50 \times 10^{-5}$  mol.dm<sup>-3</sup>
- (d)  $1.75 \times 10^{-3}$  mol.dm<sup>-3</sup>

30.

Which one of the following represents the correct order of acid strength?

- (a) [Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup> < [Al(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> < Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup>
- (b) [Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup> < Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> < [Al(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup>
- (c) Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> < [Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup> < [Al(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup>
- (d) [Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> < [Al(H<sub>2</sub>O)<sub>6</sub>]<sup>3+</sup> < [Fe(H<sub>2</sub>O)<sub>6</sub>]<sup>2+</sup>

31.

Consider the following hydroxides:

1.  $\text{Be}(\text{OH})_2$
2.  $\text{Sr}(\text{OH})_2$
3.  $\text{Mg}(\text{OH})_2$
4.  $\text{Ba}(\text{OH})_2$

The correct order of basicity of the above hydroxides will be:

- (a)  $\text{Sr}(\text{OH})_2 < \text{Be}(\text{OH})_2 < \text{Ba}(\text{OH})_2 < \text{Mg}(\text{OH})_2$
- (b)  $\text{Be}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Ba}(\text{OH})_2 < \text{Sr}(\text{OH})_2$
- (c)  $\text{Mg}(\text{OH})_2 < \text{Ba}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Be}(\text{OH})_2$
- (d)  $\text{Be}(\text{OH})_2 < \text{Mg}(\text{OH})_2 < \text{Sr}(\text{OH})_2 < \text{Ba}(\text{OH})_2$

32.

Which one of the following is the correct order of Lewis Acidity in Boron halides?

- (a)  $\text{BF}_3 < \text{BI}_3 < \text{BBr}_3 < \text{BCl}_3$
- (b)  $\text{BI}_3 < \text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$
- (c)  $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3 < \text{BI}_3$
- (d)  $\text{BBr}_3 < \text{BI}_3 < \text{BF}_3 < \text{BCl}_3$

33.

Which one of the following statements regarding acid-base property is NOT correct?

- (a)  $\text{pH} + \text{pOH} = 14$ , for all aqueous solutions
- (b) The pH of  $10^{-8}$  (M) HCl solution is 8
- (c) The conjugate base of  $\text{H}_2\text{PO}_4^-$  is  $\text{HPO}_4^{2-}$
- (d)  $\text{H}_2\text{SO}_4$  is a strong acid in aqueous solution

34.

What will be the value of pOH of 0.03M aqueous solution of HCl at  $25^\circ\text{C}$ ?

(Given  $\log 0.03 = -1.52$ )

- (a) 12.21
- (b) 12.48
- (c) 11.48
- (d) 10.48

35.

What will be the value of mole fraction of the solute in 1.00 molal aqueous solution?

- (a) 1.7700
- (b) 1.7770
- (c) 0.0180
- (d) 0.0344

36.

Equivalent weight of  $K_2Cr_2O_7$  in acidic medium will be:

(Atomic weight of K = 39, Cr = 52 and O = 16)

- (a)  $294 / 2$
- (b)  $294 / 3$
- (c)  $294 / 6$
- (d) 294

37.

Which one of the following is a primary standard substance?

- (a)  $KMnO_4$
- (b)  $K_2Cr_2O_7$
- (c)  $Na_2S_2O_3$
- (d) NaOH

38.

The equivalence point of titration of oxalate solution (acidic medium) with  $KMnO_4$  solution will be:

- (a) Pink
- (b) Colourless
- (c) Orange
- (d) Light green

39.

In which of the following titrations, an external indicator is NOT necessary?

- (a) Titration of oxalate solution with  $KMnO_4$  solution
- (b) Titration of HCl with NaOH solution
- (c) Titration of Hard water with EDTA
- (d) Titration of  $Na_2CO_3$  with HCl solution

40.

Which one among the following is a metal ion type indicator?

- (a) Methylene blue
- (b) Diphenylamine sulphonic acid
- (c) Eriochrome black T
- (d) Cresol red

41.

At what temperature does the total kinetic energy of 0.3 mole of Helium equals the total kinetic energy of 0.4 mole of Argon at 400 K?

- (a) 533.3 K
- (b) 433.3 K
- (c) 346.3 K
- (d) 373.0 K

42.

The ratio of Boyle's temperature ( $T_B$ ) and critical temperature ( $T_C$ ) of a gas obeying van der Waals equation is given by:

- (a)  $T_B : T_C = 27 : 8$
- (b)  $T_B : T_C = 4 : 27$
- (c)  $T_B : T_C = 3 : 2$
- (d)  $T_B : T_C = 8 : 27$

43.

Weight of  $O_2$  necessary to fill up a cylinder of 0.082 litre capacity at  $0^\circ C$  and 96 atm pressure would be:

(Compressibility factor = 0.96 and gas constant ( $R$ ) =  $0.082 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}$ )

- (a) 11.72 g
- (b) 1.172 g
- (c) 117.2 g
- (d) 10.72 g

44.

Which one of the following gas samples will have the highest average molecular speed?

(Atomic weight of O = 16, Ne = 20, C = 12 and He = 4)

- (a) 1.0 mole of  $O_2$  at 560 K
- (b) 0.50 mole of Ne at 500 K
- (c) 0.20 mole of  $CO_2$  at 440 K
- (d) 2.0 mole of He at 140 K

45.

The root mean square velocity of a monoatomic gas of molar mass ' $M$ ' ( $\text{g mol}^{-1}$ ) is ' $u$ '. What is the correct relation between ' $u$ ' and average kinetic energy ( $E$ ) per mole?

- (a)  $u = \sqrt{\frac{3E}{M}}$
- (b)  $u = \sqrt{\frac{2E}{3M}}$
- (c)  $u = \sqrt{\frac{2E}{M}}$
- (d)  $u = \sqrt{\frac{E}{3M}}$

46.

The amount of energy (per mole of a monoatomic gas) that will increase by increasing the temperature by one degree at constant volume is:

- (a)  $C_p - C_v$
- (b)  $R/2$
- (c)  $3/2 R$
- (d)  $C_v + R$

47.

Which one among the following gases has the largest mean free path under the same external conditions?

- (a)  $\text{H}_2$
- (b)  $\text{Cl}_2$
- (c)  $\text{N}_2$
- (d)  $\text{O}_2$

48.

50 mL of  $\text{H}_2$  gas diffuses through a small hole from a vessel in 20 minutes. Time taken by 40 mL of  $\text{O}_2$  gas to diffuse under similar condition will be:

- (a) 12 minutes
- (b) 64 minutes
- (c) 8 minutes
- (d) 32 minutes

49.

What will be the slope of the plot of  $\log P$  vs  $\log V$  for a reversible adiabatic expansion of an ideal gas? [ $\gamma = C_p/C_v$ ]

- (a)  $\gamma$
- (b)  $-\gamma$
- (c) zero
- (d)  $-1$

50.

The latent heat of vaporization of  $\text{Br}_2$  at  $59^\circ\text{C}$  and at 1 atm pressure is  $29.2 \text{ kJ mol}^{-1}$ . The value of  $\Delta U$  would be:

( $R = 8.314 \times 10^{-3} \text{ kJ mol}^{-1} \text{ K}^{-1}$ )

- (a)  $26.44 \text{ kJ mol}^{-1}$
- (b)  $2.644 \text{ kJ mol}^{-1}$
- (c)  $264.4 \text{ kJ mol}^{-1}$
- (d)  $31.96 \text{ kJ mol}^{-1}$

51.

The ratio of specific heat of gases at constant pressure ( $C_p$ ) and constant volume ( $C_v$ ) of  $\text{N}_2$  molecule is:

- (a) 1.667
- (b) 1.400
- (c) 1.330
- (d) 1.520

52.

The total heat content of a system at constant pressure is known as:

- (a) Enthalpy
- (b) Entropy
- (c) Internal energy
- (d) Activation energy

53.

In the Joule-Thomson expansion of real gas at inversion temperature, the Joule-Thomson coefficient:

- (a) will be negative if the gas cools post expansion
- (b) will be positive if the gas gets heated post expansion
- (c) will be zero if  $[\partial(PV)/\partial P]_T$  is positive
- (d) is zero

54.

For  $N_2(g) + 3H_2(g) \rightleftharpoons 2 NH_3(g)$ , the expression for  $\Delta H$  is:

- (a)  $\Delta U + 2 RT$
- (b)  $\Delta U + RT$
- (c)  $\Delta U - 2 RT$
- (d)  $\Delta U - RT$

55.

The entropy of vaporization of a liquid is  $100 J mol^{-1}K^{-1}$  and it boils at 300K. What would be the value of  $\Delta H_{vap}$ ?

- (a)  $3.0 kJ mol^{-1}$
- (b)  $30.0 kJ mol^{-1}$
- (c)  $300 kJ mol^{-1}$
- (d)  $3000 kJ mol^{-1}$

56.

The maximum efficiency of a Carnot engine operating between  $100^\circ C$  to  $200^\circ C$  will be:

- (a) 21.85 %
- (b) 21.14 %
- (c) 22.14 %
- (d) 20.14%

57.

Which one of the following is the correct thermodynamic equation of state?

- (a)  $dG = (\partial G/\partial P)_T dP + (\partial G/\partial T)_P dT$
- (b)  $(\partial U/\partial V)_T = P + T (\partial P/\partial T)_V$
- (c)  $dU = (\partial U/\partial V)_S dV + (\partial U/\partial S)_V dS$
- (d)  $(\partial H/\partial P)_T = V - T (\partial V/\partial T)_{P, n}$

58.

Which one of the following changes will necessarily lead to a non-spontaneous change?

- (a) Positive  $\Delta H$  and positive  $\Delta S$
- (b) Negative  $\Delta H$  and negative  $\Delta S$
- (c) Positive  $\Delta H$  and negative  $\Delta S$
- (d) Negative  $\Delta H$  and positive  $\Delta S$

59.

Equal volumes of what concentrations of  $\text{AgNO}_3$  and  $\text{HCl}$  should be mixed to form a  $\text{AgCl}$  precipitate? [ $K_{sp}$  for  $\text{AgCl} = 10^{-10}$ ]

- (a)  $10^{-4}$  M  $\text{AgNO}_3$  and  $10^{-7}$  M  $\text{HCl}$
- (b)  $10^{-5}$  M  $\text{AgNO}_3$  and  $10^{-6}$  M  $\text{HCl}$
- (c)  $10^{-6}$  M  $\text{AgNO}_3$  and  $10^{-6}$  M  $\text{HCl}$
- (d)  $10^{-4}$  M  $\text{AgNO}_3$  and  $10^{-5}$  M  $\text{HCl}$

60.

The solubility product of  $\text{Ag}_2\text{CrO}_4$  is  $32 \times 10^{-12}$ . What is the concentration of  $\text{CrO}_4^{2-}$  ion in that solution?

- (a)  $2 \times 10^{-4}$  M
- (b)  $16 \times 10^{-4}$  M
- (c)  $8 \times 10^{-4}$  M
- (d)  $8 \times 10^{-8}$  M

61.

What will be the degree of dissociation of 0.1 (M)  $\text{Ba}(\text{NO}_3)_2$  solution, if van't Hoff factor of the solution is 2.74?

- (a) 91.3 %
- (b) 87 %
- (c) 100%
- (d) 74%

62.

Which one of the following colligative properties can provide the most precise molar mass of peptides?

- (a) Elevation of boiling point
- (b) Depression of freezing point
- (c) Relative lowering of vapour pressure
- (d) Osmotic pressure

63.

At 298 K, the total vapour pressure in Torr for a mixture of volatile components A and B is given by  $P = 120 - 75 \chi_B$  ( $\chi_B$  is the mole fraction of B). What is the vapour pressure of pure A and B (in Torr) respectively?

- (a) 120 and 75
- (b) 120 and 195
- (c) 120 and 45
- (d) 75 and 45

64.

Which one of the following equations represents the correct relation between relative lowering in vapour pressure and osmotic pressure ( $\pi$ ) for a dilute aqueous solution?

(a)  $\frac{\Delta P}{P^0} = \frac{\pi \bar{V}}{RT}$

(b)  $\frac{\Delta P}{P^0} = \frac{\pi RT}{\bar{V}}$

(c)  $\frac{\Delta P}{P^0} = \frac{\pi R}{T \bar{V}}$

(d)  $\frac{\Delta P}{P^0} = \pi RT$

65.

A 1% aqueous solution (mass by volume) of a certain substance is isotonic with a 3% solution of glucose (Molar mass =  $180 \text{ g mol}^{-1}$ ) at a given temperature. The molar mass of the substance (in  $\text{kg mol}^{-1}$ ) will be:

(a) 0.60

(b) 180

(c) 0.18

(d) 0.06

66.

Which among the following is the correct order for osmotic pressure of equimolar solutions of glucose, sodium chloride and barium chloride?

(a)  $\text{C}_6\text{H}_{12}\text{O}_6 > \text{BaCl}_2 > \text{NaCl}$

(b)  $\text{C}_6\text{H}_{12}\text{O}_6 > \text{NaCl} > \text{BaCl}_2$

(c)  $\text{BaCl}_2 > \text{NaCl} > \text{C}_6\text{H}_{12}\text{O}_6$

(d)  $\text{NaCl} > \text{C}_6\text{H}_{12}\text{O}_6 > \text{BaCl}_2$

67.

0.05 molal aqueous solution of  $\text{K}_4[\text{Fe}(\text{CN})_6]$  freezes at  $-0.26^\circ\text{C}$ . Its degree of dissociation will be:

( $k_f = 1.86^\circ\text{C Kg mol}^{-1}$ )

(a) 48.2 %

(b) 54.9 %

(c) 44.9 %

(d) 51.6 %

68.

What will be the value of freezing point depression constant of cyclobutane having freezing point of 280 K and molar enthalpy of fusion of  $2.68 \text{ kJ mol}^{-1}$ ?

(Molar mass of cyclobutane =  $56.108 \text{ g mol}^{-1}$  and  $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$ )

- (a)  $14.63 \text{ K kg mol}^{-1}$
- (b)  $16.14 \text{ K kg mol}^{-1}$
- (c)  $13.64 \text{ K kg mol}^{-1}$
- (d)  $12.64 \text{ K kg mol}^{-1}$

69.

Which one of the following statements is correct about the Henry's law?

- (a) It is related to effect of pressure only on solubility of a gas in a liquid
- (b) It is related to effect of temperature only on solubility of a gas in a liquid
- (c) It is related to effect of pressure as well as temperature on solubility of a gas in a liquid
- (d) It is related to effect of pressure as well as temperature on solubility of a gas in a solid

70.

What will be the ratio of mole fractions of  $\text{O}_2$  and  $\text{N}_2$  dissolved in water at  $25^\circ\text{C}$ ?

(Given that Henry's law constant (in torr) for  $\text{O}_2$  and  $\text{N}_2$  are  $3.3 \times 10^7$  and  $6.5 \times 10^7$  respectively at  $25^\circ\text{C}$ ; mole fractions of  $\text{O}_2$  and  $\text{N}_2$  in air are taken as 0.2 and 0.8 respectively)

- (a)  $\sim 0.51$
- (b)  $\sim 0.66$
- (c)  $\sim 0.25$
- (d)  $\sim 0.49$

71.

The cell constant with 0.1 N KCl solution is found to be  $0.98 \text{ cm}^{-1}$  and the resistance offered by 0.01 N HCl is  $89 \Omega$ . The specific conductance of HCl will be:

- (a)  $1.101 \times 10^2 \Omega^{-1} \text{ cm}^{-1}$
- (b)  $1.101 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$
- (c)  $2.202 \times 10^{-3} \Omega^{-1} \text{ cm}^{-1}$
- (d)  $2.202 \times 10^3 \Omega^{-1} \text{ cm}^{-1}$

72.

What will be the correct order of mobility of the following alkali metal ions in aqueous solution?

- (a)  $\text{Li}^+ > \text{Na}^+ > \text{K}^+ > \text{Rb}^+$
- (b)  $\text{Na}^+ > \text{K}^+ > \text{Rb}^+ > \text{Li}^+$
- (c)  $\text{K}^+ > \text{Rb}^+ > \text{Na}^+ > \text{Li}^+$
- (d)  $\text{Rb}^+ > \text{K}^+ > \text{Na}^+ > \text{Li}^+$

73.

During electrolysis of silver nitrate solution, loss in the anode compartment was 0.589 g. In a Voltmeter connected in series, 1.259 g of silver was deposited. What would be the transport number of two ions?

- (a)  $t_+ = 0.468$  and  $t_- = 0.532$
- (b)  $t_+ = 0.532$  and  $t_- = 0.468$
- (c)  $t_+ = 0.670$  and  $t_- = 0.330$
- (d)  $t_+ = 0.330$  and  $t_- = 0.670$

74.

The molar conductivities of KOAc and HCl at infinite dilution in water at 25°C are 90.0 and 426.2 S cm<sup>2</sup> mol<sup>-1</sup>, respectively. To calculate the molar conductivity of HOAc at infinite dilution, the additional molar conductivity value of which one of the following electrolytes will be required?

- (a) NaCl
- (b) KCl
- (c) KNO<sub>3</sub>
- (d) NaOH

75.

What will be the effect of dilution on specific and equivalent conductance of an aqueous solution of a strong electrolyte?

- (a) The specific conductance decreases and equivalent conductance increases
- (b) The specific conductance increases and equivalent conductance decreases
- (c) Both will increase
- (d) Both will decrease

76.

The mean ionic activity co-efficient is denoted as  $\gamma_{\pm}$ , while that of cation and anion are denoted as  $\gamma_+$  and  $\gamma_-$ , respectively. The correct relation among them will be:

(Given that  $v_+$  and  $v_-$  are the number of cations and the anions respectively in the molecular formula of the compound)

- (a)  $\gamma_{\pm} = \frac{1}{v_+ + v_-}(\gamma_+ + \gamma_-)$
- (b)  $\gamma_{\pm} = (\gamma_+^{v_+} \gamma_-^{v_-})^{\frac{1}{v_+ + v_-}}$
- (c)  $\gamma_{\pm} = (\gamma_+^{v_-} \gamma_-^{v_+})^{\frac{1}{v_+ + v_-}}$
- (d)  $\gamma_{\pm} = \frac{1}{v_+ + v_-}(v_+ \gamma_+ + v_- \gamma_-)$

77.

The specific conductance of 0.01 M solution of acetic acid was found to be  $0.015 \text{ S m}^{-1}$  at  $25^\circ\text{C}$ . Molar conductance of acetic acid at infinite dilution is  $400 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ . The degree of dissociation of acetic acid will be:

- (a) 0.375
- (b) 0.0375
- (c) 0.00375
- (d) 0.357

78.

In a moving boundary experiment with 0.01 mole LiCl, the boundary in a tube with cross sectional area of  $0.125 \text{ cm}^2$  moves through 8.1 cm in 1500 sec for a current of  $1.8 \times 10^{-3}$  ampere. What will be the value of transport number of  $\text{Cl}^-$ ?

(Given that  $F = 96,500$  Coulomb and temperature is 300K)

- (a) 0.639
- (b) 0.361
- (c) 0.510
- (d) 0.369

79.

When HCl is titrated against NaOH, the conductance at the end point is:

- (a) Zero
- (b) Minimum
- (c) Maximum
- (d) Infinite

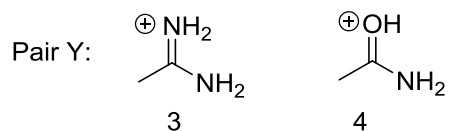
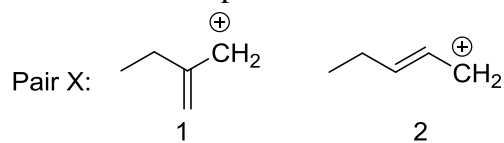
80.

A cell is bathed in a solution that has a greater osmolarity than that of cytosol. The solution can be described as:

- (a) Hypertonic
- (b) Hypotonic
- (c) Isotonic
- (d) Hydrotonic

81.

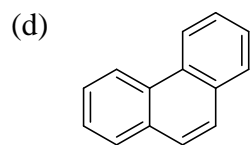
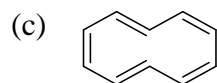
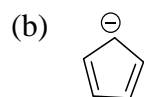
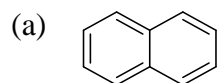
Which cationic species is more stable in each of the following pairs?



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

82.

Which one of the following structures is non-aromatic?



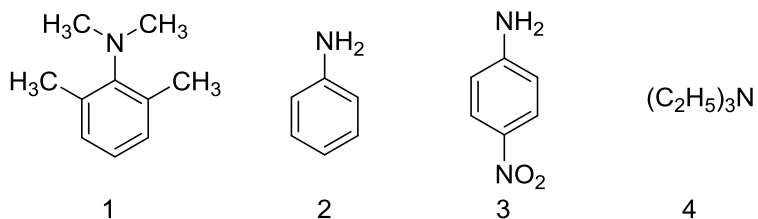
83.

The *o/p*-directing effect of methyl group in electrophilic substitution reaction of toluene is due to:

- (a) Inductive effect
- (b) Hyperconjugation effect
- (c) Resonance effect
- (d) Electromeric effect

84.

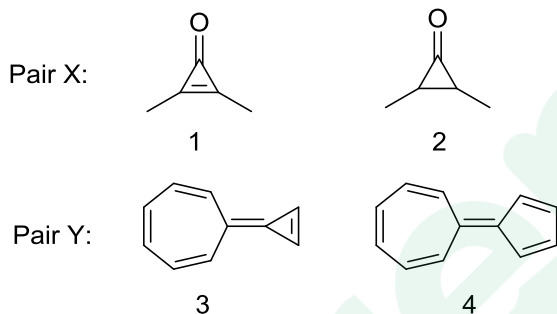
The relative order of basicity of the following amines is:



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

85.

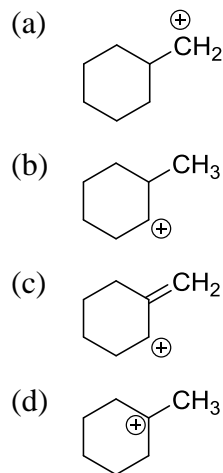
Which molecule in each of the following pairs has a higher dipole moment?



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

86.

Which one of the following carbocations is NOT expected to rearrange?



87.

Classify the following species as electrophiles (**E**) and nucleophiles (**N**) in organic reactions:

$\text{SO}_3$ ,  $\text{Cl}^+$ ,  $\text{NO}_2^+$ ,  $\text{CH}_3\text{NH}_2$ ,  $\text{H}_3\text{O}^+$ ,  $\text{BH}_3$ ,  $\text{CN}^-$

(a) **E** =  $\text{SO}_3$ ,  $\text{Cl}^+$ ,  $\text{NO}_2^+$ ,  $\text{H}_3\text{O}^+$  and **N** =  $\text{BH}_3$ ,  $\text{CH}_3\text{NH}_2$ ,  $\text{CN}^-$

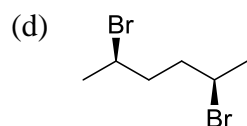
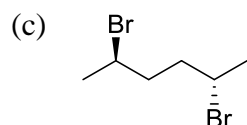
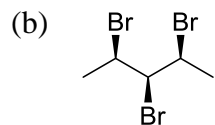
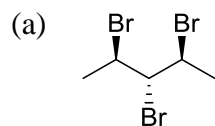
(b) **E** =  $\text{Cl}^+$ ,  $\text{NO}_2^+$ ,  $\text{H}_3\text{O}^+$  and **N** =  $\text{SO}_3$ ,  $\text{BH}_3$ ,  $\text{CH}_3\text{NH}_2$ ,  $\text{CN}^-$

(c) **E** =  $\text{SO}_3$ ,  $\text{BH}_3$ ,  $\text{Cl}^+$ ,  $\text{NO}_2^+$ ,  $\text{H}_3\text{O}^+$  and **N** =  $\text{CH}_3\text{NH}_2$ ,  $\text{CN}^-$

(d) **E** =  $\text{CH}_3\text{NH}_2$ ,  $\text{NO}_2^+$ ,  $\text{H}_3\text{O}^+$ ,  $\text{Cl}^+$  and **N** =  $\text{SO}_3$ ,  $\text{BH}_3$ ,  $\text{CN}^-$

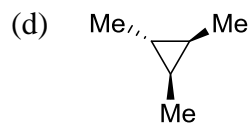
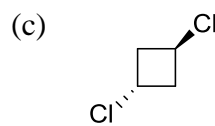
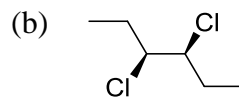
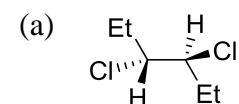
88.

Which one of the following molecules does NOT exist as a *meso* isomer?



89.

Which one of the following molecules does NOT have a plane of symmetry?



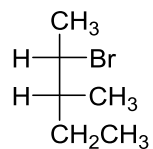
90.

Which one of the following amino acids is achiral?

- (a) Alanine
- (b) Glycine
- (c) Proline
- (d) Valine

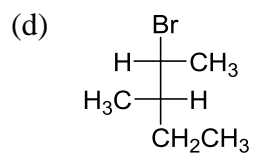
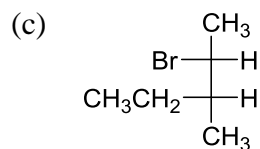
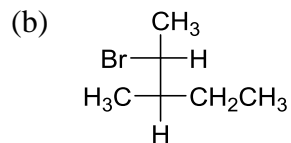
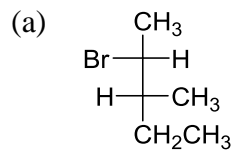
91.

Consider the following compound [A]:



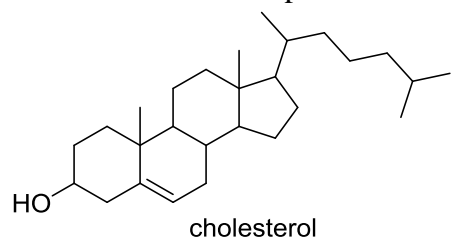
[A]

Which one of the following represents an enantiomer of [A]?



92.

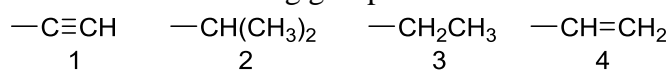
The total number of optical isomers possible for cholesterol is:



- (a) 128
- (b) 256
- (c) 64
- (d) 512

93.

Consider the following groups attached to a chiral carbon centre:

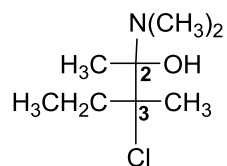


What is the decreasing order of priority of above groups based on Cahn-Ingold-Prelog (CIP)-nomenclature?

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

94.

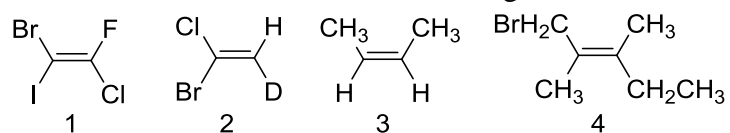
What is the correct configuration of C2 and C3 carbons in the following compound?



- (a) 2*R*, 3*S*
- (b) 2*S*, 3*R*
- (c) 2*R*, 3*R*
- (d) 2*S*, 3*S*

95.

The *E/Z*-nomenclature for the following molecules is:

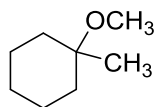


- (a) 1: *Z*, 2: *Z*, 3: *Z*, 4: *E*
- (b) 1: *Z*, 2: *E*, 3: *E*, 4: *E*
- (c) 1: *E*, 2: *Z*, 3: *Z*, 4: *E*
- (d) 1: *E*, 2: *Z*, 3: *E*, 4: *Z*

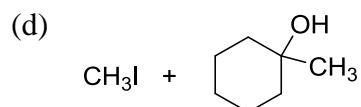
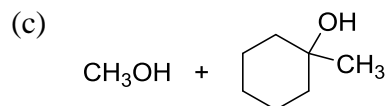
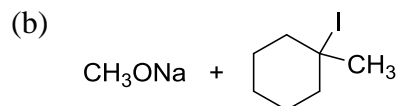
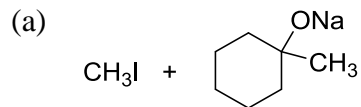


99.

Consider the following compound:

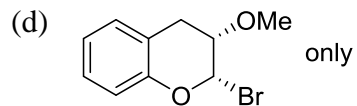
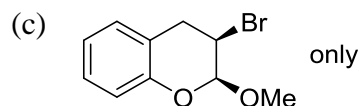
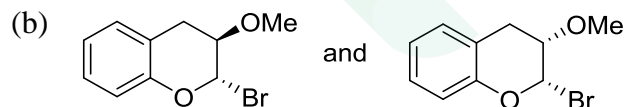
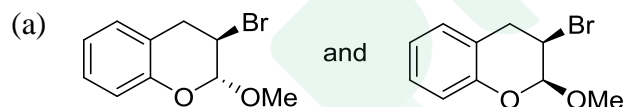
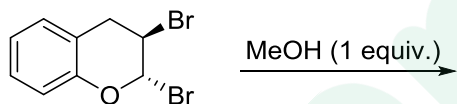


Which one of the following substrate sets is the best for synthesizing above compound?



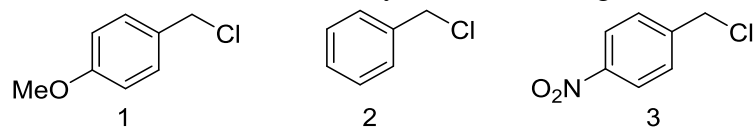
100.

The major product(s) formed in the following reaction is/are:



101.

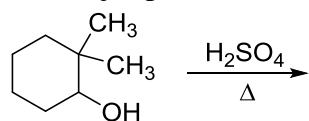
The relative order of reactivity of the following chlorides in  $S_N1$  reaction is:

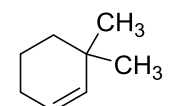
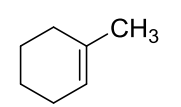
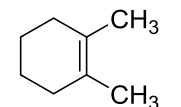
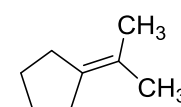


- (a)  $2 > 1 > 3$
- (b)  $3 > 2 > 1$
- (c)  $1 > 2 > 3$
- (d)  $1 > 3 > 2$

102.

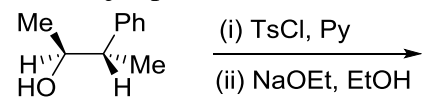
The major product formed in the following reaction is:

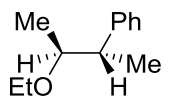
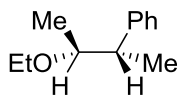
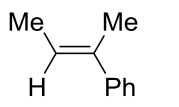
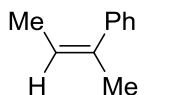


- (a) 
- (b) 
- (c) 
- (d) 

103.

The major product formed in the following reaction is:



- (a) 
- (b) 
- (c) 
- (d) 

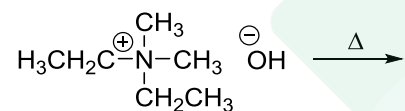
104.

Which one of the following bromides CANNOT form an alkene by E2 process?

- (a) 1-Bromo-2,2-dimethylpropane  
(b) 2-Bromo-2-methylbutane  
(c) 2-Bromo-3-methylbutane  
(d) 1-Bromo-3-methylbutane

105.

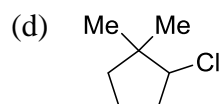
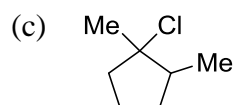
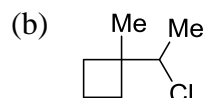
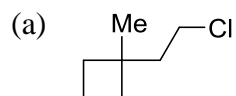
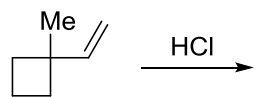
The major product formed in the following reaction is:



- (a)  $\text{CH}_3\text{CH}=\text{CH}_2$   
(b)  $\text{CH}_3\text{CH}=\text{CHCH}_3$   
(c)  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$   
(d)  $\text{H}_2\text{C}=\text{CH}_2$

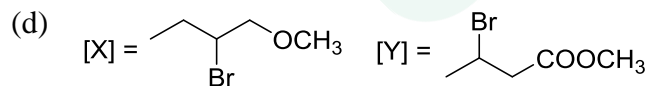
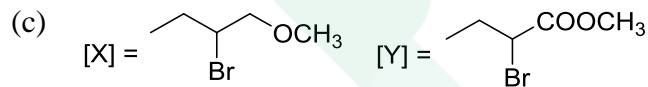
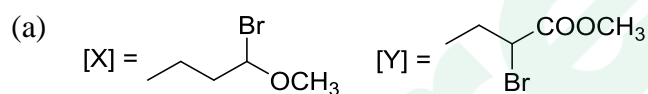
106.

The major product formed in the following reaction is:



107.

The major products [X] and [Y] formed in the following transformations are:



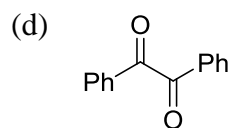
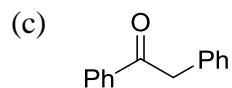
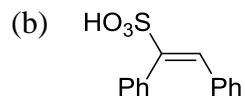
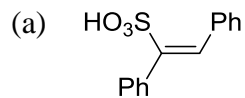
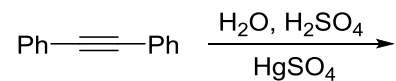
108.

The major product formed in the reaction of 3-phenylpropene with HBr in the presence of peroxide is:

- (a) 2-Bromo-1-phenylpropane
- (b) 1,2-Dibromo-3-phenylpropane
- (c) 1-Bromo-3-phenylpropane
- (d) 3-(*p*-Bromophenyl) propene

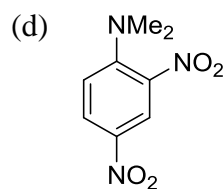
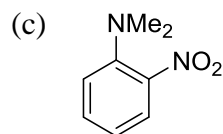
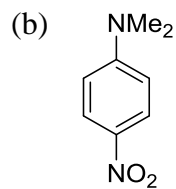
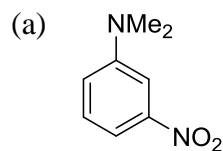
109.

The major product formed in the following reaction is:



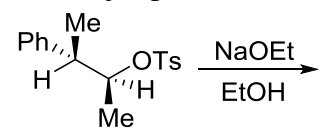
110.

The major product formed in the reaction of *N,N*-dimethylaniline with concentrated  $\text{H}_2\text{SO}_4/\text{HNO}_3$  mixture is:



111.

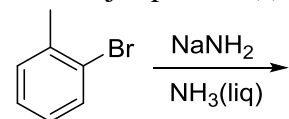
The major product formed in the following reaction is:



- (a)
- (b)
- (c)
- (d)

112.

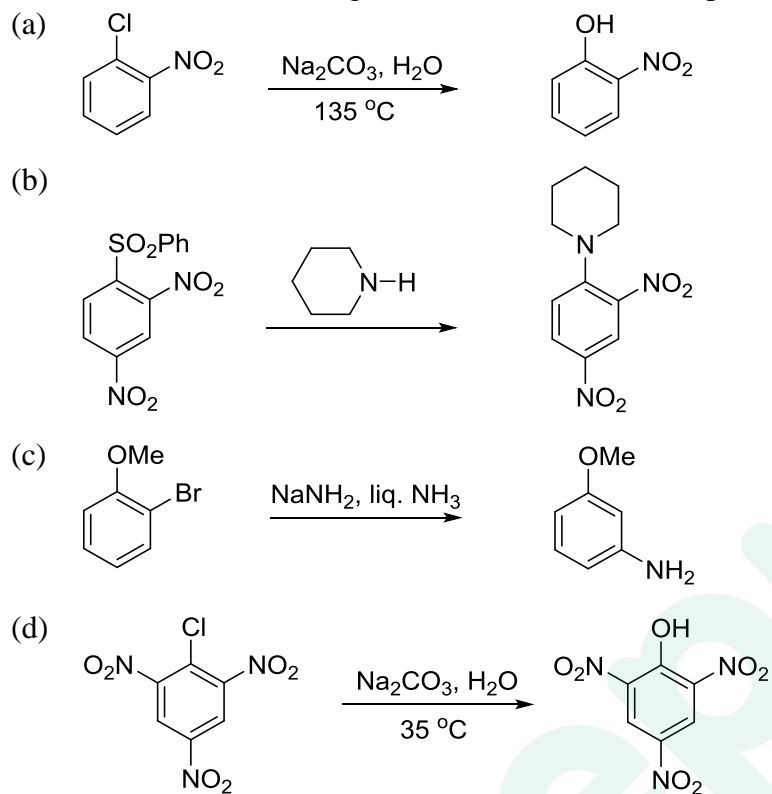
The major product(s) formed in the following reaction is/are:



- (a) only
- (b)
- (c) only
- (d) +

113.

Which one of the following reactions is NOT an example of *ipso*-substitution?



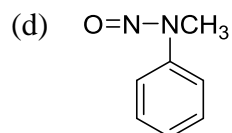
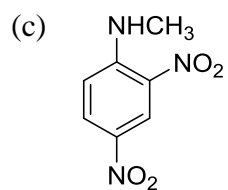
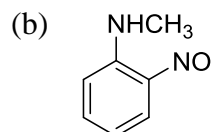
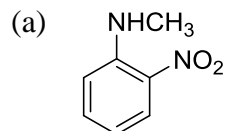
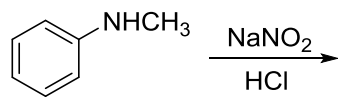
114.

The product formed by the reaction of toluene with chlorine in the presence of sunlight is:

- (a) *o*-chlorotoluene
- (b) 2,4-dichlorotoluene
- (c) *p*-chlorotoluene
- (d) benzylchloride

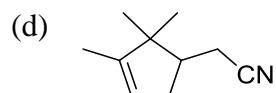
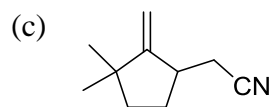
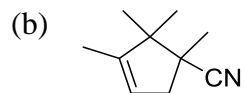
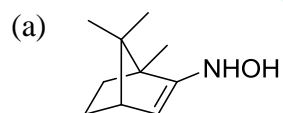
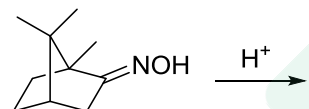
115.

The major product formed in the following reaction is:



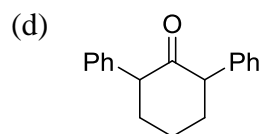
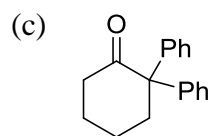
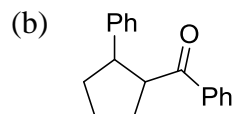
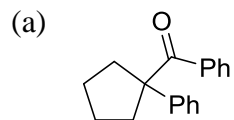
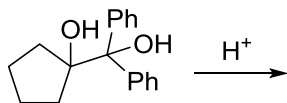
116.

The major product formed in the following reaction is:



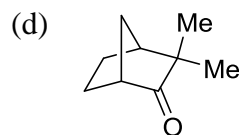
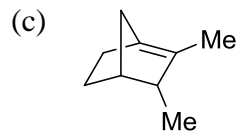
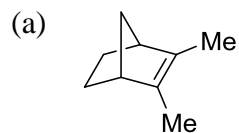
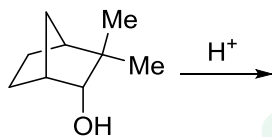
117.

The major product formed in the following reaction is:



118.

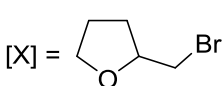
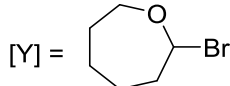
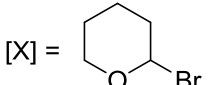
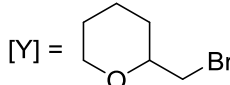
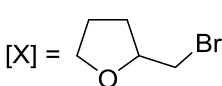
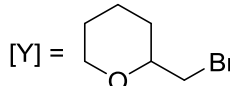
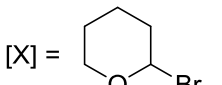
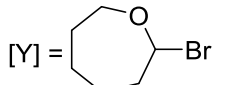
The major product formed in the following reaction is:



119.

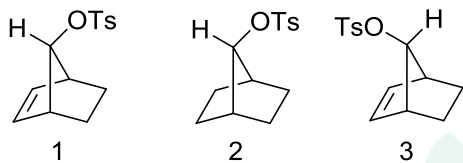
The major products [X] and [Y] formed in the following reactions are:



- (a) [X] =  [Y] = 
- (b) [X] =  [Y] = 
- (c) [X] =  [Y] = 
- (d) [X] =  [Y] = 

120.

The relative order of the rate of acetolysis among the following norbornyl derivatives is:



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



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