

chem 2017

2

Questions 1 - 36 (Thirty-six questions).

Directions: each of the questions or incomplete statements in this section is followed by four suggested answers. Select the best answer in each case.

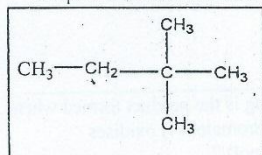
1. The number of moles of carbon dioxide (CO<sub>2</sub>) gas present in 44.8 cm<sup>3</sup> at standard temperature and pressure (STP) (molar gas volume = 22,400 cm<sup>3</sup>) is given by:
- A 44.8 cm<sup>3</sup>/22,400 cm<sup>3</sup>/mol
  - B 44.0 cm<sup>3</sup>/22,400 cm<sup>3</sup>/mol
  - C 44.0 cm<sup>3</sup>/44.8 cm<sup>3</sup>/mol
  - D (44.8 cm<sup>3</sup> × 44 cm<sup>3</sup>) / 22,400 cm<sup>3</sup>/mol

2. When the nuclide <sup>239</sup><sub>93</sub>Np undergoes beta decay (β<sup>-</sup> decay) the nuclide produced is
- A <sup>239</sup><sub>92</sub>U
  - B <sup>238</sup><sub>92</sub>U
  - C <sup>239</sup><sub>94</sub>Pa
  - D <sup>240</sup><sub>93</sub>Np

3. The relative molecular mass of a hydrocarbon is 56. What is its molecular formula?
- A C<sub>4</sub>H<sub>8</sub>
  - B C<sub>5</sub>H<sub>6</sub>
  - C C<sub>4</sub>H<sub>10</sub>
  - D C<sub>5</sub>H<sub>8</sub>

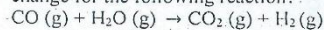
4. In a nitrate(V), NO<sub>3</sub><sup>-</sup>
- A The nitrogen reacting atom uses 5 unpaired electrons for bonding.
  - B Nitrogen forms one dative bond and three covalent bonds
  - C Nitrogen promotes one 2s electron to a higher energy level
  - D Nitrogen readily loses five electrons

5. What is the accepted conventional name of the compound indicated below?



- A. 2,2-dimethylpropane
  - B. 3,3-dimethylbutane
  - C. 2,2-dimethylbutane
  - D. trimethylpropane
6. An element, X, has an atomic number of 25. The electronic configuration of its ion X<sup>2+</sup> is
- A [Ar]3d<sup>5</sup> 4s<sup>2</sup>
  - B [Ar]3d<sup>3</sup> 4s<sup>0</sup>
  - C [Ar]3d<sup>4</sup> 4s<sup>1</sup>
  - D [Ar]3d<sup>3</sup> 4s<sup>2</sup>

7. Given that the standard enthalpies of formation in kJ mol<sup>-1</sup> of CO(g), CO<sub>2</sub>(g) and H<sub>2</sub>O(g) are respectively -110, -394 and -242. What is the standard enthalpy change for the following reaction?



- A -262
- B +42
- C -746
- D -42

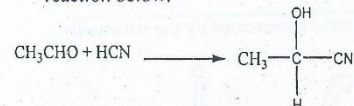
8. For the elements across period 2 of the Periodic Table, lithium (Li) to Neon (Ne)

- A the melting point increases from Li to C and then decreases to Ne
- B the atomic radius decreases with increase in atomic number
- C all the oxides can be classified as either basic or acidic
- D all the chlorides are solids at room temperature

9. 0.15 g of a volatile organic liquid when vaporized in a suitable apparatus occupied a volume of 77 cm<sup>3</sup> at 372K and 753 mmHg pressure; molar gas constant = 0.082 atm dm<sup>3</sup> mol<sup>-1</sup> K<sup>-1</sup>. The relative molecular mass of the liquid is given by

- A  $\frac{0.15 \times 0.082 \times 373 \times 760}{(753 \times 0.077)}$
- B  $\frac{0.15 \times 0.082 \times 753}{(760 \times 0.077)}$
- C  $\frac{0.15 \times 0.082 \times 372}{(753 \times 0.077)}$
- D  $\frac{0.15 \times 0.082 \times 372}{(753 \times 77)}$

10. Identify the type of organic reaction involved in the reaction below.

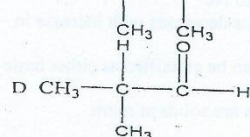
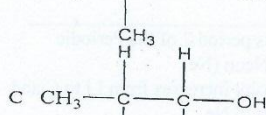
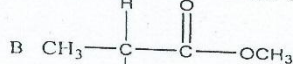
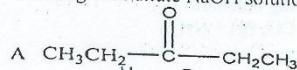


- A Nucleophilic addition
- B Condensation reaction
- C Electrophilic addition
- D Hydrolysis

11. Which of the following bond type accounts for the reaction between boron trifluoride and ammonia?

- A Ionic bond
- B Hydrogen bond
- C Dative covalent bond
- D van der Waals' force

12. Select the compound which forms methanol on warming with dilute NaOH solution.

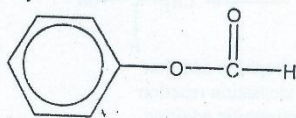


- A  
B  
C  
D

13. In an experiment to determine the relative molecular mass of ethanoic acid in an organic solvent, 120 was obtained instead of the expected value of 60. What could be the explanation for this phenomenon?

- A Vapours of volatile liquids deviate from ideal gas behavior.  
B Ethanoic acid decomposes to methane and carbon dioxide.  
C Ethanoic acid partially dissociates.  
D Ethanoic acid vapour exists in the form of the dimers.

14. When the compound represented by the structural formula



is warmed with aqueous solution of dilute sodium hydroxide, the most likely products formed are

- A benzoic acid and methanol.  
B phenol and methanoic acid.  
C phenol and sodium methanoate.  
D phenol and methanol.

15. The two nuclei in the hydrogen molecule ion ( $\text{H}_2^+$ ) are held together by

- A an ionic bond.  
B a dative covalent bond.  
C electrostatic attraction between the two hydrogen atoms.  
D mutual sharing of the electron charge cloud.

16. The acidity constant of propanoic acid is  $1.26 \times 10^{-5}$ . What is the pH of a 0.1 M solution of this acid?

- A 1.00  
B 1.12  
C 2.74  
D 2.95

17. Which of the following statements is true?

- A All oxides of the s-block elements are basic.  
B The solubility of Group 1 sulphates decreases down the group while that of Group 2 sulphates increases down the group.  
C The thermal stability of the carbonates of the s-block elements increases down both Groups 1 and 2.  
D Beryllium and magnesium both react with water to form basic hydroxides

18. Which of the following steps is unlikely to occur in the chlorination of methane?

- A  $\text{H}_2 \rightarrow \text{H}\cdot + \text{H}\cdot$   
B  $\text{Cl}_2 \rightarrow \text{Cl}\cdot + \text{Cl}\cdot$   
C  $\text{CH}_3\cdot + \text{Cl}_2 \rightarrow \text{CH}_3\text{Cl} + \text{Cl}\cdot$   
D  $\text{CH}_4 + \text{Cl}\cdot \rightarrow \text{CH}_3\cdot + \text{HCl}$

19. Two pure liquids, S and T, which form an ideal mixture, have vapour pressures 12.9 kPa and 26.8 kPa respectively at 25 °C. What is the vapour pressure of a mixture containing 2.0 moles of S and 1.0 mole of T and 25 °C.

- A 39.7 kPa  
B 22.2 kPa  
C 17.5 kPa  
D 19.9 kPa

20. Which of the following is the product formed when acidified sodium dichromate(VI) oxidises propan-2-ol (2-propanol)?

- A propanoic acid  
B propanone  
C propanal  
D methoxyethane

21. In which of the following solutions will the reaction with 1.0 g  $\text{CaCO}_3$  be fastest?

- A 100 cm<sup>3</sup> of 1.0 M  $\text{H}_2\text{SO}_4$   
B 50 cm<sup>3</sup> of 1.0 M  $\text{HNO}_3$   
C 25 cm<sup>3</sup> 2.0 M  $\text{HCl}$   
D 100 cm<sup>3</sup> of 0.5 M  $\text{HNO}_3$

22. A sample of oxygen gas contains  $^{16}\text{O}$  and  $^{18}\text{O}$ . The peaks in the mass spectrum of the oxygen sample would be at mass numbers

- A 17 and 34
- B 16 and 18
- C 16, 18, 32 and 36
- D 16, 18, 32, 34 and 36

23. One property of a buffer solution, prepared from a weak acid and its sodium salt is that

- A its pH is less than the pH of the original acid
- B its pH is unaffected by the addition of any quantity of  $\text{H}^+$  ions
- C its pH is greater than the pH of the original acid
- D It has a pH of 7.

24. Which of the following species is trigonal bipyramidal?

- A  $\text{AlH}_4^-$
- B  $\text{PCl}_4^+$
- C  $\text{PCl}_5$
- D  $\text{SnH}_4$

25. An oxidizing agent is a species that

- A is oxidized in a reaction
- B is reduced in a reaction
- C loses electrons
- D has an increase in oxidation state

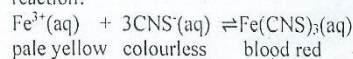
26. The half-life of radioactive  $^{233}_{91}\text{Pa}$  is 28 days. How many days will it take for the radioactivity to fall to one-eighth of the initial value?

- A 56
- B 84
- C 112
- D 28

27. In the production of sulphuric acid, the sulphur trioxide in the Contact process is

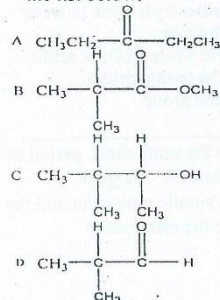
- A dissolved in water
- B dissolved in oleum or fuming sulphuric acid
- C absorbed by concentrated sulphuric acid
- D liquefied by applying pressure

28. What colour would be observed when iron(III) chloride is added to the following equilibrium reaction?



- A colourless
- B Blood red
- C Pale yellow
- D Green

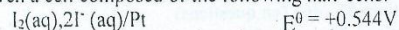
29. Select the compound which is optically active from the list below.



30. Which of the following statements is true for a pair of miscible liquids whose mixture shows negative deviation from Raoult's Law?

- A The total vapour pressure decreases.
- B Slight drop in temperature is observed when the liquids are mixed.
- C The intermolecular forces are broken.
- D The total volume of the mixture is increased.

31. Given a cell composed of the following half-cells:



Which of the following species is the strongest reducing agent?

- A  $\text{I}_2(\text{aq})$
- B  $\text{Fe}^{3+}(\text{aq})$
- C  $\text{Fe}^{2+}(\text{aq})$
- D  $\text{I}^-(\text{aq})$

32. A possible isomer of buta-1,3-diene (1,3-butadiene),  $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$  is

- A cyclobutane
- B butene
- C butyne
- D cyclobutadiene

5

33. The reaction  $\text{H}_2\text{O} + \text{NH}_3 \rightleftharpoons \text{NH}_4\text{OH}$  could be classified as

- A Substitution
- B Redox
- C Acid/base
- D Disproportionation

34. For the Group 14 (Group IV) elements C to Pb;

- A The stability of +2 oxidation state decreases down the group
- B All the tetrachlorides hydrolyze in water to give acidic solutions
- C PbO is amphoteric while  $\text{PbO}_2$  is acidic
- D The stability of the tetrahydrides decreases down the group

35. K, L and M are elements in the same short period of the Periodic Table. The oxide of K is a giant molecule, the oxide of L is a simple molecular and the oxide of M is ionic. Arrange the elements in increasing atomic number.

- A K,M,L
- B M,K,L
- C L,M,K
- D K,L,M

36. Which of the following gases has the highest volume at STP? (RAM: He :4; O: 16; Cl : 35.5;N:14)

- A 4.0 g Helium
- B 14.0 g Nitrogen
- C 16.0 g Oxygen
- D 35.5 g chlorine

Questions 37 - 46 (Ten questions)

Directions: For each of the questions below, ONE or MORE of the responses is (are) correct. Decide which of the responses is (are) correct. Then choose:

- A if 1,2 and 3 are all correct
- B if 1 and 2 only are correct
- C if 2 and 3 only are correct
- D if 3 only is correct

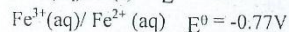
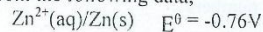
Directions Summarized			
A	B	C	D
1,2,3 correct	1,2 only	2,3 only	3 only

37. Which of the following compounds will give a yellow precipitate when reacted with a solution of potassium iodide (KI) and sodium hypochlorite (NaOCl)

- 1  $\text{CH}_3\text{CH}_2\text{OH}$
- 2  $\text{CH}_3\text{CHO}$
- 3  $\text{C}_6\text{H}_5\text{COCH}_3$

- A
- B
- C
- D.

38. From the following data;



It can be deduced that

- 1 The standard emf for the cell  $\text{Zn}(\text{s})/\text{Zn}^{2+}(\text{aq})\|\text{Fe}^{3+}(\text{aq})/\text{Fe}^{2+}(\text{aq})/\text{Pt}$  is -1.54V
- 2 Zinc is a more powerful reductant than  $\text{Fe}^{2+}(\text{aq})$
- 3  $\text{Fe}^{3+}(\text{aq})$  can oxidize Zinc under standard condition

- A
- B
- C
- D

39. The anomalous behavior of lithium (Li) in group I can be attributed to:

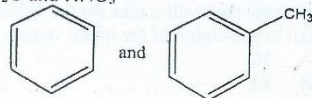
- 1 its high electropositivity
- 2 its small size
- 3 the ability of  $\text{Li}^+$  ions to polarize small anions like  $\text{N}^{3-}$

- A
- B
- C
- D

40. Which of the following pairs of compounds will form an ideal mixture?

- 1  $\text{CHCl}_3$  and  $\text{CH}_3\text{COCH}_3$
- 2  $\text{H}_2\text{O}$  and  $\text{HNO}_3$

3



- A
- B
- C
- D

41. The graph of boiling point against hydrides of Group 14,15,16,17 (Group IV, V, VI, VII) reveals that:

- 1 The boiling points of the hydrides of the Group 14 element increases down the group due to increase in van der waal's forces.
- 2 The boiling points of the first members of the hydrides of Group 15, 16 and 17 have abnormally high boiling points because their molecules are held by hydrogen bonds.
- 3 The boiling points of the hydrides of Group 17 decrease down the group due to decrease in the strength of the hydrogen bonds.

- A
- B
- C
- D

42. The two isomers corresponding to the molecular formula  $C_3H_6O_2$
- 1 can be distinguished using  $PCl_5$
  - 2 are functional group isomers
  - 3 will undergo condensation reaction

A  
B  
C  
D

43. The Rutherford gold-foil experiment led to the discovery of
- 1 The electron
  - 2 The neutron
  - 3 The position and properties of the nucleus

A  
B  
C  
D

44. Phenylamine ( $C_6H_5NH_2$ ) is a brown liquid.
- 1 It is insoluble in water but soluble in dilute acids
  - 2 It will react with bromine water to give a white precipitate
  - 3 It can be separated from the reaction mixture when prepared by reduction of nitrobenzene by steam distillation

A  
B  
C  
D

45. Which of the following group 14 (Group IV) element/compounds have giant covalent lattices?

- 1  $SiO_2$
- 2 Ge
- 3  $SnO_2$

A  
B  
C  
D

46. The solubility of ionic compounds depends on

- 1 the strength of the electrostatic attraction between the oppositely charged ions
- 2 hydration energy
- 3 the sizes of the ions

A  
B  
C  
D

Questions 47 - 50 (Four questions)

Directions: Each of the following questions consists of a statement in the left-hand column followed by a second statement in the right-hand column.

Decide whether the first statement is true or false. Decide whether the second statement is true or false. Then choose:

- A If both statements are true and the second statement is a CORRECT explanation of the first statement
- B If both statements are true and the second statement is NOT a CORRECT explanation of the first statement.
- C If the first statement is true, but the second statement is false.
- D If the first statement is false, but the second statement is true.

Summary of Directions

	First Statement	Second Statement	
A	True	True	Second statement is a CORRECT explanation of the first
B	True	True	Second statement is NOT a CORRECT explanation of the first
C	True	False	
D	False	True	

FIRST STATEMENT

47. Chlorination of methyl benzene in UV light proceeds via free radical substitution

SECOND STATEMENT

Methyl benzene is oxidized to benzoic acid by  $H^+/KMnO_4(aq)$

48. The hydrogen atom shows only one series of spectral lines

The hydrogen atom contains only one electron

49. All d-block elements are transition metals

Transition metals and compounds function as catalyst because they contain available empty d-orbitals

50. Ethoxyethane has a lower boiling point than butan-1-ol (1-butanol).

Butan-1-ol (1-butanol) molecules are held by hydrogen bonds which are stronger than van der Waal's forces of attraction in ethoxyethane.