

Answer all the questions

1. **A** contains 1.85 g of a monobasic acid, $C_nH_{2n+1}COOH$ in 250 cm^3 . **B** contains 4.00 g NaOH in 1 dm^3 of solution.

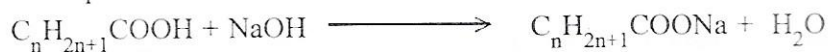
A was put into the burette and titrated against 25.0 cm^3 portions of **B** using phenolphthalein as indicator.

The results are recorded in the table below.

Burette readings/ cm^3	1	2	3
Final reading	28.10	26.70	30.40
Initial reading	2.80	1.70	5.50
Volume of A used/ cm^3	25.30	25.00	24.90

- (a) Calculate the average volume of **A** used.

The equation of the reaction is:



- (b) What was the colour of the phenolphthalein:
- in **B** before the titration?
 - at the end-point?
- (c) From the results and the information provided, calculate the concentration of:
- NaOH in **B** in mol dm^{-3} ;
 - $C_nH_{2n+1}COOH$ in **A** in mol dm^{-3} .
- (d)
- Find the molecular mass of the monobasic acid.
 - Determine the molecular formula of the acid.
 - Write the structural formula of the acid.
- (e) Give a reason why phenolphthalein was used as the indicator.
[H = 1.0, C = 12.0, O = 16.0, Na = 23.0]

[21 marks]

2. C is a mixture of two inorganic salts. The table below shows the tests performed to identify the ions present in C. Copy and complete the table below.

	TEST	OBSERVATION	INFERENCE
(a)	$C_{(aq)} + HCl_{(aq)}$	No gas evolved/ no observable reaction
(b)	$C_{(aq)} + BaCl_{2(aq)}$ +	White precipitate formed precipitate insoluble/ remains undissolved
(c)(i)	$C_{(aq)} + NaOH_{(aq)}$ in drops, then in excess	No precipitate/ no visible reaction No observable reaction
(ii)	Mixture in (c)(i) warmed	NH_3 gas evolved hence NH_4^+ present
(d)(i)	$C_{(aq)} + HNO_{3(aq)}$ +	No observable reaction/ No gas evolved Cl^- present Cl^- confirmed
(ii)	precipitate +	

(e) Write the:

- formulae of the compounds likely to be in C;
- names of the likely compounds in C.

[18 marks]

3. (a) State what would be observed on adding dilute HCl to **each** of the following substances:

- $Na_2SO_{3(s)}$;
- $FeS_{(s)}$;
- $CuCO_{3(s)}$.

[6 marks]

(b) $Zn(OH)_2$ and $Ca(OH)_2$ are white substances.

- What reagent would be **suitable** to distinguish between the two substances?
- Give a reason for the answer stated in 3(b)(i).

[3 marks]

- State **one** disadvantage of evaporation to dryness over crystallization.
- Why is it necessary to recrystallize organic solids after they are synthesized?

[2 marks]

END OF PAPER

Answer **four** questions in all: Question **1** in Section A and **three** questions from Section B.

All questions carry equal marks.

No marks will be awarded for answering questions **not** specified for your own Country.
Credit will be given for clarity of expression and orderly presentation of material.

SECTION A

Answer all the questions in this section.

1. (a) State what would be observed and the substance responsible for the observation in each of the following reactions:
- (i) $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow[\text{heat}]{\text{I}_2/\text{NaOH}}$:
- (ii) $\text{CH}_3\text{CH}_2\text{C} \equiv \text{CH} \xrightarrow{\text{ammoniacal AgNO}_3}$ [4 marks]
- (b) Distinguish between *empirical formula* and *structural formula*. [2 mark]
- (c) (i) What is *resonance*?
(ii) What are *canonical forms*? [3 marks]
- (d) (i) Draw the structure of the **major** product formed when water is added to $\text{CH}_3\text{CH}=\text{CH}_2$.
(ii) Give the IUPAC name of the structure drawn in (d)(i). [2 marks]
- (e) State **two** of the guiding principles used in filling in electrons in an atom. [4 marks]
- (f) A compound of formula $\text{C}_n\text{H}_{2n+2}$ is completely oxidized with oxygen.
(i) Name the products formed;
(ii) Write a balanced equation for the reaction. [4 marks]
- (g) Consider the electrode potential for the following elements: potassium, aluminium,
 $E^\theta, \text{K}^+/\text{K} = -2.92 \text{ V}$
 $E^\theta, \text{Al}^{3+}/\text{Al} = -1.66 \text{ V}$
 Which of the elements is a **stronger** reducing agent? [1 mark]
- (h) (i) Arrange the following compounds in order of **increasing** boiling points:
 $\text{CH}_3\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{COOH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$.
 (ii) Explain **briefly** the answer given in (h)(i). [3 marks]
- (i) Give **one** reason why acids have similar reactions. [1 mark]

- (j) What is the name of the heat change that accompanies the reaction represented by the following equation:



[1 mark]

SECTION B

Answer **three** questions **only** from this section.

FOR ALL CANDIDATES

2. (a) Explain **briefly** each of the following observations:
- There is a general increase in melting point from sodium to aluminium;
 - Silicon has the **highest** melting point among the elements in period 3.
- [4 marks]
- (b) The following results were obtained when copper(II) tetraoxosulphate(VI) solution was electrolysed using copper electrodes.
- Mass of anode before electrolysis = 6.83 g
 Mass of anode after electrolysis = 3.64 g
 Mass of cathode before electrolysis = 4.28 g
- Write ionic equation for the reaction at the:
 - anode;
 - cathode.
 - Calculate the mass of the cathode after the electrolysis.
 - If the electrolysis was carried out for 40 minutes using a current of 4 amperes, calculate the value of the faraday.
- [9 marks]
- (c) (i) Which of the following molecules has hydrogen bonds as intermolecular forces?
 CH_3COOH , HF , HI , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_2\text{H}_5\text{Cl}$
- (ii) State **three** physical properties of liquids that could be increased as a result of hydrogen bonding.
- [6 marks]
- (d) Write balanced equations for the reactions involved in the extraction of iron in the blast furnace.
- [6 marks]
3. (a) Write balanced chemical equations to illustrate **three** chemical properties of chlorine.
- [6 marks]
- (b) (i) Write a chemical equation for the formation of ethylpropanoate.
 (ii) What are the monomers of protein called?
 (iii) State the functional groups present in a monomer of protein.
 (iv) State the type of reaction involved in the formation of proteins from their monomers.
- [6 marks]

- (c) Consider the physical properties of the following substances:

Substance	Melting point/°C	Boiling point/°C	Solubility in water at 25°C
K	30	107	insoluble
L	31	140	insoluble
M	861	1100	soluble

If K and L are miscible when melted and L and M react when heated, describe how a mixture of K, L and M could be separated. [6 marks]

- (d) Dilute tetraoxosulphate(VI) acid reacts with aqueous sodium hydroxide.

- Write a balanced chemical equation for the reaction;
- Name the products formed;
- What is the effect of the resulting solution on blue litmus paper?
- What happens when the resulting solution is heated nearly to dryness and cooled. [7 marks]

FOR CANDIDATES IN GHANA ONLY

4. (a) Show by means of a chemical equation, the product of self-ionization in each of the following solvents:

- H_2O ;
- NH_3 .

[4 mark]

- (b) An experiment was performed to detect the presence of sulphur and the halogens in an organic compound. A piece of sodium metal was added to a portion of the sample in a test tube and heated to red hot. The test tube with its content was plunged into a small amount of water and boiled again. The mixture was filtered to obtain a stock solution. How could the stock solution be treated to detect the presence of:

- sulphur;
- the halogens.

[6 mark]

- (c) (i) Distinguish between **each** of the following pairs of terms:
- nucleon and nuclide;
 - α -particle and β -particle.
- (ii) State **three** peaceful applications of radioactivity.
- (iii) A radioisotope Q_RX undergoes α -decay. Give the:
- mass number;
 - atomic number of the nuclide formed.

[7 mark]

- (d) (i) Write an equation for the reaction between ethanoic acid and pentan-1-ol.
 (ii) If 1.10 g of pentan-1-ol and 1.20 g of ethanoic acid were mixed and allowed to reach equilibrium at 298 K,
 (α) write an expression for the equilibrium constant, K_c , for this reaction.
 (β) if at equilibrium, 0.60 g of ethanoic acid remained, calculate the value for K_c .
 [H = 1.0, C = 12.0, O = 16.0, CH₃COOH = 60, C₅H₁₁OH = 88]

[8 marks]

5. (a) State the charge on the complex ion formed by:

- (i) Cr(III) in [CrCl(H₂O)₅];
 (ii) Fe(II) in [Fe(CN)₆];
 (iii) Ni(II) in [Ni(NH₃)₅Cl]

[3 marks]

- (b) Consider the following data:

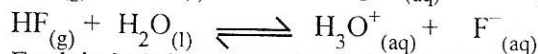
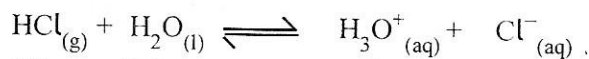
Bond	Bond energy in kJ mol ⁻¹
H—H	+436
F—F	+158
H—F	+562

Use the data to show that the following reaction is exothermic:



[5 marks]

- (c) (i) Define *an acid* in terms of Bronsted-Lowry Concept.
 (ii) Both hydrogen chloride and hydrogen fluoride react with water to form acidic solutions as follows:



Explain **briefly** why water behaves as a Bronsted-Lowry base in **both** reactions.

- (iii) Explain why the conjugate base of a weak acid is a strong base.
 (iv) (α) Write an equation for the reaction between ammonia and water.
 (β) State which of the species acts as an acid in the reverse reaction in the equation in (α).

[8 marks]

- (d) (i) Define the term *half-life* in radioactivity.
 (ii) The half-life of two nuclides, A and B, are 24 days and 68 seconds respectively.
 (α) Which of the **two** nuclides is **more** stable?
 (β) Give a reason for the answer stated in (α).
 (iii) State **two** factors that determine the stability of an atomic nucleus.

[6 marks]

- (e) State the type of bond that holds molecules of **each** of the following compounds:

- (i) ice;
 (ii) H₂S;
 (iii) NaBr.

[3 marks]
Turn over

FOR CANDIDATES IN NIGERIA, SIERRA LEONE, THE GAMBIA AND LIBERIA

4. (a) Using appropriate equations, show the chemical changes that occur when a piece of sodium metal is exposed to the atmosphere for a long period of time. [6 marks]
- (b) (i) Describe **briefly** the laboratory preparation of oxygen from hydrogen peroxide.
 (ii) Write the equation for the reaction in (i). [7 marks]
- (c) List the **major** product(s) of **each** of the following reactions:
 (i) burning carbon in limited air;
 (ii) heating carbon with calcium at high temperature;
 (iii) heating carbon with concentrated trioxonitrate(V) acid. [6 marks]
- (d) (i) State **two** sources of air pollution.
 (ii) Suggest **two** ways of reducing air pollution;
 (iii) Mention **two** sources of water pollution. [6 marks]
5. (a) Ammonia is manufactured industrially by the reaction between nitrogen gas and hydrogen gas.
 (i) State **one** major source of:
 (α) nitrogen;
 (β) hydrogen.
 (ii) Write a balanced chemical equation for the reaction.
 (iii) State **two** conditions necessary for a high yield of ammonia.
 (iv) Give **two** uses of ammonia. [8 marks]
- (b) (i) State the method of collecting gases which are denser than air.
 (ii) Give **two** examples of gases that could be collected by the method stated in (i).
 (iii) Name **two** gases that could be used to perform the fountain experiment.
 (iv) State the property of the gases that makes them suitable for the experiment mentioned in (iii). [6 marks]
- (c) Decomposition of MgCO_3 produced 78 cm^3 of CO_2 at 27°C and 200 kPa according to the following reaction equation:

$$\text{MgCO}_{3(s)} \xrightarrow{\Delta} \text{MgO}_{(s)} + \text{CO}_{2(g)}$$

 Calculate the mass of CO_2 produced.
 [Molar mass of $\text{CO}_2 = 44.0$, $R = 8.31 \text{ kPa dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$] [7 marks]
- (d) (i) Write an equation for the reaction by which sulphur dioxide in solution could be converted to tetraoxosulphate(VI) acid.
 (ii) State the reaction of concentrated tetraoxosulphate(VI) acid with:
 (α) oxalic acid;
 (β) copper. [4 marks]

END OF ESSAY TEST

**DO NOT TURN OVER THIS PAGE
UNTIL YOU ARE TOLD TO DO SO.**

**YOU WILL BE PENALIZED SEVERELY IF YOU ARE
FOUND LOOKING AT THE NEXT PAGE BEFORE
YOU ARE TOLD TO DO SO.**

**WHILE YOU ARE WAITING, READ THE FOLLOWING
INSTRUCTIONS CAREFULLY.**

PAPER 1
OBJECTIVE TEST
[50 marks]

1 hour

- Use 2B pencil throughout.
- On the pre-printed answer sheet, check that the following details are **correctly** printed:
 - In the space marked *Name*, check your **surname** followed by your **other names**.
 - In the spaces marked *Examination*, *Year*, *Subject* and *Paper*, check, 'WASSCE', 'PC 2020', 'CHEMISTRY', and '1' in that order.
 - In the box marked *Index Number*, your index number has been printed vertically in the spaces on the left-hand side, and each numbered space has been shaded in line with each digit. **Reshade** each of the shaded spaces.
 - In the box marked *Subject Code*, the digits 505213 are printed vertically in the spaces on the left-hand side. **Reshade** the corresponding numbered spaces as you did for your index number.
- An example is given below. This is for a female candidate whose *name* is Gifty Adzo AMANOR. Her *index number* is 7102143958 and she is offering *Chemistry* 1.

**THE WEST AFRICAN EXAMINATIONS COUNCIL
ANSWER SHEET**

PRINTED IN BLOCK LETTERS		GHA	
Name: AMANOR GIFTY ADZO		Year: PC 2020	
Examination: WASSCE		Paper: 1	
Subject: CHEMISTRY			

INSTRUCTIONS TO CANDIDATES

- Use grade 8B pencil throughout.
- Answer each question by choosing one letter and shading it like this: A B C D E
- Erase completely any answer you wish to change.
- Leave extra spaces blank if the answer spaces provided are more than you need.

INDEX NUMBER	
7	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
0	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
4	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9
9	0 1 2 3 4 5 6 7 8 9
5	0 1 2 3 4 5 6 7 8 9
8	0 1 2 3 4 5 6 7 8 9

SUBJECT CODE	
5	0 1 2 3 4 5 6 7 8 9
0	0 1 2 3 4 5 6 7 8 9
5	0 1 2 3 4 5 6 7 8 9
2	0 1 2 3 4 5 6 7 8 9
1	0 1 2 3 4 5 6 7 8 9
3	0 1 2 3 4 5 6 7 8 9

For Supervisors only
If candidate is absent
shade this space

Answer **all** the questions.

Each question is followed by four options lettered A to D. Find the **correct** option for each question and shade in **pencil** on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only **one** answer to **each** question. An example is given below.

Which of the following elements reacts with water?

- A. Carbon
- B. Iodine
- C. Sulphur
- D. Sodium

The correct answer is Sodium which is lettered D and therefore answer space D would be shaded.

A

B

C

D

Think carefully before you shade the spaces; erase completely any answer you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

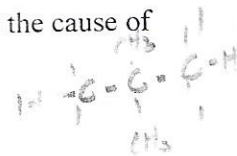
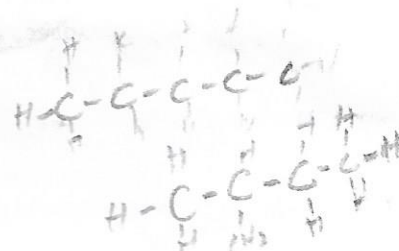
1. Which of the following statements describes a redox reaction? It
 - A. takes place only in acidic medium.
 - B. involves only the loss of electrons.
 - C. involves the loss and gain of electrons.
 - D. takes place only in alkaline medium.

2. Benzene is produced from ethyne by
 - A. polymerization.
 - B. addition reaction.
 - C. hydrolysis.
 - D. cracking.

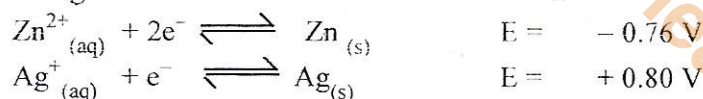
3. The increasing concentration of carbon(IV) oxide and other green house gases is the cause of
 - A. photochemical smog.
 - B. air pollution.
 - C. global warming.
 - D. acid rain.

4. How many structural isomers has the molecular formula C_5H_{12} ?
 - A. 2
 - B. 5
 - C. 4
 - D. 3

5. Which of the following ions would migrate to the cathode during electrolysis?
 - A. Zinc ions
 - B. Sulphide ions
 - C. Trioxonitrate(V) ions
 - D. Tetraoxosulphate(VI) ions



6. The following half-cells were connected to form a cell.

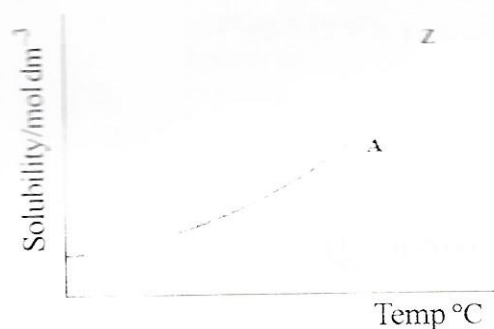


The e.m.f. of the cell formed is

- A. + 0.04 V.
 B. - 0.04 V.
 C. + 1.56 V.
 D. - 1.56 V.
7. Dehydration of ethanol in the presence of excess tetraoxosulphate(VI) acid produces
- A. ethene.
 B. methanol.
 C. ethane.
 D. ethanoic acid.
8. Which of the following substances would form a precipitate when reacted with $\text{Ca}(\text{NO}_3)_2(\text{aq})$?
- A. SO_2
 B. H_2SO_4
 C. NH_3
 D. HCl
9. Which of the following compounds is **not** a hydrocarbon?
- A. Benzene
 B. Ethane
 C. Propanol
 D. Methane
10. If 56.0 cm^3 of a hydrocarbon weighs 0.07 g at s.t.p., what is the relative molar mass of the hydrocarbon? [Molar volume at s.t.p. = 22.4 dm^3]
- A. 28
 B. 30
 C. 32
 D. 36
11. The chemical process by which protein is digested is
- A. condensation.
 B. decomposition.
 C. dehydration.
 D. hydrolysis.
12. The bonding electrons of zinc (${}_{30}\text{Zn}$) are contained in the
- A. f - orbital.
 B. d - orbital.
 C. s - orbital.
 D. p - orbital.
13. A catalyst **increases** the rate of a reaction by
- A. increasing the collision frequency of particles.
 B. increasing the temperature of the reaction.
 C. increasing the speed of the particles.
 D. lowering the activation energy.

14. An increase in concentration increases the rate of a reaction by increasing the
- closeness between reactant particles.
 - energy barrier of the reaction.
 - surface area of reactant particles.
 - average kinetic energy of reactant particles.
15. The rate of reaction depends on the molar concentration of reactants which
- remains the same with time.
 - does not depend on time.
 - keeps increasing with time.
 - keeps decreasing with time.
16. A reaction is endothermic if the
- enthalpy change is negative.
 - heat of reactants exceeds the heat of products.
 - reaction vessel feels cool during the reaction.
 - energy evolved in bond formation exceeds the energy absorbed in bond breaking.
17. When activation energy is lowered, the reaction becomes
- slower.
 - faster.
 - reversible.
 - irreversible.
18. Solubility is practically applied in
- the determination of saturation in hydrocarbons.
 - the determination of pH.
 - fractional distillation.
 - solvent extraction.

The graph below is the solubility curve of salt Z. Use the information given to answer question 19.



19. Point A on the graph represents
- an unsaturated solution.
 - a supersaturated solution.
 - a saturated solution.
 - a concentrated solution.
20. The solubility of CaCl_2 containing 12.20 g in 40.0 cm^3 of water at 30°C is
 $[\text{CaCl}_2 = 111]$
- 4.22 mol dm^{-3} .
 - 5.50 mol dm^{-3} .
 - 3.10 mol dm^{-3} .
 - 2.75 mol dm^{-3} .

21. Ethanoic acid is a weaker acid than hydrochloric acid because it
- partially dissociates in aqueous solution.
 - fully dissociates in aqueous solution.
 - is a mineral acid.
 - is an organic acid.

22. Consider the following reaction equation:



What is the mass of $\text{Ca}(\text{OH})_{2(aq)}$ that would be formed, when 40 g of calcium reacts with 100 g of water?

[H = 1.0, O = 16.0, Ca = 40.0]

- 74 g
 - 58 g
 - 138 g
 - 140 g
23. Which of the following acids is the **weakest**?
- HCl
 - HBr
 - HF
 - HI

24. What volume of 0.5 mol dm^{-3} tetraoxosulphate(VI) acid would neutralize 20.0 cm^3 of 0.1 mol dm^{-3} sodium hydroxide solution?

- 4.00 cm^3
- 2.00 cm^3
- 0.025 cm^3
- 0.020 cm^3

Handwritten calculation:

$$0.5 \times V = 20.0 \times 0.1$$

$$0.5V = 2.0$$

$$V = \frac{2.0}{0.5} = 4.0 \text{ cm}^3$$

25. The bonding in the following compounds is of the same character **except** in

- sodium chloride.
- potassium chloride.
- calcium chloride.
- hydrogen chloride.

26. The high melting point of sodium chloride could be attributed to

- weak van der Waal forces.
- strong electrovalent bond between ions.
- strong metallic bond between sodium and chlorine atoms.
- weak ionic attraction within its crystal lattice.

27. Phosphorus **cannot** be used in making electric wire because it

- reacts quickly with gases in air.
- is a liquid at room temperature.
- is not ductile.
- does not occur in nature.

28. Which of the following particles takes part in a chemical reaction?
- Neutrons
 - Electrons
 - Nucleons
 - Protons
29. Which of the following compounds undergoes an addition reaction with chlorine?
- CH_3COOH
 - $\text{C}_2\text{H}_5\text{OH}$
 - C_2H_6
 - C_2H_4
30. Which of the following atoms would form a trivalent anion?
- Nitrogen
 - Lithium
 - Oxygen
 - Aluminium
31. What is the concentration of 100 cm^3 solution prepared by diluting 10 cm^3 of 0.10 mol dm^{-3} stock solution?
- $1.000 \text{ mol dm}^{-3}$
 - $0.100 \text{ mol dm}^{-3}$
 - $0.001 \text{ mol dm}^{-3}$
 - $0.010 \text{ mol dm}^{-3}$
32. Which of the following formulae **correctly** represents lead(II) trioxocarbonate(IV)?
- Pb_2CO_3
 - PbCO_3
 - $\text{Pb}_2(\text{CO}_3)_2$
 - $\text{Pb}(\text{CO}_3)_2$
33. What is the shape of carbon(IV) oxide molecule?
- Trigonal planar
 - Tetrahedral
 - Linear
 - Pyramidal
34. Which of the following products are formed when chlorine reacts with water?
- O_2 , H_2 and HCl
 - HOCl , H_2 and Cl_2
 - H_2 and OCl_2
 - HCl and HOCl
35. The oxidation number of carbon in C_2H_2 is
- +2.
 - 2.
 - +1.
 - 1.

$\text{C}_2\text{H}_2 \rightarrow 4$

36. Compounds with very high melting points are likely to contain
- ionic bond.
 - dative bond.
 - covalent bond.
 - hydrogen bond.
37. Which of the following statements about Group (VII) elements is **not** correct? They
- have high electronegativity values.
 - have relatively low ionization energy.
 - are good oxidizing agents.
 - are diatomic.
38. Which of the following statements is **not** a property of an alkali?
- Turns red litmus paper blue
 - Corrosive when concentrated
 - Soapy to touch
 - Sour to taste
39. Differences between solids, liquids and gases are explained in terms of the kinetic theory. Which of the following statements are **correct**?
- Particles are closer together in liquids than in gases.
 - All liquids are viscous.
 - Molecules leave the liquid surface and become gaseous when they have sufficient velocity.
 - There are forces of attraction between liquid particles but not between gas particles.
- I, III and IV only
 - I, II and III only
 - II and III only
 - I and II only
40. The method of separation and purification of substances based on the unequal distribution of substances between two carrier phases is known as
- distillation.
 - refluxing.
 - chromatography.
 - crystallization.
41. A 4.00 dm^3 of a gas has a pressure of 1.15 kPa. What would be the volume after the pressure has been increased to 2.30 kPa at constant temperature?
- 16.00 dm^3
 - 8.00 dm^3
 - 4.00 dm^3
 - 2.00 dm^3
42. The molarity of a given solution is defined as
- mole of solute in 1 dm^3 of solution.
 - mass of solute in 1 dm^3 of solution.
 - mole of solute in a given volume of solution.
 - mass of solute in a given volume of solution.
43. The atomic number of an atom would be equal to its mass number if it
- does not contain neutrons.
 - has a totally filled valence shell.
 - has a high charge to mass ratio.
 - exhibits isotopy.

44. What is the electron configuration of ${}_{12}\text{Mg}^{2+}$?
- $1s^1 2s^2 2p^6 3s^2 3p^2$
 - $1s^2 2s^2 2p^6 3s^2$
 - $1s^2 2s^2 2p^6$
 - $1s^2 2s^2 2p^4$
45. Which of the following substances sublimes?
- Ammonium chloride
 - Aluminium oxide
 - Sodium chloride
 - Calcium oxide
46. What group of the periodic table does an element with the electron configuration $1s^2 2s^2 2p^2$ belong?
- II
 - I
 - IV
 - III
47. In condensation polymerization.
- two different repeating monomer units are involved.
 - one kind of repeating monomer units are involved.
 - monomer units are unsaturated.
 - small molecules like H_2O and NH_3 are eliminated.
- I, II and III only
 - I, II and IV only
 - I, III and IV only
 - II, III and IV only
48. *Pauli exclusion principle* is related to
- quantum numbers of electrons.
 - filling degenerate orbitals.
 - filling the orbitals with lower energy first.
 - quantity of electrons in the valence shell.
49. The temperature referred to as absolute zero is
- 0°C .
 - 273°C .
 - 273 K .
 - -273°C .
50. The total number of protons and neutrons in an atom is referred to as
- molar mass.
 - mass number.
 - atomic mass.
 - atomic number.

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