

**Part One**

**Time: 50 minutes**

**Value: 50 %**

**Instructions : Shade in the letter of the correct response on the answer sheet provided.**

- Which measurement shows three significant digits?
  - 0.006 g
  - 0.010 g
  - 0.2040 g
  - 3050 g
- Which value is 25.2 L converted to millilitres with the same number of significant digits?
  - 252 mL
  - 2 500 mL
  - 25 200 mL
  - $2.520 \times 10^4$  mL
- What can atoms of different elements possess?
  - Same atomic number
  - Same number of electrons
  - Same number of neutrons
  - Same number of protons
- An element with atomic number 17 on the periodic table has a mass number of 35. It contains, in respective order of protons, neutrons and electrons, which of the following?
  - 17, 17, 35
  - 17, 18, 17
  - 17, 35, 18
  - 18, 17, 28
- What is the molar mass of  $\text{Fe}_2(\text{SO}_3)_3 \cdot 5\text{H}_2\text{O}(\text{s})$ ?
  - 121.93 g
  - 345.98 g
  - 369.90 g
  - 442.01 g
- Which is **not** equivalent to the other three choices?
  - Avogadro's number of oxygen molecules
  - 1.00 mol of oxygen molecules
  - 16.00 g of oxygen molecules
  - $6.02 \times 10^{23}$  oxygen molecules
- What is the mass of  $6.02 \times 10^{23}$  molecules of carbon tetrachloride?
  - 47.5 g
  - 154 g
  - $6.02 \times 10^{23}$  g
  - 1 mol
- A sample of iron contains 3.6 mol. How many atoms are contained in the sample?
  - $6.0 \times 10^{-24}$
  - $2.2 \times 10^1$
  - $1.9 \times 10^{23}$
  - $2.2 \times 10^{24}$
- 9.1 L of neon gas contains what number of moles at STP?
  - $4.1 \times 10^{-1}$
  - $2.5 \times 10^0$
  - $2.0 \times 10^1$
  - $2.0 \times 10^2$

10. What volume would 1.62 mol of helium gas occupy at STP?
- A. 36.288 L
  - B. 36.3 L
  - C. 40.176 L
  - D. 40.2 L
11. If 1.424 mol of cobalt are required for an experiment, then what is the mass of cobalt required?
- A. 0.02416 g
  - B. 41.38 g
  - C. 58.93 g
  - D. 83.92 g
12. If 67 mL of skidoo oil was completely dissolved in 879 mL of gasoline, which statement below would accurately describe the resulting solution?
- A. 67 mL of solute and 879 mL of solvent
  - B. 67 mL of solvent and 879 mL of solute
  - C. 67 mL of solvent and 946 mL of solute
  - D. 879 mL of solute and 946 mL of solvent
13. In a dilution problem, which of the following is correct?
- A. Concentration doesn't change in dilution
  - B. Initial concentration is always greater than final concentration
  - C. Initial concentration is always less than the final concentration
  - D. Initial volume is always more than the final volume
14. A student added an ionic compound such as NaOH to water. It completely dissolved, no presence of solid was observable. The molar concentration of NaOH solution was found to be 5.036 mol/L. Which statement best describes the solution?
- A. concentrated and saturated
  - B. concentrated and unsaturated
  - C. dilute and saturated
  - D. dilute and unsaturated
15. How many moles of NaCl are needed to prepare 0.4L of 1.28 mol/L solution?
- A. 0.5 mol
  - B. 0.512 mol
  - C. 3 mol
  - D. 3.2 mol
16. A solution was formed by adding 3.5 mol of KOH to make a 4.7 L solution. Which is the correct molar concentration?
- A.  $7.4 \times 10^{-1}$  mol/L
  - B.  $1.2 \times 10^0$  mol/L
  - C.  $1.3 \times 10^0$  mol/L
  - D.  $1.6 \times 10^1$  mol/L
17. A student was asked to dilute a 3.5 mol/L solution to make a 0.034 mol/L solution with a volume of 3.8 L. What was the initial volume of the solution?
- A.  $3.1 \times 10^{-2}$  L
  - B.  $3.7 \times 10^{-2}$  L
  - C.  $2.7 \times 10^1$  L
  - D.  $3.2 \times 10^1$  L
18. What volume would you need to remove from a stock solution of 2.8mol/L calcium phosphate to make a new 500.0mL, 0.3mol/L solution?
- A. 0.054 L
  - B. 1.7 L
  - C.  $1.9 \times 10^1$  L
  - D. 4.7 L

19. A sodium fluoride solution contains 268.0mL of water and 62.8g of solute. What is the concentration of the solution?
- 5.58 mol/L
  - $1.79 \times 10^2$  mol/L
  - $7.07 \times 10^2$  mol/L
  - $9.84 \times 10^3$  mol/L
20. The actual yield of a precipitate during a chemical reaction was found to be 85.0 g. The chemist that performed the experiment had calculated that she should have produced 95.6 g of precipitate. What was the percentage yield of this reaction?
- 11.1
  - 12.0
  - 88.9
  - 112
21. What is the concentration of acetate ions in 2.00 mol/L solution of aluminum acetate?
- 2.00 mol/L
  - 4.00 mol/L
  - 6.00 mol/L
  - 8.00 mol/L
22. A reaction between potassium and sulfur ended after all the sulfur was consumed. What is the best way to describe potassium in this situation?
- excess reagent
  - limiting reagent
  - theoretical reagent
  - theoretical yield
23. Which substance exhibits the strongest London Dispersion Forces?
- $C_6H_{14}$
  - HBr
  - $PF_2Cl$
  - Xe
24. Which type of bonding occurs between an element with low electronegativity and an element with high electronegativity?
- Covalent
  - Hydrogen
  - Ionic
  - Network covalent
25. Which substance exhibits the strongest London Dispersion Forces?
- Ar
  - $CO_2$
  - $C_2H_6$
  - HCl
26. What explains the ductility, conductivity, and malleability of metals?
- a sea of moving electrons
  - electrons locked into position
  - equally shared electron pairs
  - unequally shared electron pairs
27. Which pair of elements will form compounds with ionic bonding?
- carbon and fluorine
  - chlorine and bromine
  - phosphorus and chlorine
  - potassium and fluorine
28. Which substance is a network covalent solid?
- $CO_2$  (g)
  - $H_2O$  (l)
  - NaCl (s)
  - SiC (s)

29. Which structural formula is correct?
- A.  $\text{H}=\text{C}=\text{N}$
- B.  $\text{H}-\text{C}\equiv\text{C}-\text{H}$
- C.  $\begin{array}{c} \text{H}-\text{C}=\text{C}=\text{C}-\text{H} \\ | \quad | \quad | \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$
- D.  $\text{O}=\text{C}=\text{O}-\text{H}$
30. Which molecule has a V-shaped (bent) molecule?
- A. ammonia
- B. hydrogen chloride
- C. methane
- D. water
31. Which situation does not involve intermolecular forces in bonding?
- A. Acid molecules attracting other acid molecules
- B. Forces of attraction holding molecules of ethanol together in alcohol
- C. The hydrogen atoms in an  $\text{H}_3\text{P}$  molecule attracting the phosphorus atoms
- D. The hydrogen atoms of water attracting the oxygen atom of  $\text{CH}_3\text{OH}$
32. Which is a covalently-bonded compound?
- A.  $\text{AgNO}_3$  (s)
- B.  $\text{CaCl}_2$  (s)
- C.  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  (s)
- D.  $\text{ZnCl}_2$  (s)
33. Which molecule has a pyramidal shape?
- A. ammonia
- B. hydrogen chloride
- C. methane
- D. water
34. Which is likely to have the highest boiling point?
- A.  $\text{CH}_4$
- B.  $\text{HF}$
- C.  $\text{H}_2\text{O}$
- D.  $\text{PH}_3$
35. The boiling point of  $\text{C}_3\text{H}_8$  is  $-45^\circ\text{C}$  while  $\text{CH}_3\text{Cl}$  is  $-24^\circ\text{C}$ . What force accounts for the difference in boiling point?
- A. dipole-dipole
- B. hydrogen bonding
- C. ionic bonding
- D. LDF
36. Which is likely to have the lowest boiling point?
- A.  $\text{CH}_4$
- B.  $\text{HF}$
- C.  $\text{H}_2\text{O}$
- D.  $\text{NH}_3$
37. Which type of bonding occurs between an element with low electronegativity and another element with low electronegativity?
- A. Covalent
- B. Hydrogen
- C. Ionic
- D. Metallic

38. Which is a nonpolar molecule?  
A.  $\text{CH}_3\text{Br}$   
B.  $\text{C}_2\text{H}_5\text{F}$   
C.  $\text{NH}_3$   
D.  $\text{PH}_3$
39. Which compound is **not** an organic compound?  
A.  $\text{CH}_3\text{CONH}_2$   
B.  $\text{CaCO}_3$   
C.  $\text{C}_5\text{H}_{11}\text{CHO}$   
D.  $\text{CH}_2\text{CHSCH}_3$
40. What property of carbon atoms accounts for the great variety of hydrocarbon compounds?  
A. They are produced by living organisms  
B. They have high electronegativity  
C. They form covalent bonds  
D. They have four bonding electrons
41. Which represents the general formula for an alkyne?  
A.  $\text{C}_n\text{H}_n$   
B.  $\text{C}_n\text{H}_{2n}$   
C.  $\text{C}_n\text{H}_{2n-2}$   
D.  $\text{C}_n\text{H}_{2n+2}$
42. Which represents the general formula for a cyclic alkane?  
A.  $\text{C}_n\text{H}_n$   
B.  $\text{C}_n\text{H}_{2n}$   
C.  $\text{C}_n\text{H}_{2n-2}$   
D.  $\text{C}_n\text{H}_{2n+2}$
43. Pentene is which type of compound?  
A. Aliphatic hydrocarbon  
B. Alkyne  
C. Aromatic hydrocarbon  
D. Cyclic hydrocarbon
44. Which ending denotes a triple bond?  
A. -ane  
B. -ene  
C. -yne  
D. -benzene
45. The formula  $\text{C}_8\text{H}_{14}$  is an example of which of the following?  
A. Condensed structural formula  
B. Complete structural formula  
C. Skeletal formula  
D. Molecular formula
46. Which name is **incorrect** according to the IUPAC rules of nomenclature?  
A. 3,5-diethyl-2,3-dimethyl-5-propyldecane  
B. 3,4-dimethylpropane  
C. 3-ethylpentane  
D. 4-ethyl-2,3,4-trimethylnonane
47. Which defines molecules containing the same numbers and types of atoms but different arrangements?  
A. Isomers  
B. Isotopes  
C. Monomers  
D. Polymers

48. Which name correctly describes the molecule shown?

- A. 3-butyl-5,5-dimethylpentane
- B. 1,2-diethyl-1,4-dimethylpentane
- C. 2,3-diethyl-5-methylhexane
- D. 2,5-dimethyl-4-ethylheptane

49. What is the name of the following compound?



- A. 2-ethyl-3-methyl-4-hexene
- B. 5-ethyl-4-methyl-2-hexene
- C. 2,3-dimethyl-5-heptene
- D. 4,5-dimethyl-2-heptene

50. Which is an aromatic compound?

- A.  $\text{C}_5\text{H}_8$
- B.  $\text{C}_6\text{H}_5(\text{CH}_3)$
- C.  $\text{C}_7\text{H}_{16}$
- D.  $\text{C}_9\text{H}_{18}$

### Part Two

**Time: 60 minutes**

**Value: 50%**

**Instructions: Complete ALL questions on the paper provided. Be careful to copy it correctly. Show formulas and calculations for numerical problems.**

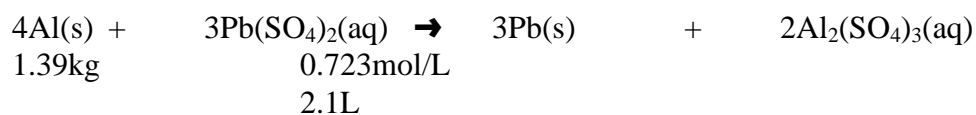
51. (A)  $1.32 \times 10^{24}$  molecules of carbon dioxide decomposes into its elements. Find the volume of oxygen produced if conditions were at STP.

3%

(B) What mass of aluminum sulfide is produced by the reaction of 32.0 mL of 0.423 mol/L lithium sulfide with an aluminum nitrate solution?

5%

(C) Given the following reaction:



(i) Which is the limiting reagent?

3%

(ii) What is the theoretical yield (mass) of the solid lead?

5%

(iii) What is the percent yield for this reaction if the actual yield of lead was measured to be 51.2 g ?

2%

- 2% (D) 15.95g of aluminum nitrate was added to water that resulted in a solution concentration of  $2.66 \times 10^{-1}$  mol/L. What was the volume of water required to make this solution?
- (E) Cinnamaldehyde,  $C_9H_8O$  is responsible for the characteristic odour of cinnamon. Determine its percentage composition.
- 5%
52. (A) Differentiate among ionic, covalent, network covalent and metallic bonding. Use examples where appropriate.
- 4%
- (B) Draw Lewis Dot diagrams, predict the VSEPR shape and determine polarity for each of the following:
- (i)  $CCl_4$
- 9% (ii)  $PH_3$
- (iii)  $CO_2$
- (C) Explain the reason why behind each of the following statements.
- 2% (i)  $H_2O$  has a higher boiling point than  $H_2S$
- (ii)  $CH_3Cl$  has a higher boiling point than  $CH_4$
53. (A) Draw structural formulas, **including your hydrogen**, for each of the following:
- 4% (i) 2,3- dimethylpentane
- (ii) 2-ethyl-4-methyl-3-hexene
- (iii) 4-propyl-2-heptyne
- (iv) p-dimethylbenzene
- (B) **Draw and name** any two (2) isomers of  $C_6H_{12}$ .
- 4%
- (C) Name these compounds
- 2% (i)  $CH_3CH_2C(CH_3)_2CCCH_3$
- (ii)  $C_6H_5CH_3$

