



**GRADE 11 CHEMISTRY (30S)**

**Final Practice Examination**

**Answer Key**



# GRADE 11 CHEMISTRY (30S)

## Final Practice Examination Answer Key

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### Instructions

The final examination will be weighted as follows

Modules 1–3	15–20%
Modules 4–6	80–85%

The format of the examination will be as follows:

Part A: Fill-in-the-Blanks	22 x 1 = 22 marks
Part B: Multiple Choice	46 x 1 = 46 marks
Part C: Short Answer	32 marks
Total Marks	100 marks

Include units with all answers as required.

### Useful Information

You will need the following in order to complete this examination:

- writing utensils and eraser or correction fluid
- some scrap paper
- a ruler
- a scientific calculator

You will have a maximum of 2.5 hours to complete your final exam.

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## Part A: Fill-in-the-Blanks (22 Marks)

Use the Word Bank at the end of this exam to help you complete the “Fill in the Blank” questions. As each blank is worth one mark, some questions will have a total value of two marks. Note that there are MORE terms provided than you need, so read over the list carefully and choose the terms you want to use. The same term may be used more than once in this section.

### Stoichiometry (4 marks)

1. The calculated amount of product formed during a reaction is called the \_\_\_\_\_ yield. *Theoretical*
2. For a given chemical reaction, the actual yield is always \_\_\_\_\_ than the theoretical yield. *Less / smaller*
3. For \_\_\_\_\_ changes, the release of energy is represented by writing the energy term as a product when writing a chemical equation. *Exothermic*
4. Balanced chemical equations contain important information about the amount of reactants required to produce given products. These amounts are represented by \_\_\_\_\_. *Coefficients*

### Solutions (10 marks)

5. A \_\_\_\_\_ is defined as a mixture of two or more substances that are evenly distributed. *Solution*
6. The shape of the water molecule, combined with the nature of its bonds, makes water a \_\_\_\_\_ molecule. *Polar*
7. The total heat change in the dissolving process is called the heat of \_\_\_\_\_. *Solution*
8. Non-polar substances, like waxes and oils, are \_\_\_\_\_ in water. *Insoluble / immiscible*
9. If a solution could dissolve more solute at a particular temperature, the solution is \_\_\_\_\_. *Unsaturated*
10. The number of moles of solute dissolved in 1 L of solution is known as \_\_\_\_\_. *Molarity / concentration*
11. The attraction an atom has for the shared electrons in a covalent bond is called \_\_\_\_\_. *Electronegativity*
12. When water surrounds individual molecules or ions, the molecules or ions are said to be \_\_\_\_\_. *Hydrated*

13. Polar and charged substances dissolve well in \_\_\_\_\_ solvents because of the electrostatic attraction between opposite charges. *Polar*
14. Adding a solute to a solvent lowers the \_\_\_\_\_ pressure of the solvent. *Vapour*

**Organic Chemistry (8 marks)**

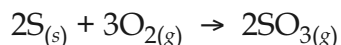
15. Inorganic compounds do NOT tend to contain \_\_\_\_\_. *Carbon*
16. Decaying animals and vegetation is a major source of \_\_\_\_\_ compounds. *Hydrocarbon*
17. When carbon atoms are bonded together in a tetrahedral lattice arrangement, \_\_\_\_\_ is created. *Diamond*
18. Any alkane with one or more alkyl groups is automatically a \_\_\_\_\_ alkane. *Branched-chain*
19. Ethene, a simple alkene, can be transformed back into ethane by adding \_\_\_\_\_. *Hydrogen*
20. All hydrocarbons that do not possess rings are called \_\_\_\_\_ compounds. *Aliphatic*
21. The functional group that identifies a compound as an alcohol is called the \_\_\_\_\_ group. *Hydroxyl*
22. The process of forming an ester from a reaction between an organic acid and an \_\_\_\_\_ is called esterification. *Alcohol*

## Part B: Multiple Choice (46 Marks)

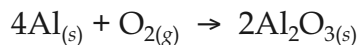
For each Multiple Choice question, shade in the circle that corresponds to your answer on the Bubble Sheet at the end of this exam. DO NOT circle your answers directly on the exam.

### Stoichiometry (6 marks)

1. Which of these interpretations of the following balanced equation is TRUE?



- a) 2 atoms of S and 3 atoms of O<sub>2</sub> form 2 atoms of SO<sub>3</sub>
  - b) 2 grams of S and 3 grams of O<sub>2</sub> form 2 grams of SO<sub>3</sub>
  - c) 2 moles of S and 3 moles of O<sub>2</sub> form 2 moles of SO<sub>3</sub>
  - d) 2 L of S and 3 L of O<sub>2</sub> form 2 L of SO<sub>3</sub>
2. Which type of stoichiometric calculation does not involve the gram formula mass?
- a) Mass-mass problems
  - b) Mass-particle problems
  - c) Mass-volume problems
  - d) Volume-volume problems
3. The ratio of the actual yield to the theoretical yield is known as the
- a) Excess yield
  - b) Reagent yield
  - c) Percent yield
  - d) Experimental yield
4. In the following balanced equation, how many moles of aluminum are needed to form 3.70 moles of aluminum oxide, Al<sub>2</sub>O<sub>3</sub>?



- a) 7.40 moles
- b) 3.70 moles
- c) 2.00 moles
- d) 1.85 moles

5. Convert 35.0 L of nitrogen gas to moles of nitrogen gas at STP.
- a) 1.56 moles
  - b) 0.640 moles
  - c) 7.84 moles
  - d) 22.4 moles
6. Which of the following quantities is conserved in *every* chemical reaction?
- a) Molecules
  - b) Mass
  - c) Formula units
  - d) Moles

**Solutions** (20 marks)

7. Which of the following is LESS soluble in hot water than in cold water?
- a)  $\text{CO}_2$
  - b)  $\text{NaCl}$
  - c)  $\text{NaNO}_3$
  - d)  $\text{KBr}$
8. What can be done to crystallize a supersaturated solution?
- a) Heat the solution.
  - b) It will crystallize if you leave it alone.
  - c) Add a crystal of the solute or scratch the glass.
  - d) Expose the solution to ultraviolet light.
9. In a concentrated solution, there is
- a) No solvent.
  - b) A large amount of solute.
  - c) A small amount of solvent.
  - d) No solute.

10. In which of the following is concentration expressed in percent by volume?
- a) 10% (v/v)
  - b) 10% (m/v)
  - c) 10% (m/m)
  - d) 10%
11. Which of the following is NOT a colligative property of a solution?
- a) Boiling point elevation
  - b) Freezing point depression
  - c) Vapour pressure lowering
  - d) Solution saturation
12. What is the maximum amount of KCl that can be dissolved into 150.0 g of water?  
(The solubility of KCl is 34.0 g/100 mL at STP.)
- a) 51.0 g
  - b) 22.7 g
  - c) 34.0 g
  - d) 5.10 g
13. Which of the following pairs of substances are miscible?
- a) Water and gasoline
  - b) Water and salt (NaCl)
  - c) Water and oxygen
  - d) Water and ethanol (alcohol)

14. At STP, the solubility of solute XY is  $\frac{10 \text{ g}}{100 \text{ g water}}$ . Which of the following solution concentrations could represent an *unsaturated* solution of solute XY?

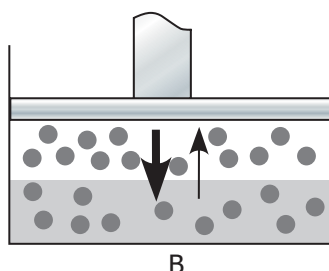
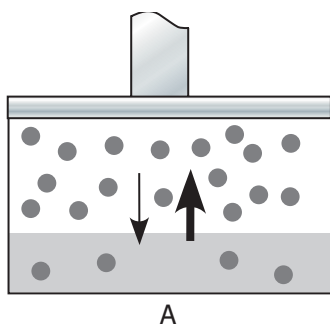
a)  $\frac{10 \text{ g}}{100 \text{ g water}}$

b)  $\frac{9 \text{ g}}{100 \text{ g water}}$

c)  $\frac{5 \text{ g}}{50 \text{ g water}}$

d)  $\frac{11 \text{ g}}{100 \text{ g water}}$

15. Use the following two diagrams of a gas-liquid solution to help you determine which statement below is FALSE.



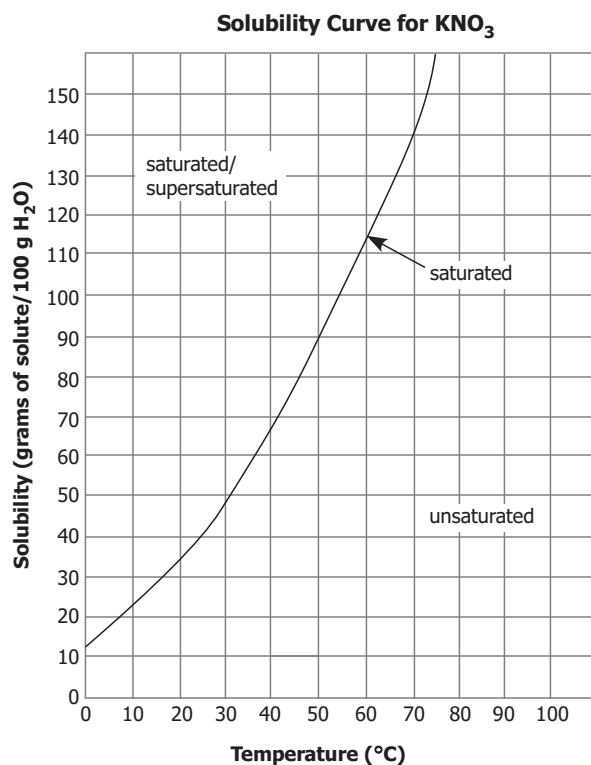
- a) The increased pressure in diagram B illustrates an increased solubility of the gas in the liquid.
- b) The increased pressure shown in diagram B forces the gas into contact with the liquid.
- c) Diagram A shows a greater amount of gas in solution, whereby the liquid holds onto the gas particles.
- d) When the pressure is reduced in diagram A, the solubility of the dissolved gas is reduced.

16. The solubility of a gas in a liquid

- a) Increases as the pressure of the gas above the liquid increases.
- b) Decreases as the pressure of the gas above the liquid increases.
- b) Increases as the pressure of the gas above the liquid decreases.
- d) Is unrelated to the pressure of the gas above the liquid.

17. Which type of mixture could most likely be filtered using filter paper?
- a) A colloid
  - b) A suspension
  - c) A solution
  - d) An emulsion
18. Which of these statements regarding the water molecule is FALSE?
- a) Oxygen is more electronegative than the hydrogen.
  - b) The electrons between the hydrogen and oxygen atoms in each bond lie more towards the oxygen than they do towards the hydrogen.
  - c) The hydrogen atoms are bonded to the oxygen at an angle of  $104.5^\circ$ , which gives the water molecule its characteristic bent shape.
  - d) The water molecule is a non-polar molecule.
19. Which statement below would NOT ensure greater conductivity of an electric current?
- a) There must be charged particles or ions present in the solution.
  - b) Particles must move freely through the solution.
  - c) There must be fewer ions present in solution.
  - d) There must be a lower volume of solvent in which the ions are dissolved.

Use the "Solubility Curve for  $\text{KNO}_3$ " below for Questions 20 to 22.



20. Estimate the approximate solubility of  $\text{KNO}_3$  at  $30^\circ\text{C}$ .
- 16 g/100 g  $\text{H}_2\text{O}$
  - 33 g/100 g  $\text{H}_2\text{O}$
  - 48 g/100 g  $\text{H}_2\text{O}$
  - 60 g/100 g  $\text{H}_2\text{O}$
21. Estimate the temperature at which the solubility of potassium nitrate is 50 g/100 g.
- About  $90^\circ\text{C}$
  - About  $20^\circ\text{C}$
  - About  $30^\circ\text{C}$
  - About  $8^\circ\text{C}$
22. Indicate which of the following sets of data represents a *saturated* solution of potassium nitrate.
- $25^\circ\text{C}$ : 40 g/100 g  $\text{H}_2\text{O}$
  - $63^\circ\text{C}$ : 140 g/100 g  $\text{H}_2\text{O}$
  - $8^\circ\text{C}$ : 10 g/100 g  $\text{H}_2\text{O}$
  - $74^\circ\text{C}$ : 150 g/100 g  $\text{H}_2\text{O}$

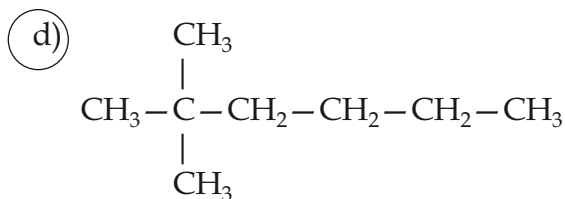
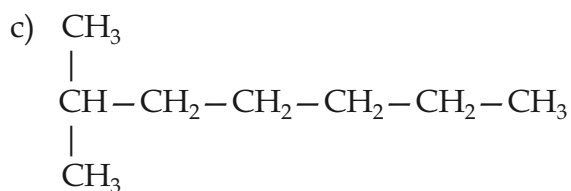
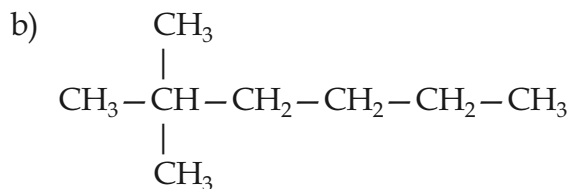
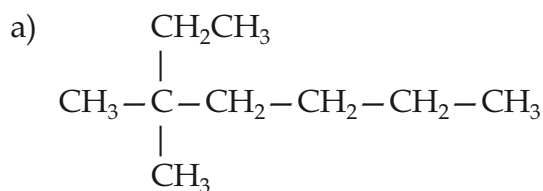
23. How many moles of NaOH would be needed to make 0.0500 L of a 0.750 mol/L solution?
- a) 15.0 mol
  - b) 0.0375 mol
  - c) 50.0 mol
  - d) 0.750 mol
24. Identify the FINAL step to follow when preparing a solution.
- a) Mass out the solute and add it to the flask.
  - b) Add more solvent until you reach the required amount.
  - c) Mass out the solvent and add it to the flask.
  - d) Add about half the required volume of solvent to the flask.
25. You start with a solution that is 0.800 mol/L and exactly 0.0700 L. You need to prepare a 0.300 mol/L solution. What is the final volume of the solution?
- a) 3.43 L
  - b) 0.026 L
  - c) 0.580 L
  - d) 0.187 L
26. Which method of water treatment is useful for controlling disease-causing organisms such as viruses, bacteria, and parasites?
- a) Water softening
  - b) Filtration
  - c) Chlorination
  - d) Distillation

### Organic Chemistry (20 marks)

27. Which of these statements does NOT accurately describe tar sands?
- a) Tar sands provide a synthetically produced source of hydrocarbons.
  - b) Tar sands are a combination of clay, sand, water, and bitumen.
  - c) Tar sands can be mined and processed to extract the oil-rich bitumen.
  - d) Bitumen requires no further refining and can be pumped from the ground in its natural state.

28. Which type of bond will carbon commonly form?
- a) Covalent
  - b) Ionic
  - c) Metallic
  - d) None of these
29. All of these hydrocarbons are *unsaturated* except for
- a) Benzene
  - b) Alkenes
  - c) Alkanes
  - d) Alkynes
30. Which of the following is the correct condensed structural formula for *butane*?
- a)  $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$
  - b)  $\text{CH}_3(\text{CH}_2)_2\text{CH}_3$
  - c)  $(\text{CH}_3)_3\text{CH}_3$
  - d)  $\text{C}_4\text{H}_{10}$
31. Name the following alkane:  $\text{C}_7\text{H}_{16}$
- a) Heptane
  - b) Hexane
  - c) Decane
  - d) Octane

32. The correct structural formula for *2,2-dimethylhexane* is:



33. Molecules that have the same molecular formula but different structural formulas are called

- a) Allotropes
- b) Stereoisomers
- c) Structural isomers
- d) Isotopes

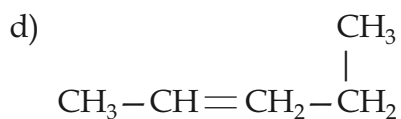
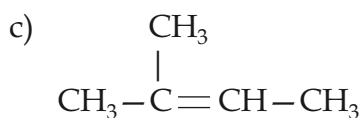
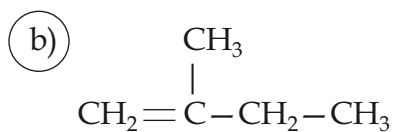
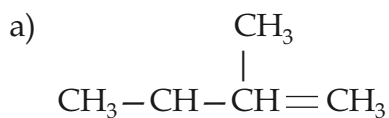
34. Which straight-chain alkane is a structural isomer of *3-propylheptane*?

- a) 10 carbon atoms = decane
- b) 6 carbon atoms = hexane
- c) 9 carbon atoms = nonane
- d) 5 carbon atoms = pentane

35. The correct name for the alkene  $\text{CH}_3\text{CH}=\text{CH}_2$  is

- a) propene
- b) prop-2-ene
- c) 2-propene
- d) prop-3-ene

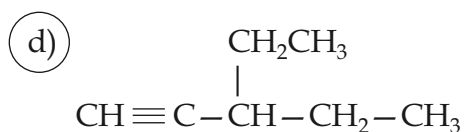
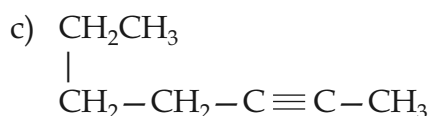
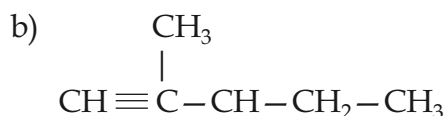
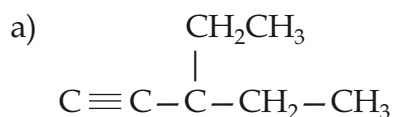
36. The correct structural formula for *2-methylbut-1-ene* is



37. The correct name for the alkyne  $\text{CH}\equiv\text{CCH}_2\text{CH}_2\text{CH}_3$  is

- a) pent-1-yne
- b) 1-pentyne
- c) pentyne
- d) pent-4-yne

38. The correct structural formula for 3-ethylpent-1-yne is



39. Give the IUPAC name for the alcohol  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_3$ .

a) 2-methylpentan-4-ol

b) 2-methyl-4-pentanol

c) 4-methylpentan-2-ol

d) 4-methyl-2-pentanol

40. Identify which of the following alcohols is most likely used to make hand soap.

a) Isopropyl

b) Glycerol

c) Ethanol

d) Methanol

41. Name the following carboxylic acid:  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{COOH}$

a) 3-methylpentanoic acid

b) 2-methylbutanoic acid

c) methyl-3-pentanoic acid

d) methyl-2-butanoic acid

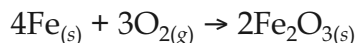
42. Identify which of the following carboxylic acids is responsible for the sting in ant bites.
- a) Benzoic acid
  - b) Lactic acid
  - c) Formic acid
  - d) Acetic acid
43. Name the ester  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{COOCH}_3$ .
- a) methyl butanoate
  - b) methylpentanoic acid
  - c) pentyl methanoate
  - d) methyl pentanoate
44. A very large molecule made of many smaller repeating units is known as
- a) A monomer
  - b) A polymer
  - c) An ester
  - d) An allotrope
45. Which of these examples of is NOT a polymer formed by an addition reaction?
- a) Graphite
  - b) Teflon<sup>TM</sup>
  - c) Polypropylene
  - d) Synthetic rubber
46. Which of these polymers is used for moulded plastics and film?
- a) Polyethylene
  - b) Polyvinyl chloride (PVC)
  - c) Teflon<sup>TM</sup>
  - d) Polypropylene

## Part C: Short Answer (32 Marks)

Answer each of the questions below using the space provided. Pay attention to the number of marks that each question is worth, as this may help you decide how much information to provide for full marks. For questions that involve calculations, show your work and check your final answer for the correct number of significant figures and the appropriate unit.

### Stoichiometry (15 marks)

1. How many moles of  $O_{2(g)}$  react with 2.4 moles of Fe in the following rusting reaction? (2 marks)

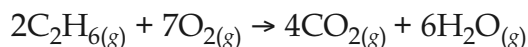


Answer:

$$2.4 \cancel{\text{ mol Fe}} \times \frac{3 \text{ mol } O_2}{4 \cancel{\text{ mol Fe}}} = 1.8 \text{ mol}$$

(1 mark for the calculation, 1 mark for the correct answer)

2. What quantity of heat is produced in the complete combustion of 60.2 g of ethane gas ( $C_2H_6$ ), according to the following balanced chemical reaction? The heat of combustion of ethane is 1560 kJ/mol and its molar mass is 30.0 g/mol. (4 marks)



Answer:

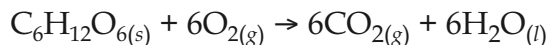
$$\text{mol} = 60.2 \cancel{\text{ g}} \times \left( \frac{1 \text{ mol}}{30.0 \cancel{\text{ g}}} \right) = 2.01 \text{ mol}$$

$$\text{or, mol} = \left( \frac{60.2 \cancel{\text{ g}}}{30.0 \cancel{\text{ g}}/\text{mol}} \right) = 2.01 \text{ mol}$$

$$\text{energy} = 2.01 \cancel{\text{ mol}} \times \left( \frac{1560 \text{ kJ}}{1 \cancel{\text{ mol}}} \right) = 3140 \text{ kJ}$$

(1 mark for each step of the calculation for 3 marks total, 1 mark for the correct answer)

3. How many grams of  $\text{CO}_2$  would be produced if 45 g of  $\text{C}_6\text{H}_{12}\text{O}_6$  (glucose) reacted completely with oxygen? Glucose = 180.0 g/mol;  $\text{CO}_2$  = 44.0 g/mol. (4 marks)

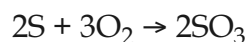


Answer:

$$45 \cancel{\text{g}} \text{C}_6\text{H}_{12}\text{O}_6 \times \frac{1 \cancel{\text{mol}}}{180.0 \cancel{\text{g}}} = 0.25 \text{ mol C}_6\text{H}_{12}\text{O}_6 \quad (2 \text{ marks})$$

$$0.25 \cancel{\text{ mol C}_6\text{H}_{12}\text{O}_6} \times \frac{6 \cancel{\text{ mol CO}_2}}{1 \cancel{\text{ mol C}_6\text{H}_{12}\text{O}_6}} \times \frac{44.0 \cancel{\text{ g}}}{\cancel{\text{ mol}}} = 66 \text{ g CO}_2 \quad (2 \text{ marks})$$

4. Given 5.0 moles of sulfur and 8.4 moles of oxygen gas, as well as



- a) Identify the limiting factor and the excess reactant. (3 marks)

Answer:

$$\text{moles O}_2 = 5.0 \cancel{\text{ mol S}} \times \frac{3 \cancel{\text{ mol O}_2}}{2 \cancel{\text{ mol S}}} = 7.5 \text{ mol O}_2 \quad (2 \text{ marks})$$

7.5 mol  $\text{O}_2$  is needed to use up all of the S. You are given more than 7.5 moles of  $\text{O}_2$ , so S is the limiting factor, and  $\text{O}_2$  is the excess reactant. (1 mark)

- b) Calculate the moles of excess reactant that remain. (2 marks)

Answer:

$$\begin{aligned} \text{moles O}_2 \text{ remaining} &= \text{initial moles} - \text{reacted moles} \\ &= 8.4 \text{ mol} - 7.5 \text{ mol} \\ &= 0.9 \text{ mol O}_2 \text{ excess} \quad (2 \text{ marks}) \end{aligned}$$

### Solutions (7 marks)

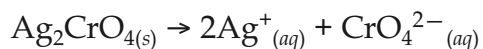
5. Describe any three properties that are true of a solution in terms of the particulate view of matter. (3 marks)

*Answer:*

Any three of the following properties for one mark each: Solutions are homogeneous, their particles are spread evenly throughout the solution, they have a single phase, their particles are too small to be seen, they are transparent, their particles are too small to reflect light, their components do not settle out, and their parts cannot be separated by filtration.

6. Write the equation for dissolving  $\text{Ag}_2\text{CrO}_{4(s)}$  in water. (2 marks)

*Answer:*



7. What is the number of moles of solute in 0.650 L of a 0.40 mol/L solution? (2 marks)

*Answer:*

$$0.650 \text{ L} \times \frac{0.40 \text{ mol}}{1 \text{ L}} = 0.26 \text{ mol}$$

### Organic Chemistry (10 marks)

8. Draw the structural formulas for the following hydrocarbons. (2 marks x 3 = 6 marks)

- a) 2,4-dimethylpentane

*Answer:*



- b) hex-2-ene

*Answer:*



- c) 4-ethylhex-2-yne

*Answer:*



9. Complete the following table. (4 marks)

	<b>Aliphatic Hydrocarbon</b>	<b>Aromatic Hydrocarbon</b>
Similarities	Can be saturated or unsaturated.	Unsaturated.
Differences	Does not contain a benzene ring, does not show resonance.	Contains a benzene ring, demonstrates resonance.

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## NOTES

## Grade 11 Chemistry Final Practice Examination

### Word Bank

Use the following word bank to help you complete the "Fill-in-the-Blank" portion of your Final Examination. Note that there may be MORE terms here than you need, so read over the list carefully before choosing the terms that you want to use. You can also use certain words more than once.

alcohol(s)	dehydrogenation	hydroxyl	ratio(s)
aliphatic	depression	immiscible	R-COOH
alkyl	diamond	increase(s)	reactant
allotrope	dilution	inorganic	saturated
amorphous carbon	electronegativity	insoluble	smaller
aqueous	electrons	isomers	soluble
aromatics	electrostatic	less	solute
benzene	emulsion	limiting	solution
boiling	endothermic	miscible	solvation
branched-chain	equal	molarity	solvent
buckminsterfullerene	esterification	moles	stoichiometry
carbon	excess	more	substituent
carboxyl	exothermic	non-polar	supersaturated
carboxylic	graphite	number	suspensions
coefficients	greater	organic	theoretical
colligative	higher	percent	unsaturated
concentration	hydrogenation	phenyl	vapour
cracking	hydrated	polar	water
crude	hydrocarbon	products	
decrease(s)	hydrogen	proportion(s)	



**Grade 11 Chemistry  
Final Practice Examination  
Bubble Sheet**

Name: \_\_\_\_\_

\_\_\_\_\_ / 46

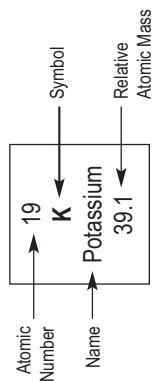
For each Multiple Choice question, shade in the circle that corresponds to your answer. DO NOT circle your answers directly on the exam.

A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D				
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	14.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	27.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	40.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	15.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	28.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	41.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	16.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	29.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	42.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	17.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	30.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	43.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	18.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	31.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	44.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	19.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	32.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	45.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	20.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	33.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	46.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	21.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	34.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	22.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	35.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	23.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	36.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
11.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	24.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	37.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
12.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	25.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	38.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
13.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	26.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	39.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					



# Periodic Table of the Elements

Group 1	2	17	18
1 H Hydrogen 1.0	2 He Helium 4.0	1 H Hydrogen 1.0	2 He Helium 4.0
3 Li Lithium 6.9	4 Be Beryllium 9.0	9 F Fluorine 19.0	10 Ne Neon 20.2
11 Na Sodium 23.0	12 Mg Magnesium 24.3	17 Cl Chlorine 35.5	18 Ar Argon 39.9
19 K Potassium 39.1	20 Ca Calcium 40.1	35 Br Bromine 79.9	36 Kr Krypton 83.8
37 Rb Rubidium 85.5	38 Sr Strontium 87.6	53 I Iodine 126.9	54 Xe Xenon 131.3
55 Cs Cesium 132.9	56 Ba Barium 137.3	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	116 Uuh Ununhexium (286)	118 Uuo Ununoctium (293)
13 B Boron 10.8	14 C Carbon 12.0	15 N Nitrogen 14.0	16 O Oxygen 16.0
13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulphur 32.1
31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0
49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.7	52 Te Tellurium 127.6
81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (209)
112 Cn Copernicium (277)	114 Uuq Ununquadium (285)	116 Uuh Ununhexium (286)	118 Uuo Ununoctium (293)
12 Mg Magnesium 24.3	13 Al Aluminum 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0
12 Zn Zinc 65.4	30 Zn Zinc 65.4	48 Cd Cadmium 112.4	80 Hg Mercury 200.6
11 Cu Copper 63.5	29 Cu Copper 63.5	47 Ag Silver 107.9	79 Au Gold 197.0
10 Ni Nickel 58.7	28 Ni Nickel 58.7	46 Pd Palladium 106.4	78 Pt Platinum 195.1
9 Co Cobalt 58.9	27 Co Cobalt 58.9	45 Rh Rhodium 102.9	77 Ir Iridium 192.2
8 Fe Iron 55.8	26 Fe Iron 55.8	44 Ru Ruthenium 101.1	76 Os Osmium 190.2
7 Mn Manganese 54.9	25 Mn Manganese 54.9	43 Tc Technetium (98)	75 Re Rhenium 186.2
6 Cr Chromium 52.0	24 Cr Chromium 52.0	42 Mo Molybdenum 95.5	74 W Tungsten 183.8
5 V Vanadium 50.9	23 V Vanadium 50.9	41 Nb Niobium 92.9	73 Ta Tantalum 180.9
4 Ti Titanium 47.9	22 Ti Titanium 47.9	40 Zr Zirconium 91.2	72 Hf Hafnium 178.5
3 Sc Scandium 45.0	21 Sc Scandium 45.0	39 Y Yttrium 88.9	71 Lu Lutetium 175.0
57 La Lanthanum 138.9	59 Pr Praseodymium 140.9	61 Pm Promethium (145)	63 Eu Europium 152.0
58 Ce Cerium 140.1	60 Nd Neodymium 144.2	62 Sm Samarium 150.4	64 Gd Gadolinium 157.2
89 Ac Actinium (227)	91 Pa Protactinium (231)	93 Np Neptunium (237)	95 Am Americium (243)
90 Th Thorium 232.0	92 U Uranium 238.0	94 Pu Plutonium (244)	96 Cm Curium (247)
102 No Nobelium (259)	101 Md Mendelevium (256)	100 Fm Fermium (257)	99 Es Einsteinium (254)
102 No Nobelium (259)	101 Md Mendelevium (256)	100 Fm Fermium (257)	99 Es Einsteinium (254)
102 No Nobelium (259)	101 Md Mendelevium (256)	100 Fm Fermium (257)	99 Es Einsteinium (254)



57 La Lanthanum 138.9	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.4	63 Eu Europium 152.0	64 Gd Gadolinium 157.2	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0
89 Ac Actinium (227)	90 Th Thorium 232.0	91 Pa Protactinium (231)	92 U Uranium 238.0	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (256)	102 No Nobelium (259)

Inner Transition Elements

- Lanthanide Series
- Actinide Series







## Alphabetical Listing of the Elements and Their Atomic Masses

Element	Atomic Mass	Element	Atomic Mass	Element	Atomic Mass
Actinium	(227)	Gold	197.0	Praseodymium	140.9
Aluminum	27.0	Hafnium	178.5	Promethium	(145)
Americium	(243)	Hassium	(265)	Protactinium	(231)
Antimony	121.7	Helium	4.0	Radium	(226)
Argon	39.9	Holmium	164.9	Radon	(222)
Arsenic	74.9	Hydrogen	1.0	Rhenium	186.2
Astatine	(210)	Indium	114.8	Rhodium	102.9
Barium	137.3	Iodine	126.9	Rubidium	85.5
Berkelium	(247)	Iridium	192.2	Ruthenium	101.1
Beryllium	9.0	Iron	55.8	Rutherfordium	(261)
Bismuth	209.0	Krypton	83.8	Samarium	150.4
Bohrium	(264)	Lanthanum	138.9	Scandium	45.0
Boron	10.8	Lawrencium	(257)	Seaborgium	(263)
Bromine	79.9	Lead	207.2	Selenium	79.0
Cadmium	112.4	Lithium	6.9	Silicon	28.1
Calcium	40.1	Lutetium	175.0	Silver	107.9
Californium	(251)	Magnesium	24.3	Sodium	23.0
Carbon	12.0	Manganese	54.9	Strontium	87.6
Cerium	140.1	Meitnerium	(266)	Sulfur	32.1
Cesium	132.9	Mendelevium	(256)	Tantalum	180.9
Chlorine	35.5	Mercury	200.6	Technetium	(98)
Chromium	52.0	Molybdenum	95.9	Tellurium	127.6
Cobalt	58.9	Neodymium	144.2	Terbium	158.9
Copernicium	(277)	Neon	20.2	Thallium	204.4
Copper	63.5	Neptunium	(237)	Thorium	232.0
Curium	(247)	Nickel	58.7	Thulium	168.9
Dubnium	(262)	Niobium	92.9	Tin	118.7
Dysprosium	162.5	Nitrogen	14.0	Titanium	47.9
Einsteinium	(254)	Nobelium	(259)	Tungsten	183.8
Erbium	167.3	Osmium	190.2	Uranium	238.0
Europium	152.0	Oxygen	16.0	Vanadium	50.9
Fermium	(257)	Palladium	106.4	Xenon	131.3
Fluorine	19.0	Phosphorus	31.0	Ytterbium	173.0
Francium	(223)	Platinum	195.1	Yttrium	88.9
Gadolinium	157.2	Plutonium	(244)	Zinc	65.4
Gallium	69.7	Polonium	(209)	Zirconium	91.2
Germanium	72.6	Potassium	39.1		



# Names, Formulas, and Charges of Common Ions

## Positive Ions (Cations)

Name	Symbol	Name	Symbol
aluminum	$\text{Al}^{3+}$	magnesium	$\text{Mg}^{2+}$
ammonium	$\text{NH}_4^+$	<b>manganese(II)</b>	<b><math>\text{Mn}^{2+}</math></b>
barium	$\text{Ba}^{2+}$	manganese(IV)	$\text{Mn}^{4+}$
cadmium	$\text{Cd}^{2+}$	mercury(I)	$\text{Hg}_2^{2+}$
calcium	$\text{Ca}^{2+}$	mercury(II)	$\text{Hg}^{2+}$
chromium(II)	$\text{Cr}^{2+}$	<b>nickel(II)</b>	<b><math>\text{Ni}^{2+}</math></b>
<b>chromium(III)</b>	<b><math>\text{Cr}^{3+}</math></b>	nickel(III)	$\text{Ni}^{3+}$
copper(I)	$\text{Cu}^+$	potassium	$\text{K}^+$
<b>copper(II)</b>	<b><math>\text{Cu}^{2+}</math></b>	silver	$\text{Ag}^+$
hydrogen	$\text{H}^+$	sodium	$\text{Na}^+$
iron(II)	$\text{Fe}^{2+}$	strontium	$\text{Sr}^{2+}$
<b>iron(III)</b>	<b><math>\text{Fe}^{3+}</math></b>	tin(II)	$\text{Sn}^{2+}$
<b>lead(II)</b>	<b><math>\text{Pb}^{2+}</math></b>	<b>tin(IV)</b>	<b><math>\text{Sn}^{4+}</math></b>
lead(IV)	$\text{Pb}^{4+}$	zinc	$\text{Zn}^{2+}$
lithium	$\text{Li}^+$		

*continued*

## Negative Ions (Anions)

Name	Symbol	Name	Symbol
acetate	$C_2H_3O_2^-$ ( $CH_3COO^-$ )	nitrate	$NO_3^-$
azide	$N_3^-$	nitride	$N^{3-}$
bromide	$Br^-$	nitrite	$NO_2^-$
bromate	$BrO_3^-$	oxalate	$C_2O_4^{2-}$
carbonate	$CO_3^{2-}$	hydrogen oxalate	$HC_2O_4^-$
hydride	$H^-$	oxide	$O^{2-}$
hydrogen carbonate or bicarbonate	$HCO_3^-$	perchlorate	$ClO_4^-$
chlorate	$ClO_3^-$	permanganate	$MnO_4^-$
chloride	$Cl^-$	phosphate	$PO_4^{3-}$
chlorite	$ClO_2^-$	monohydrogen phosphate	$HPO_4^{2-}$
chromate	$CrO_4^{2-}$	dihydrogen phosphate	$H_2PO_4^-$
citrate	$C_6H_5O_7^{3-}$	silicate	$SiO_3^{2-}$
cyanide	$CN^-$	sulfate	$SO_4^{2-}$
dichromate	$Cr_2O_7^{2-}$	hydrogen sulfate	$HSO_4^-$
fluoride	$F^-$	sulfide	$S^{2-}$
hydroxide	$OH^-$	hydrogen sulfide	$HS^-$
hypochlorite	$ClO^-$	sulfite	$SO_3^{2-}$
iodide	$I^-$	hydrogen sulfite	$HSO_3^-$
iodate	$IO_3^-$	thiocyanate	$SCN^-$

# Common Ions

## Cations (Positive Ions)

1 <sup>+</sup> charge		2 <sup>+</sup> charge		3 <sup>+</sup> charge	
NH <sub>4</sub> <sup>+</sup>	Ammonium	Ba <sup>2+</sup>	Barium	Al <sup>3+</sup>	Aluminum
Cs <sup>+</sup>	Cesium	Be <sup>2+</sup>	Beryllium	Cr <sup>3+</sup>	Chromium(III)
Cu <sup>+</sup>	Copper(I)	Cd <sup>2+</sup>	Cadmium	Co <sup>3+</sup>	Cobalt(III)
Au <sup>+</sup>	Gold(I)	Ca <sup>2+</sup>	Calcium	Ga <sup>3+</sup>	Gallium
H <sup>+</sup>	Hydrogen	Cr <sup>2+</sup>	Chromium(II)	Au <sup>3+</sup>	Gold(III)
Li <sup>+</sup>	Lithium	Co <sup>2+</sup>	Cobalt(II)	Fe <sup>3+</sup>	Iron(III)
K <sup>+</sup>	Potassium	Cu <sup>2+</sup>	Copper(II)	Mn <sup>3+</sup>	Manganese
Rb <sup>+</sup>	Rubidium	Fe <sup>2+</sup>	Iron(II)	Ni <sup>3+</sup>	Nickel(III)
Ag <sup>+</sup>	Silver	Pb <sup>2+</sup>	Lead(II)		
Na <sup>+</sup>	Sodium	Mg <sup>2+</sup>	Magnesium	<b>4<sup>+</sup> charge</b>	
		Mn <sup>2+</sup>	Manganese(II)	Pb <sup>4+</sup>	Lead(IV)
		Hg <sub>2</sub> <sup>2+</sup>	Mercury(I)	Mn <sup>4+</sup>	Manganese(IV)
		Hg <sup>2+</sup>	Mercury(II)	Sn <sup>4+</sup>	Tin(IV)
		Ni <sup>2+</sup>	Nickel(II)		
		Sr <sup>2+</sup>	Strontium		
		Sn <sup>2+</sup>	Tin(II)		
		Zn <sup>2+</sup>	Zinc		

(continued)

## Anions (Negative Ions)

1 <sup>-</sup> charge		1 <sup>-</sup> charge		2 <sup>-</sup> charge	
CH <sub>3</sub> COO <sup>-</sup> (C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> <sup>-</sup> )	Acetate (or ethanoate)	HS <sup>-</sup>	Hydrogen sulfide	CO <sub>3</sub> <sup>2-</sup>	Carbonate
BrO <sub>3</sub> <sup>-</sup>	Bromate	OH <sup>-</sup>	Hydroxide	CrO <sub>4</sub> <sup>2-</sup>	Chromate
Br <sup>-</sup>	Bromide	IO <sub>3</sub> <sup>-</sup>	Iodate	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	Dichromate
ClO <sub>3</sub> <sup>-</sup>	Chlorate	I <sup>-</sup>	Iodide	O <sup>2-</sup>	Oxide
Cl <sup>-</sup>	Chloride	NO <sub>3</sub> <sup>-</sup>	Nitrate	O <sub>2</sub> <sup>2-</sup>	Peroxide
ClO <sub>2</sub> <sup>-</sup>	Chlorite	NO <sub>2</sub> <sup>-</sup>	Nitrite	SO <sub>4</sub> <sup>2-</sup>	Sulfate
CN <sup>-</sup>	Cyanide	ClO <sub>4</sub> <sup>-</sup>	Perchlorate	S <sup>2-</sup>	Sulfide
F <sup>-</sup>	Fluoride	IO <sub>4</sub> <sup>-</sup>	Periodate	SO <sub>3</sub> <sup>2-</sup>	Sulfite
H <sup>-</sup>	Hydride	MnO <sub>4</sub> <sup>-</sup>	Permanganate	S <sub>2</sub> O <sub>3</sub> <sup>2-</sup>	Thiosulfate
HCO <sub>3</sub> <sup>-</sup>	Hydrogen carbonate (or bicarbonate)	SCN <sup>-</sup>	Thiocyanate	<b>3<sup>-</sup> charge</b>	
ClO <sup>-</sup>	Hypochlorite			N <sup>3-</sup>	Nitride
HSO <sub>4</sub> <sup>-</sup>	Hydrogen sulfate			PO <sub>4</sub> <sup>3-</sup>	Phosphate
				P <sup>3-</sup>	Phosphide
				PO <sub>3</sub> <sup>3-</sup>	Phosphite