

PRESBYTERIAN LADIES' COLLEGE, SYDNEY

Year 12 Chemistry

Semester One Examination, 2001

Question Booklet

Time allowed: 3 hours (Plus 5 minutes reading time)

Marks: /100

DIRECTIONS TO CANDIDATES:

- Answer ALL questions in the Answer Book provided
- Anything written in the Question Book will NOT be marked
- No answers will be considered for re-marking if:
 - a) they are written in pencil
 - b) they are written outside the space provided
 - c) any alternation of any kind has been made at any time
 - d) any material has been inserted by caret (^)
- Every question is compulsory
- Write your student number on each Answer Book.
- Paper consists of:

		MARKS
Section A	Multiple Choice	/ 20
Section B	Written Response	/ 80
	TOTAL	/ 100

SECTION 1**MULTIPLE CHOICE****(20 marks)****Each question is worth 1 mark**

1. Acrylonitrile is the monomer from which polyacrylonitrile is built. What is the systematic name for acrylonitrile?
 - a) acrylic
 - b) chloroethene
 - c) polypropenenitrile
 - d) propenenitrile

2. Ethene is a monomer from which many polymers are made. Which of the following polymers is **NOT** made from ethene?
 - a) polyester
 - b) polyethylene
 - c) polystyrene
 - d) polyvinyl acetate

3. Which substance is a byproduct of the condensation polymerisation reaction that forms nylon?
 - a) carbon dioxide
 - b) hydrogen
 - c) hydrogen chloride
 - d) water

4. Cellulose is produced from a condensation polymerization reaction. What is the monomer in this reaction?
 - a) amino acid
 - b) ethanol
 - c) ethene
 - d) glucose

5. One effect of the addition of a catalyst to a certain reaction mixture is to lower the activation energy. What will this result in?
 - a) an increase in the reaction rate
 - b) a higher concentration of products at equilibrium
 - c) a lower heat of reaction
 - d) a reversal of the equilibrium conditions

6. Which of the following equations best represents the fermentation of glucose?

- a) $C_{12}H_{22}O_{11}(aq) \rightarrow 4CH_3CH_2OH(aq) + 4CO_2(g)$
- b) $C_{12}H_{22}O_{11}(aq) + H_2O(l) \rightarrow 4CH_3CH_2OH(aq) + 4CO_2(g)$
- c) $C_6H_{12}O_6(aq) \rightarrow CH_3CH_2OH(aq) + CO_2(g)$
- d) $C_6H_{12}O_6(aq) \rightarrow 2CH_3CH_2OH(aq) + 2CO_2(g)$

7. What types of radiation can be detected by a Geiger counter?

- a) alpha particles only
- b) beta particle only
- c) gamma rays only
- d) alpha and beta particles and gamma rays

8. During the radioactive decay of uranium the following sequence occurs:

What is the sequence of particle emissions for steps a), c) and d) ?

- a) alpha, beta, alpha
- b) beta, alpha, beta
- c) alpha, alpha, alpha
- d) beta, alpha, alpha

9. A 0.1M solution of vinegar has a pH of 5. Which of the following is a correct description of the vinegar?

- a) a dilute, strong acid
- b) a concentrated, strong acid
- c) a dilute, weak acid
- d) a concentrated, weak acid

10. Grapes have a pH of 4.0 and urine has a pH of 6.0. Which of the following describes the hydrogen ion concentration of urine?

- a) 2 times less than in grapes
- b) 2 times more than in grapes
- c) 100 times less than in grapes
- d) 100 times more than in grapes

11. Consider the following reaction:



Which of the following changes to equilibrium conditions would favour the formation of iron?

- a) the addition of finely powdered FeO
- b) an increase in temperature
- c) a decrease in pressure
- d) the removal of carbon dioxide

12. 50.0g of calcium carbonate reacts with dilute hydrochloric acid according to the following equation:



If the reaction is carried out at 25°C and 101.3 kPa, what volume of carbon dioxide is liberated from this reaction?

- a) 1.00 L
- b) 6.13 L
- c) 12.1 L
- d) 24.5 L

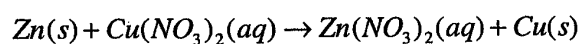
13. Which equation shows the relationship between the molecules of a weak acid and its ions?

- a) $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightarrow \text{H}_3\text{O}^+(aq) + \text{SO}_4^{2-}(aq)$
- b) $\text{HSO}_4^-(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{SO}_4^{2-}(aq)$
- c) $\text{HNO}_3(aq) + \text{H}_2\text{O}(l) \rightarrow \text{H}_3\text{O}^+(aq) + \text{NO}_3^-(aq)$
- d) $\text{HNO}_3(aq) + \text{H}_2\text{O}(l) \rightleftharpoons \text{H}_3\text{O}^+(aq) + \text{NO}_3^-(aq)$

14. What is the pH of a $5.0 \times 10^{-5} \text{ mol L}^{-1}$ solution of barium hydroxide?

- a) 4.0
- b) 4.3
- c) 9.7
- d) 10.0

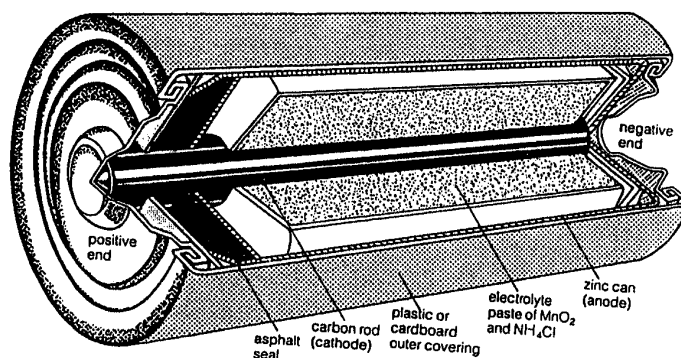
15. Look at the equation:



Which statement is correct?

- a) Copper ions are reduced
- b) Zinc ions are the reduction product
- c) Nitrate ions are oxidised
- d) Zinc is reduced

16. Cells used in devices such as flashlights and radios are known as dry cells. The oxidation reaction occurring at the anode of the zinc-carbon cell is: $\text{Zn}(s) \rightarrow \text{Zn}^{2+}(aq) + 2e^-$



Which reaction occurs at the cathode?

- a) $2e^- + \text{PbO}_2(s) + \text{SO}_4^{2-}(aq) + 4\text{H}^+(aq) \rightarrow \text{PbSO}_4(s) + 2\text{H}_2\text{O}(l)$
- b) $2\text{MnO}_2(s) + 2\text{NH}_4^+(aq) + 2e^- \rightarrow \text{Mn}_2\text{O}_3(s) + 2\text{NH}_3(aq) + \text{H}_2\text{O}(l)$
- c) $2e^- + \text{Zn}^{2+}(aq) \rightarrow \text{Zn}(s)$
- d) $\text{Zn}(s) + 2\text{H}^+(aq) + 2\text{MnO}_2(s) \rightarrow \text{Zn}^{2+}(aq) + \text{Mn}_2\text{O}_3 + \text{H}_2\text{O}(l)$

17. A student used titration to determine the percentage of ethanoic acid in a 25.0mL sample of vinegar. The burette was filled with sodium hydroxide solution.

What should she rinse the burette with before filling it?

- a) sodium hydroxide solution
 - b) ethanoic acid
 - c) distilled water
 - d) tap water
18. Which of the following is the conjugate base of HCO_3^- ?
- a) H_2CO_3
 - b) H^+
 - c) CO_3^{2-}
 - d) H_2O
19. Inert electrodes are placed in molten potassium bromide and a current is passed between the electrodes. What product would form at the anode?
- a) potassium metal ^x
 - b) bromine gas
 - c) hydrogen gas /
 - d) potassium bromide
20. Which of the statements about electrochemical cells is FALSE?
- a) anions migrate to the anode
 - b) oxidation occurs at the anode
 - c) cations and anions move through the salt bridge
 - d) the reducing agent is at the cathode

SECTION B**EXTENDED RESPONSE****(80 Marks)**

21. a) Give the structural formulas for the major product in each of the following reactions.
- i) ethene + bromine water (1 mark)
 - ii) ethanol + concentrated sulfuric acid (1 mark)
- b) If ethane was used in reaction i) instead of ethene, a catalyst would be required. Which catalyst is required? (1 mark)
22. The most common use of ethanol in industry is as a solvent.
- a) Describe ONE use of ethanol as a solvent. (1 mark)
 - b) Relate the solvent properties of ethanol to the polarity of the ethanol molecule. Include an electron dot diagram in your answer. (2 marks)
 - c) Outline TWO uses of ethanol, not including in beverages or as a solvent (2 marks)
23. According to the article below, sugar has been used as a fermenting agent in a brew which led to a jail break-out.

Prison sugar ban leaves sour taste.

Sugar has been banned in minimum security prisons because it was used as the fermenting agent in a brew which led to a break-out.

Three prisoners assaulted a prison officer during an escape they said was inspired by a potent cell brew that gave them the bravado for the break-out.

After December 12, the 3,400 inmates in 11 minimum security institutions – half the NSW prison population – were denied their fortnightly ration of a kilo of sugar.

The ban has been in place in 16 prisons since 1998, but minimum security prisoners were allowed to take sugar to their cells for sweetening coffee and breakfast cereals.

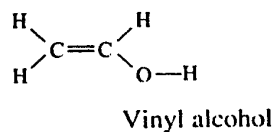
Prisoners are now given sugar substitutes and honey to take to their cells, and warders check that fruit given to the prisoners is eaten and not dropped into a brew to ferment into alcohol. Visitors are now also searched for sugar.

The sugar ban in minimum security jails will be reconsidered next December.

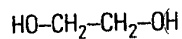
SMH: Feb 1, 2001

- a) What other raw material is mentioned in the article as being able to be used to ferment the alcohol? (1 mark)
- b) List the conditions under which fermentation of sugars is promoted. (2 marks)

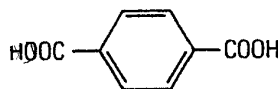
24. The diagram shows the structure of vinyl alcohol. This molecule undergoes addition polymerisation to form polyvinyl alcohol (PVA).



- a) Draw a section of the PVA polymer chain showing at least THREE monomer units. (1 mark)
- b) PVA dissolves in warm water and does not decompose. Suggest a reason why this polymer would be soluble in water. (1 mark)
- c) One of the applications of PVA has been in the production of PVA laundry bags designed for use in hospitals where bedding may be contaminated with infectious materials. The bedding is placed in the bag and sent to the laundry where the bag and its contents are washed and disinfected.
- i) Why can the bedding be added to the washing machine while still inside the bag? (1 mark)
- ii) Why is this method useful to hospital workers? (1 mark)
25. Poly(ethylene terephthalate), polyester or PET is a condensation polymer made from ethylene glycol and terephthalic acid.



ethylene glycol



terephthalic acid

- a) Draw the products of this condensation reaction. (1 mark)
- b) Explain why PET is called a condensation polymer. (1 mark)

26. Catalytic cracking is a process used in the petrochemical industry.
- a) Describe how ethene is formed from crude oil. (2 marks)
 - b) Zeolites are surface catalysts used in the cracking of longer chain alkanes. Explain how surface catalysts work. (1 mark)
27. Alternative sources of compounds presently obtained from the petrochemical industry are needed.
- a) Explain why these alternative sources are needed. (1 mark)
 - b) What are some problems with utilising biomass as an energy resource? (2 marks)
 - c) Explain how cellulose could be used as a raw material for the petrochemical industry. (1 mark)
28. Nuclear reactors, such as the ANSTO reactor at Lucas Heights, produce radioisotopes for use in medicine and industry.
- a) What is an isotope? (1 mark)
 - b) What is a radioisotope? (1 mark)
 - c) Describe ONE condition under which a nucleus is unstable. (1 mark)
 - d) Name a radioisotope used in medicine. (1 mark)
 - e) Describe the way in which your named radioisotope is used and relate this to its chemical properties. (2 marks)
 - f) Explain ONE benefit associated with the use of your named radioisotope in medicine. (1 mark)
 - g) Explain ONE problem associated with the use of your named radioisotope in medicine. (1 mark)

29. a) Use the data to answer the questions.

Indicator	Colour in low pH	pH Change	Colour in high pH
Methyl orange	Red	3.1 – 4.4	Yellow
Litmus	Red	5.0 – 8.0	Blue
Bromothymol blue	Yellow	6.0 – 7.6	Blue
Phenolphthalein	Colourless	8.3 – 10.0	Pink

i) A solution tested with methyl orange is yellow. The same solution when tested with bromothymol blue is also yellow. Would this solution be acidic, neutral or basic? Give reasons for your choice. (2 marks)

ii) A student has mixed up three beakers of $\text{HNO}_3(\text{aq})$, distilled water and $\text{NaOH}(\text{aq})$. She tested one of the beakers with phenolphthalein and declared it to be the distilled water.

1. What did she observe? (1 mark)

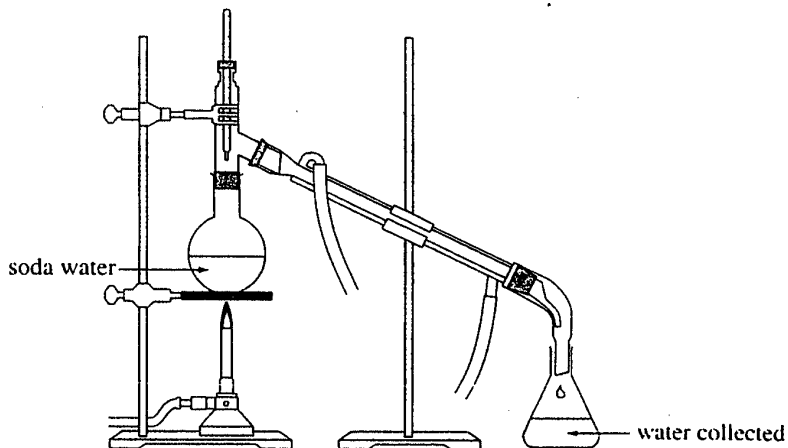
2. Can she be certain that her declaration is correct? Explain. (2 marks)

(1 mark)

b) In your studies you performed an experiment to prepare and test a natural indicator. Explain how you performed this experiment including the solutions you tested with your indicator and explain the properties of a good/useful indicator. (4 marks)

30. a) A student decided to try removing the bubbles from soda water, which is carbonated water, and calculate the mass of gas removed.

The equipment setup is shown.



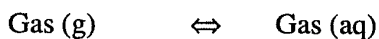
The student boiled away all the soda water and collected the water in the flask as shown. There were no bubbles left in the water collected.

Several measurements were made to collect the following data:

Mass of soda water and round-bottom flask	=	468.00g
Mass of empty round-bottom flask	=	294.11g
Mass of water collected	=	170.20g

- What is the main gas in soda water bubbles? (1 mark)
- What was the mass of the soda water sample tested? (1 mark)
- Assuming that all the change in mass was due to the bubbles of gas that boiled away, what was the mass of gas in the soda water sample? (1 mark)
- What volume would this gas occupy at 25°C and 101.3kPa? (2 marks)

- b) In a sealed bottle of soda water, the dissolved gas is in equilibrium with itself in the gaseous form:



Explain the following observations in terms of this equilibrium.

- i) If the bottle is left open, the drink goes 'flat'. (2 marks)
- ii) Bottles with only a small amount of drink remaining will go flat after several days even though the bottle has been carefully resealed. (1 mark)

31. a) The table below gives the pH values of three acids of equal concentration (0.100 mol/L).

ACID	FORMULA OF ACID	pH
Nitric acid	HNO_3	1
Hydrocyanic acid	HCN	5.10
Hydrofluoric acid	HF	2.09

- i) Which acid has the highest $[\text{H}^+]$? (1 mark)
- ii) Which acid undergoes the greatest degree of ionisation of its molecules?
Use an equation to explain your answer. (2 marks)
- b) In the boxes supplied in your answer book, draw diagrams to clearly illustrate the degree of ionisation of a strong and a weak acid of equal concentrations.
Label the boxes as STRONG and WEAK. (3 marks)
- c) Name TWO acidic oxides and give ONE use for each of these named acidic oxides. (2 marks)

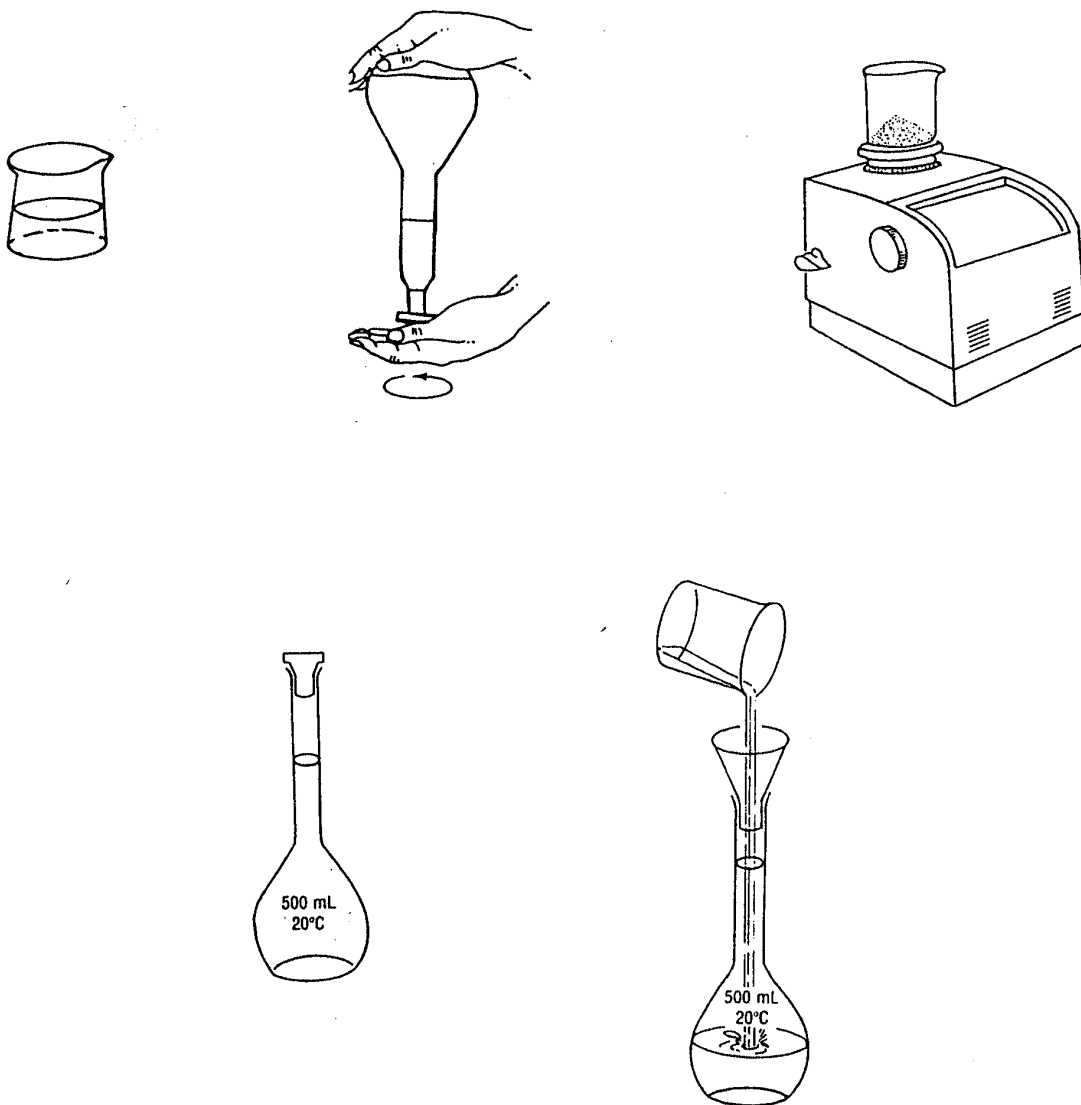
32. A student was asked to determine the ethanoic acid concentration of a sample of household vinegar.

25 mL aliquots of the vinegar were titrated with a 0.100 mol L⁻¹ sodium hydroxide solution. The results are shown below.

Titration	Volume of 0.100 mol L ⁻¹ NaOH (mL)
1	32.2
2	32.4
3	32.3

- a) Write the equation to show the reaction of ethanoic acid with sodium hydroxide. (1 mark)
- b) Calculate the concentration of ethanoic acid in the vinegar. (3 marks)
- c) Identify a suitable indicator for this reaction. Justify your choice of indicator. (2 marks)
33. a) Predict whether a solution of AlCl₃ would be acidic, basic or neutral. Justify your prediction. (1 mark)
- b) How would you test your prediction in the laboratory? (1 mark)

34. A student wanted to prepare a primary standard solution of sodium carbonate (Na_2CO_3).
The diagram shows the steps she followed, but they are not in the correct sequence.



- a) List the steps a) to e) in their correct order. (1 mark)
- b) What are TWO reasons sodium carbonate is used as a primary standard. (2 marks)

35. A galvanic cell was constructed using two half-cells. One half-cell consisted of copper metal and a copper sulfate solution and the other half cell consisted of nickel metal and a nickel sulfate solution.
- a) Draw a diagram of the cell, labelling the anode and cathode. Indicate the direction of the electron flow. (2 marks)
 - b) Calculate the theoretical voltage of this cell (2 marks)
 - c) The voltage of the cell was measured and found to be 0.30V. Suggest TWO reasons that would account for the difference between the theoretical and experimental values. (2 marks)
36. A metallic object, to be plated with copper, is one electrode in an electrolytic cell. A bar of pure copper is the other electrode. (2 marks)
- a) Is the metallic object the anode or cathode in this cell?
 - b) Name a solution that could be used as the electrolyte.
37. i) Would the pH of a solution of KCH_3COO be:
less than 7,
equal to 7 or
greater than 7? (1 mark)
- ii) Name the acid and base used to prepare a solution of this salt. (1 mark)
38. Use the Lewis definition of an acid to explain why H^+ can be considered to be an acid when it reacts with NH_3 to form NH_4^+ . (1 mark)
39. Read the observations about the reactions of metal, M. (1 mark)
- i) M reacts with a solution of silver nitrate to form a deposit of metallic silver.
 - ii) M does not react with a solution of zinc nitrate.
- List the three metals in order of decreasing strength as reducing agents.