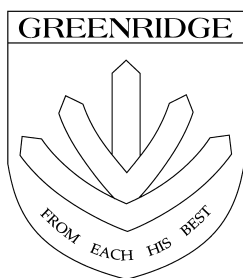


Name : _____ ()

Class : 3E1



GreenRidge Secondary School

Mid-Year Examination 2002

Subject : Chemistry (5068)
Secondary Three Express

Date : 13 May 2002

Duration : 2h

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INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces at the top of this page and on all separate answer paper used.

Section A (30 marks)

Answer **all** questions on the OMR sheet provided. Hand up the OMR sheet separately.

Section B (40 marks)

Answer **all** questions. Write your answers in the spaces provided in question paper.

Section C (20 marks)

Answer **all** questions. Write your answers on the foolscap papers provided.
Attach the foolscap papers to the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

A copy of Periodic Table is available on Page **15**.

You are allowed to use the Calculator.

FOR EXAMINER'S USE	
Section A	/30
Section B	/40
Section C	/20
Total	/90

*This paper consists **15** printed pages, including this page.*

Section A [30 marks]

Answer **all** questions on the OMR sheet provided.

- Which one of the following diffuses most rapidly?
 - Br_2
 - NO_2
 - CO_2
 - CH_4
- Which one of the following correctly describes the particles in a dilute sugar solution at room temperature?

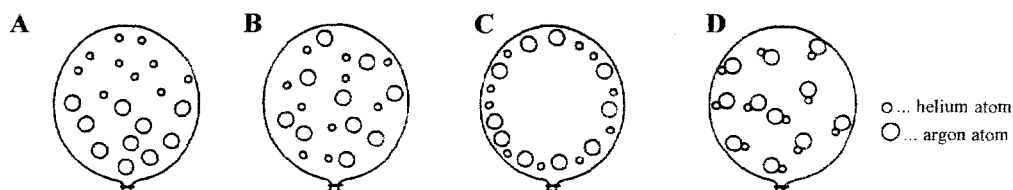
Sugar molecules

- Widely separated, moving at random
- Widely separated, moving at random
- Widely separated, not moving
- Close together, moving at random

Water molecules

- Close together, moving at random
- Close together, not moving
- Widely separated, moving at random
- Widely separated, vibrating slightly

- Which diagram shows the arrangement of particles inside a balloon filled with a mixture of helium and argon?

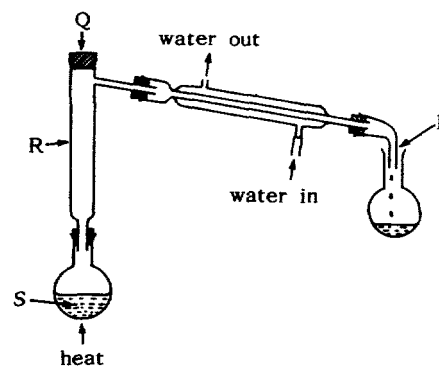


- An inflated balloon will shrink if placed in a refrigerator. This is because the lower temperature causes the gas particles in the balloon to move
 - faster and become closer together.
 - faster and become further apart.
 - slower and become closer together.
 - slower and become further apart.
- In a sample of air at 25°C , the molecules of oxygen, nitrogen and carbon dioxide all move with different average speeds.

Which of the following lists the molecules in order of decreasing average speed?

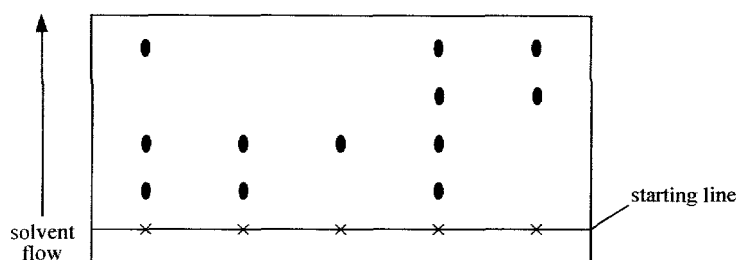
- | | Fastest | → | Slowest |
|----|----------------|----------------|----------------|
| A. | Carbon dioxide | Oxygen | Nitrogen |
| B. | Nitrogen | Carbon dioxide | Oxygen |
| C. | Nitrogen | Oxygen | Carbon dioxide |
| D. | Oxygen | Carbon dioxide | Nitrogen |

6. A mixture of two liquids is fractionally distilled in the apparatus shown in the figure to the right. Which one of the following alterations would best improve the efficiency of the separation of the liquids?
- Corking the apparatus at P
 - Inserting a thermometer at Q
 - Filling tube R with glass beads
 - Putting "anti-bumping" granules into S



7. Which gas is obtained industrially by fractional distillation?
- Carbon monoxide
 - Chlorine
 - Hydrogen
 - Oxygen

8. The diagram shows a chromatogram which was prepared using spots of five different inks.

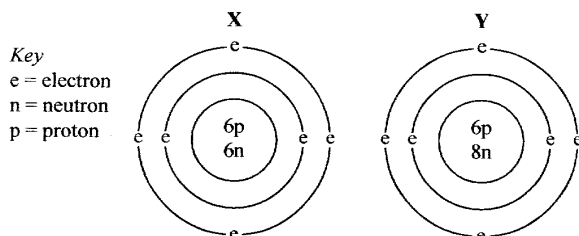


How many different dyes were used to make the five inks?

- 3
 - 4
 - 5
 - 12
9. Helium has two isotopes ${}^3_2\text{He}$ and ${}^4_2\text{He}$.
An atom of the lighter isotope contains
- two neutrons.
 - three electrons.
 - a total of three protons and neutrons.
 - one proton less than an atom of the heavier isotope.
10. An atom of argon has 18 electrons round its nucleus.
Which of the following particles does **not** have 18 electrons round its nucleus?
- Ca^{2+}
 - Cl^-
 - K^+
 - O^{2-}

11. An atom of element X has the symbol ${}^7_3\text{X}$. Which statement about element X is correct?
- It is in Group III of the Periodic Table.
 - It is in Group VII of the Periodic Table.
 - In one atom, the number of protons + the number of electrons is 6.
 - In one atom, the number of protons + the number of neutrons is 10.

12. Two particles X and Y have the structures shown.



Which term describes X and Y?

- Allotropes
 - Ions
 - Isomers
 - Isotopes
13. The table below gives some of the properties of four substances A to D.

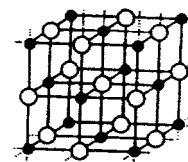
Substance	Melting point / °C	Boiling point / °C	Ability to conduct electricity	
			In molten state	In aqueous solution
A.	-144	78	None	None
B.	-144	-85	None	Good
C.	180	218	None	(Insoluble)
D.	808	1465	Good	Good

Which of the substances A, B, C or D, could be hydrogen chloride?

14. The diagram below shows the arrangement of ions in a compound. The metal ions (M) are represented by “•” and the non-metal ions (X) by “o”.

What is the simplest formula of this compound?

- $\text{M}_{14}\text{X}_{13}$
- M_2X
- MX
- MX_6



15. Which one of the following substances forms crystals containing small molecules?
- Copper
 - Diamond
 - Iodine
 - Silica (sand)

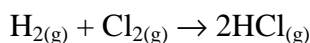
16. Which one of the substances in the table below, A, B, C or D, has the typical properties of a covalent compound?

	Melting point/ °C	Boiling point/ °C	Electrical conductivity at room temperature
A.	-39	361	Conducts
B.	-21	105	Non-conductor
C.	636	1300	Non-conductor
D.	782	1600	Non-conductor

17. A crystal of sodium chloride is held together by
- covalent bonds.
 - double bonds.
 - positive ions in a 'sea of electrons'.
 - the attraction of oppositely charged ions.
18. Element P has an electronic configuration of 2, 8, 6. Element R has an electronic configuration of 2, 8, 8, 1. What is likely to form if P and R combine?
- A covalent compound PR
 - A covalent compound P₆R₆
 - An ionic compound PR
 - An ionic compound PR₂
19. Which of the following gases has the lowest density under room conditions?
- CO
 - N₂
 - Ne
 - NH₃
20. In which pair do the elements combine to form a compound with an ionic lattice?
- Carbon and hydrogen
 - Carbon and oxygen
 - Hydrogen and chlorine
 - Potassium and chlorine
21. Which one of the following statements is true?
- Equal volumes of all gases, at the same temperature and pressure, contain the same number of particles.
 - Equal masses of all elements contain the same number of atoms.
 - The volume of a mole of atoms of any element is the same.
 - Two solutions with the same molar concentration have the same mass of solute.

22. The analysis of a hydride of nitrogen showed that 1 g of hydrogen combined with 7 g of nitrogen. What is the simplest formula of the hydride?
- N_7H
 - NH_2
 - NH_4
 - NH_7
23. A metal M forms a carbonate with the formula M_2CO_3 . The mass of 1 mole of the carbonate is 74 g. What is the relative atomic mass of M?
- 7
 - 14
 - 37
 - 74
24. Which of these nitrogenous fertilizers contains the greatest percentage by mass of nitrogen?
- Hydrazine, N_2H_4
 - Nitram, NH_4NO_3
 - Ammonia sulphate, $(NH_4)_2SO_4$
 - Urea, NH_2CONH_2
25. Magnesium chloride crystallizes as a hydrate, $MgCl_2 \cdot xH_2O$. When 20.3g of the hydrate were heated to a constant mass, 9.5g of the anhydrous salt remained. What is the value of x?
- 2
 - 5
 - 6
 - 10
26. Which one of the following solutions contains exactly 0.2 mole of the solute?
- 20 cm^3 of 10 mol dm^{-3} sulphuric acid
 - 200 cm^3 of 0.2 mol dm^{-3} hydrochloric acid
 - 250 cm^3 of 8 mol dm^{-3} sodium hydroxide
 - 2000 cm^3 of 2 mol dm^{-3} potassium hydroxide

27. The equation for the reaction between hydrogen and chlorine is given by:



This equation implies that

- 1 atom of hydrogen combines with 1 atom of chlorine.
- 1 atom of hydrogen combines with 1 atom of chlorine to give 2 molecules of hydrogen chloride.
- 1 g of hydrogen combines with 1 g of chlorine to give 2 g of hydrogen chloride.
- 2 moles of hydrogen chloride are obtained when 1 mole of chlorine reacts with 1 mole of hydrogen.

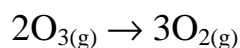
28. A 0.1 mol/dm^3 aqueous solution of sulphuric acid is mixed with a 0.05 mol/dm^3 solution of potassium hydroxide. Which one of the following mixtures will react completely to form the salt K_2SO_4 ?

	Volume of 0.1 mol/dm^3 sulphuric acid	Volume of 0.05 mol/dm^3 potassium hydroxide
A.	10 ml	40 ml
B.	10 ml	20 ml
C.	10 ml	10 ml
D.	10 ml	5 ml

29. What volume of 0.5 mol/dm^3 hydrochloric acid is required to react with 1.2 g of magnesium?

- A. 0.1 cm^3
- B. 10 cm^3
- C. 100 cm^3
- D. 200 cm^3

30. Ozone O_3 is a gas which absorbs harmful ultraviolet radiation from the sun. This gas can decompose into oxygen as shown by the equation below:



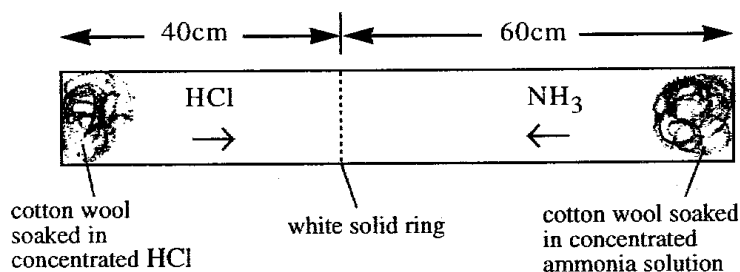
What information can be deduced from the equation above?

- A. A volume of 10 cm^3 ozone would produce 15 cm^3 oxygen.
- B. A volume of 15 cm^3 ozone would produce 10 cm^3 oxygen.
- C. One mole of ozone would decompose into 0.67 moles of oxygen.
- D. A mass of 48g ozone would produce 32g of oxygen.

Section B [40 marks]

Write your answers in the spaces provided on the question paper.

- B1. A tube was set up with a plug of aqueous ammonia at one end and a plug of concentrated hydrochloric acid at the other. After a while both the gases met and a white solid ring of ammonium chloride was formed as shown below.



- (a) What does this experiment show about the comparative speeds with which the ammonia and hydrogen chloride move? [1]
- _____
- _____
- _____
- (b) Name this type of movement of molecules. [1]
- _____
- (c) Even though the molecules of HCl and NH₃ are rapidly moving, it takes about ten to fifteen minutes for the white ring to be formed. Why is this so? [1]
- _____
- _____
- _____
- (d) Ammonium chloride is known to sublime upon heating. What does the term 'sublime' mean? [1]
- _____
- _____
- _____
- _____

(b) By means of suitable electron diagrams, illustrate the bonding in these compounds.
(*Show all electrons shells*)

(i) Sodium chloride [2]

(ii) Water [2]

(iii) Carbon disulphide, CS₂ [2]

B5. 8 dm³ of ammonia gas, measured at room temperature and pressure, was passed over excess hot copper(II) oxide. The ammonia reacted completely with the oxide, forming nitrogen gas, copper and water vapour.

(a) Write the equation for the above reaction. [1]

(b) Calculate the number of moles of ammonia gas used, [1]

(c) Calculate the mass of copper formed. [2]

B6. When 13.7 g of an oxide of lead was analysed, it was found to contain 12.42 g of lead.

(a) What is the empirical formula of the compound? [2]

(b) 0.04 mole of the above lead compound was found to weigh 27.4 g.
What is the molecular formula of the lead compound? [2]

B7. 40 cm³ of an alkali, XOH, reacted with 50 cm³ of dilute nitric acid. The acid concentration was 6.9 g/dm³ and the alkali concentration was 7.67 g/dm³. Calculate

(a) the molarity of the acid, [1]

(b) the molarity of the alkali, [2]

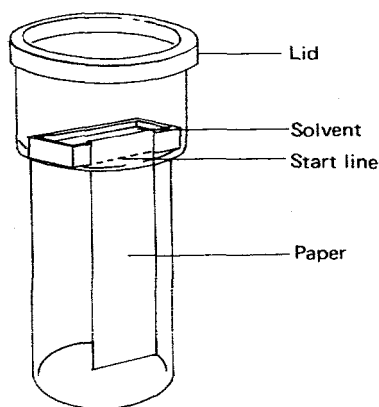
(c) the relative molecular mass of the alkali, [1]

(d) the relative atomic mass of X and hence deduce the identity of X. [1]

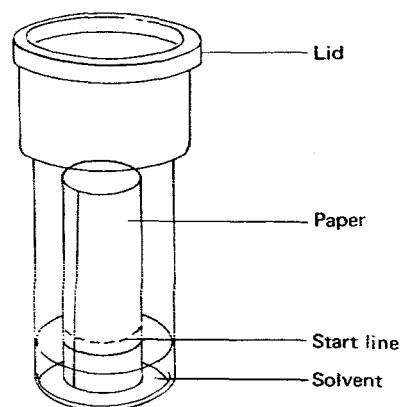
Section C [20 marks]

Answer **both** questions. Write your answers on the foolscap papers provided.
Attach the foolscap to the question paper.

- C8. (a) The diagrams below represent two methods for paper chromatography. In the descending method, the solvent flows down the paper and in the ascending method, the solvent travels up the paper.

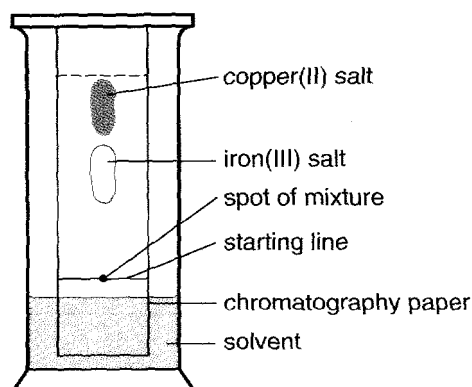


Descending Method



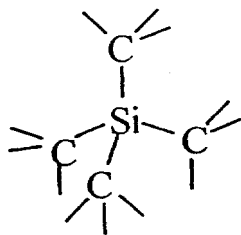
Ascending Method

- In which method will the solvent travel the faster?
Give a reason for your answer. [2]
 - Why is the start line drawn in pencil and **not** in ink? [1]
 - Why must the start line be above the solvent level in the ascending method? [1]
 - For both methods, the container is closed by a lid. Why is this necessary? [1]
 - Longer sheets of paper can be used in the descending method than in the ascending method. Why is a longer piece of paper often preferred? [2]
- (b) A mixture of a copper(II) salt (blue solution) and an iron(III) salt (yellow solution) may be separated by paper chromatography as shown in figure below.

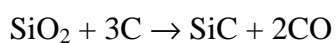


- What is the colour of the mixture of copper(II) salt and iron(III) salt solution? [1]
- Is copper(II) or iron(III) salt more soluble in the solvent? Explain. [2]

- C9. Diamond and silicon carbide are both macromolecules. Part of the structure of silicon carbide is shown below.



- (a) (i) State one difference between the structures of silicon carbide and diamond. [1]
(ii) State one similarity between the structures of silicon carbide and diamond. [1]
(b) Suggest **two** physical properties of silicon carbide. [2]
(c) Silicon carbide is manufactured by the reduction of silicon dioxide with carbon.



- (i) State one source of silicon dioxide. [1]
(ii) What mass of carbon is needed to make 20kg of silicon carbide? [1]
(d) Silicones are polymers that contain the elements silicon, oxygen, carbon and hydrogen. Suggest names of **three** combustion products of a silicone polymer. [3]
(e) Silicon carbide does **not** conduct electricity in solid state. Why? [1]

~~ *The End* ~~

The Periodic Table of the Elements

I		II		Group																III		IV		V		VI		VII		0																																																																																						
7 Li Lithium 3	9 Be Beryllium 4																	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10			27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18			39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 27	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	85 Cs Caesium 55	87 Fr Francium 87	133 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 47	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium * 72	181 Ta Tantalum 73	184 W Tungsten 74	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86	226 Ra Radium 88	227 Ac Actinium 89	232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103	232 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	144 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	Hydrogen 1

* 58 – 71 Lanthanoid series
+ 90 – 103 Actinoid series

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

a	X
Key	b

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)