

School Number	Candidate Number
Surname and Initials	

CHEMISTRY

PAPER 2 3051/2

Monday 30 MAY 2005 1.50 – 3.20 P.M.

No additional materials required.

MINISTRY OF EDUCATION NATIONAL EXAMINATIONS

BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

INSTRUCTIONS AND INFORMATION TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your school number, candidate number, surname and initials in the spaces provided above.

Answer ALL the questions on this paper.

Read each question carefully and make sure you know what you have been asked before starting your answer.

The instruction NAME . . . requires an answer in words not chemical symbols.

Show ALL your working when answering numerical questions. Lines are provided on the question paper for your answers. You should write your answers on these lines only.

The mark for each part-question is given in brackets [].

The volume of one mole of gas at room temperature and pressure (r.p.t.) is 24 000 cm³.

FOR EXAMINER'S USE	
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

This question paper consists of 21 printed pages and 3 blank pages.

The Periodic Table of the Elements

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

Lanthanoid series
Actinoid series

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

a	X	b
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1. A group of young scientists on a camping trip found an impure nugget of gold. They decided to design and build a smelting oven to purify it.

The gold was smelted in a container by placing it in the oven, Figure B.

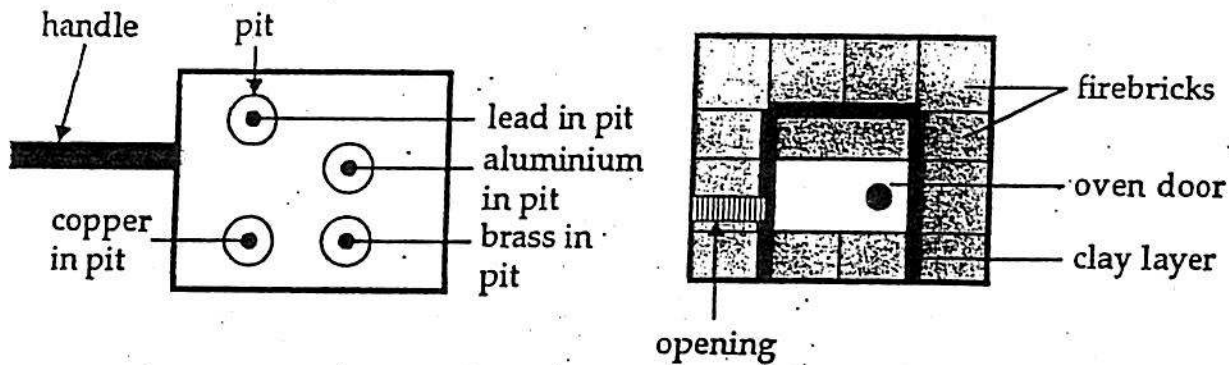


Figure A
(NOT DRAWN TO SCALE)

Figure B
Firebrick Oven

The students left a small opening in the side of the firebrick oven. When the oven was hot, they tested the temperature by inserting the four metals of Figure A in the opening. The metals were lead, aluminium, copper and brass.

- (a) The table shows the melting points of the four metals, and the gold nugget.

material	aluminium	brass	copper	gold	lead
melting point/k	933	1450	1356	1337	601

- (i) Explain briefly how the students will know, by pushing in the metals, when the oven is the right temperature for smelting the gold.

[2]

- (ii) Draw a diagram to show what happens to the metal particles before and after the temperature rises.

Before After [2]

- (iii) State which of the metals lead, aluminium, copper or brass is most similar to gold. Use the Periodic Table to help explain your answer.

Metal _____

Reason _____

_____ [2]

- (b) The smelting oven works in the same way as any other furnace for extracting metals from their ores, but no carbon was added to the gold nugget.

- (i) Explain the purpose of the layer of clay around the brick oven.

_____ [1]

- (ii) Suggest a reason why the students did not have to include carbon in the smelter.

_____ [1]

- (c) The pure gold was made into a pair of earrings.

State two properties of the gold that makes it suitable for this purpose.

Property 1 _____

Property 2 _____ [2]

Total mark [10]

2. Mendeleev's Periodic Table is shown below.

Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII
H 1							
Li 7	Be 9.4	B 11	C 12	N 14	O 16	F 19	
Na 23	Mg 24	Al 27.3	Si 28	P 31	S 32	Cl 35.5	
K 39	Ca 40	— 44	Ti 48	V 51	Cr 52	Mn 55	Fe 56 Co 59 Ni 59 Cu 63
(Cu 63)	Zn 65	— 68	— 72	As 75	Se 78	Br 80	
Rb 85	Sr 87	?Yt 88	Zr 90	Nb 94	Mo 96	— 100	Ru 104 Rh 104 Pd 105 Ag 108
(Ag 108)	Cd 112	In 113	Sn 118	Sb 122	Te 128	I 127	
Cs 133	Ba 137	?Di 138	?Ce 140	—	—	—	—
—	—	—	—	—	—	—	—
—	—	?Er 178	?La 180	Ta 182	W 184	—	Os 195 Ir 197 Pt 198 Au 199
(Au 199)	Hg 200	Tl 204	Pb 208	Bi 208	—		
—	—	—	Th 231	—	U 240	—	—

- (a) Mendeleev did not know anything about atomic structure because protons, neutrons and electrons had not been discovered.

Explain why he placed the elements in Groups.

_____ [1]

- (b) Name the group of elements that is missing from Mendeleev's Periodic Table.

_____ [1]

- (c) Name one element on Mendeleev's Periodic Table that has a different relative atomic mass when compared to the modern Periodic Table.

_____ [1]

- (d) Mendeleev predicted that an element existed that would have a relative atomic mass of 72. Name this element on the modern Periodic Table.

_____ [1]

- (e) Give one property possessed by all the elements in Mendeleev's Group VII.

_____ [1]

- (f) State what Group VII in Mendeleev's Periodic Table has become on the modern Periodic Table.

_____ [1]

- (g) Mendeleev predicted that an element, E, would be discovered with an atomic mass of 68 and said it would have an oxide with the formula E_2O_3 . State which known metal element in Mendeleev's Table would metal E most resemble.

_____ [1]

- (h) State the name given to all members of Group VII of the modern Periodic Table.

_____ [1]

- (i) Draw a diagram using the outer electrons only to show the bonding between magnesium and fluorine.

[2]

Total marks [10]

3. Diamond, graphite and the recently discovered buckyballs are different forms of carbon in the same state.

(a) Write the name given to different forms of an element that exist in the same state.

_____ [1]

(b) Explain in terms of the bonds formed by the outer shell electrons of the carbon atom, why

(i) carbon atoms can form crystals of diamond;

_____ [1]

(ii) graphite crystals will conduct electricity.

_____ [1]

(iii) Explain briefly why diamond is a good insulator.

_____ [1]

(c) State the useful physical property of

(i) diamond when it is used for drilling rock;

(ii) graphite when it is used as a lubricant.

_____ [2]

(d) (i) Write the symbol equation for the combustion of diamond in oxygen.

_____ [1]

- (ii) A 1 g diamond is burned in oxygen and the gas formed is collected at room temperature and pressure.

Calculate the volume of gas produced, (A_r ; C, 12)

[2]

- (e) At temperatures above 4200°C , graphite becomes a gas and on cooling becomes a solid.

State the name of this change.

[1]

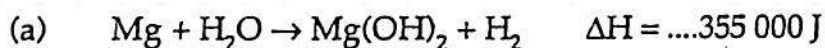
Total marks [10]

4. Using a Flameless Heater Meal a soldier can get a hot meal without fire.

Flameless
Heater Meals

JUST ADD WATER

The flameless heater is based on the reaction of magnesium with water. This is corrosion working for us. The amount of heat produced is enough to heat the food to 60 °C.



(i) Balance the equation. [1]

(ii) State the sign of ΔH in this reaction.

_____ [1]

(iii) The Flameless Heater incorporates 12.0 g of magnesium powder.

What fraction of a mole is 12.0 g of magnesium? (A_r ; Mg, 24)

_____ [1]

(iv) Find the mass of water which must be added to the 12.0 g of magnesium.

_____ [1]

(v) Calculate the amount of heat produced when 6.0 g of magnesium reacts with water.

[1]

(b) Name the

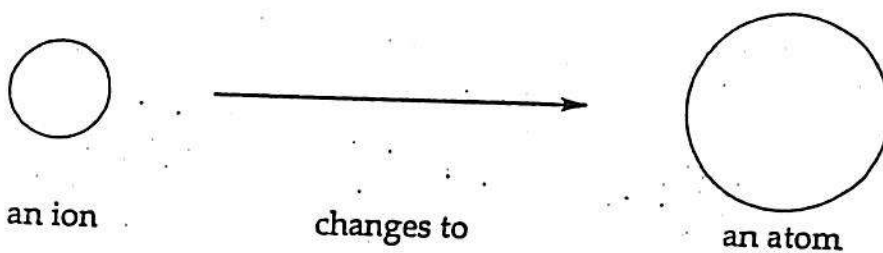
(i) substance that is oxidized,

_____ [1]

(ii) oxidizing agent.

_____ [1]

(c) When a positive ion becomes an atom, its diameter increases.



(i) State whether the diagram represents an oxidation or reduction process.

_____ [1]

(ii) Explain your answer to (c)(i).

_____ [1]

(iii) State whether the oxidation number increases or decreases when the atom is formed from the ion.

_____ [1]

Total marks [10]

5. Bacteria feed on decaying vegetation producing CH_4 . Termites produce CH_4 as a by-product of digestion. CH_4 is the main component of natural gas, used for cooking and heating.

(a) (i) Name the compound CH_4 .

_____ [1]

(ii) Name the homologous series to which this hydrocarbon belongs.

_____ [1]

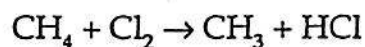
(b) The table gives information about four organic compounds containing different amounts of chlorine atoms.

Fill in the missing data to complete the Table.

[4]

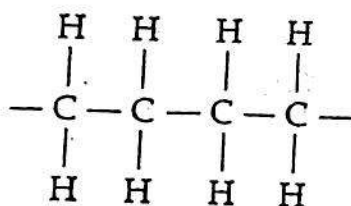
formulae	name	use
CHCl_3		refrigerant
CH_2Cl_2		solvent
CHCl_3	trichloromethane	
CCl_4	tetrachloromethane	

(c) State the name given to classify the reaction.



_____ [1]

- (d) (i) The diagram shows part of a molecule of a plastic substance used to make food containers.



In the space draw the structural formulae of the two monomer molecules used to make this part of the plastic molecule.

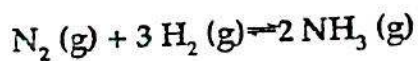
[2]

- (ii) Name the reaction by which the plastic molecule is made.

[1]

Total marks [10]

6. The equation for the manufacture of ammonia is



The process is exothermic and is often carried out around 450° C and at 200 atmosphere pressure in the presence of a catalyst.

(a) Name a suitable catalyst for this process.

_____ [1]

(b) The reaction between nitrogen and hydrogen will reach equilibrium after a time. The table shows the percentage yields of ammonia at equilibrium in various conditions of temperature and pressure.

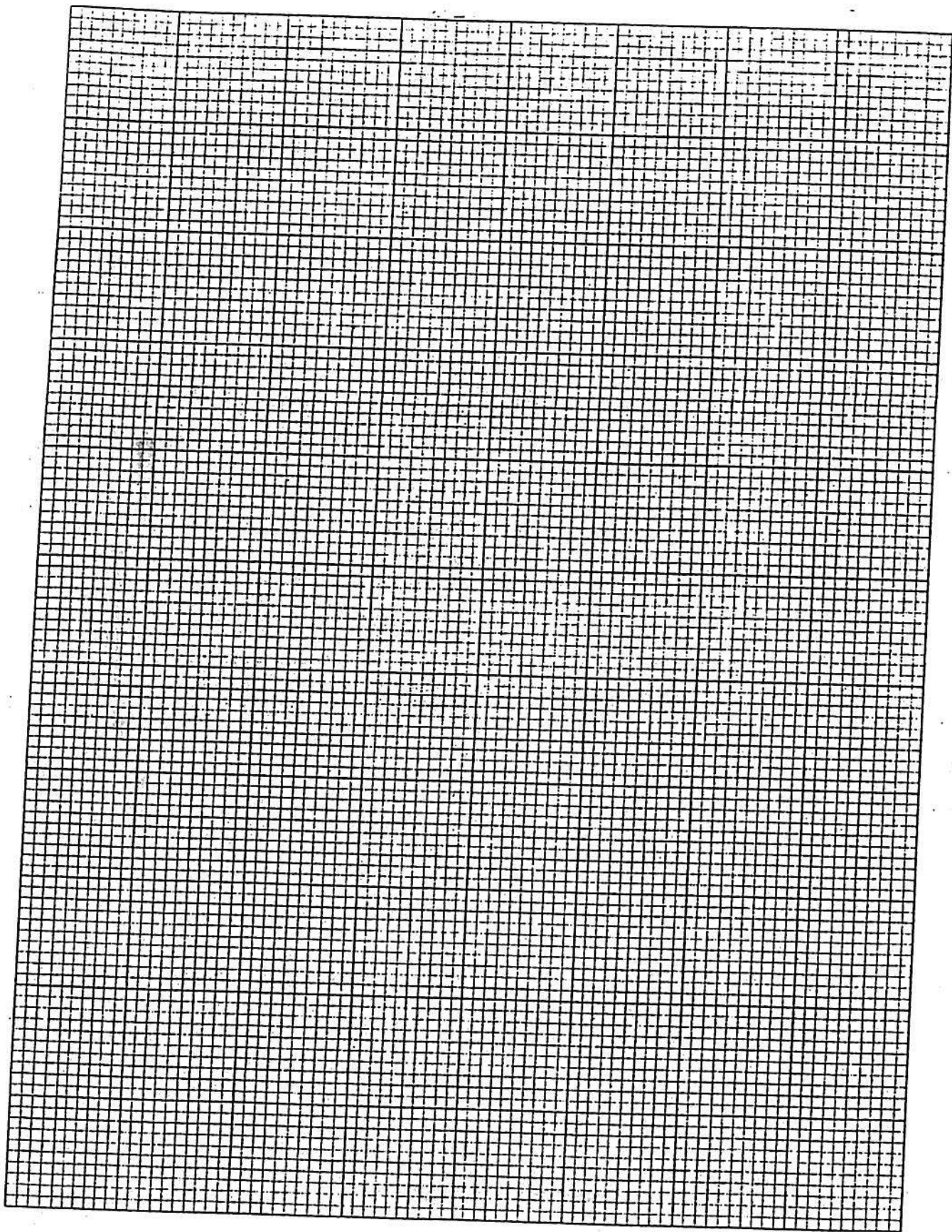
Percentage yields of ammonia

pressures/atmosphere	temp. 200 °C	temp. 300 °C	temp. 400 °C	temp. 500 °C
100	82	53	25	11
200	89	67	39	18

(i) Draw a graph of percentage yield of ammonia against temperature for a pressure of 200 atmospheres. [3]

The completed graph should have:

- labelled axis
- the four points plotted for a pressure of 200 atmospheres
- the most accurate curve drawn



- (ii) Using your completed graph to help you, write increased, decreased or unchanged to complete the table. [2]

change of condition	effect on the yield of ammonia
temperature increased from 450 °C to 500 °C	
pressure decreased from 200 to 100 atmospheres	

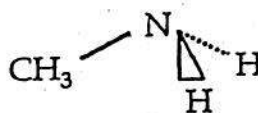
- (iii) Suggest a reason, using your knowledge of the kinetic theory, why a temperature lower than 450 °C is not used in this process.

_____ [1]

- (c) Ammonia and methylamine share many properties. Both have a strong smell and are soluble in water. Both solutions have a pH greater than 7.



Ammonia



methylamine

- (i) Suggest why ammonia and methylamine have similar properties.

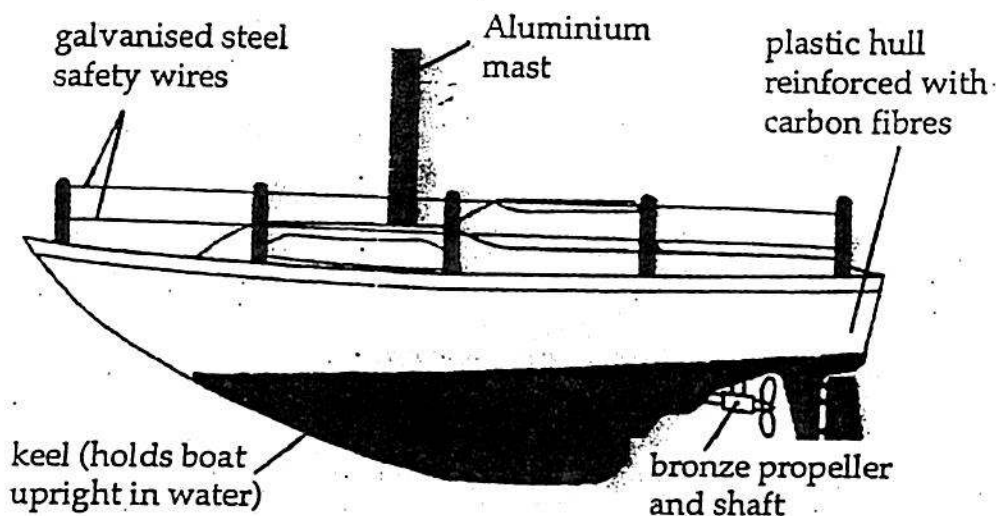
_____ [1]

- (ii) Give two large scale uses of ammonia.

1 _____

2 _____ [2]

7. The diagram shows parts of a boat.



The table shows the properties of the metals.

metal	density g/cm ³	resistance to corrosion	cost
aluminum	2.70	fair	cheap
copper	8.94	very good	cheap
gold	19.30	excellent	very expensive
lead	11.33	excellent	cheap
tin	7.31	very good	expensive

- (a) The keel is heavy, it is there to stop the boat from turning upside down.
- (i) Name the metal in the table which should be used to make the keel.

_____ [1]

(ii) State two reasons for your answer

1 _____

2 _____

[2]

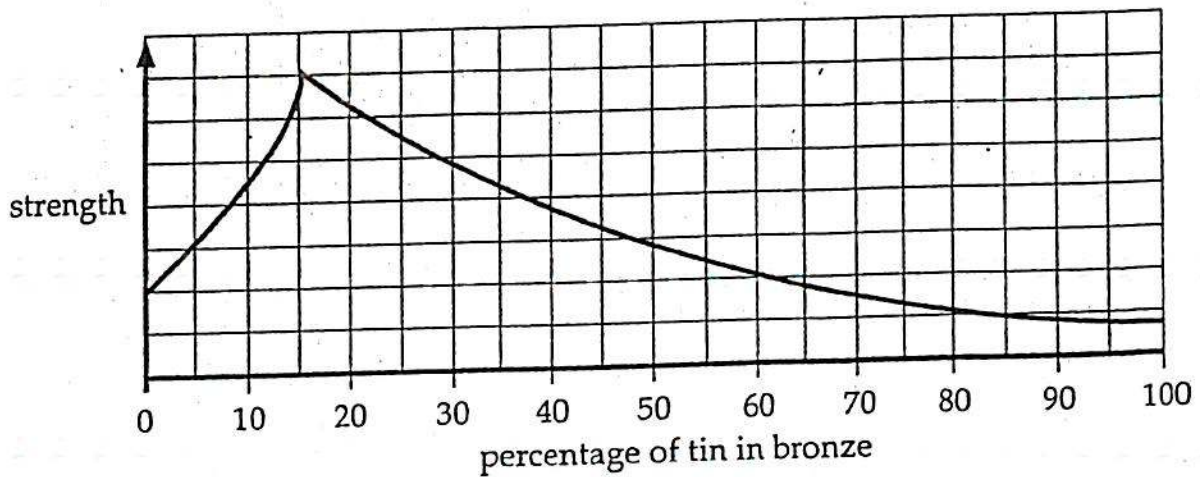
(iii) The hull is made from plastic in which carbon fibres are embedded. State the purpose of the carbon fibres.

[1]

(iv) Give one reason why aluminum is a good metal from which to make the mast.

[1]

(b) Copper has a low tensile strength but when tin is mixed with it, a much stronger metal called bronze is produced. The graph below shows how the percentage of tin in bronze affects its strength.



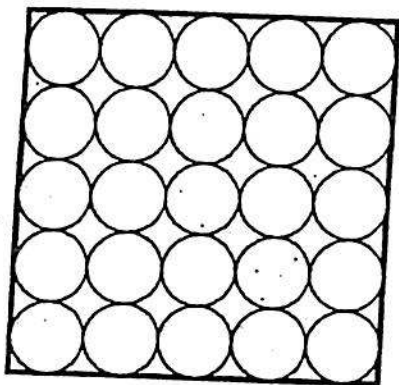
- (i) Give the percentage composition of copper and tin in bronze which is suitable for making the propeller and the shaft.

Copper _____ %

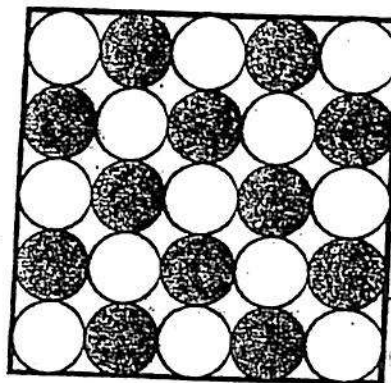
Tin _____ %

[1]

- (c) The diagrams show the arrangements of atoms in pure copper and in bronze.



Pure Copper



Bronze

Use the diagram to

- (i) explain why copper has a slightly higher density than bronze;

_____ [1]

- (ii) suggest one difference between the physical properties of copper and bronze.

_____ [1]

- (iii) Name the metal which is used instead of tin to make the alloy brass.

_____ [1]

- (d) The steel safety wires on the boat are galvanized to protect them against corrosion.

Explain one way in which galvanizing protects them against corrosion.

[1]

Total marks [10]

8. - Name one substance used in cooking that is identified as

- (a) (i) an acid _____
(ii) a base _____ [2]

(b) Hydrogen Chloride, HCl (g), will not affect blue litmus paper in a dry environment, but will change it if the litmus paper is moist.

- (i) Explain these observations by referring to the nature of the molecule in both situations.

_____ [3]

- (ii) Name one other commercially available or homemade indicator.

_____ [1]

(c) Fill in the blanks to complete the word equations

- (i) acid + base →

_____ + _____ [2]

- (ii) magnesium + sulphuric acid →

_____ + _____ [2]

Total marks [10]

