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CANDIDATE  
NUMBER

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**CHEMISTRY****0620/32**

Paper 3 Theory (Core)

**May/June 2025****1 hour 15 minutes**

You must answer on the question paper.

No additional materials are needed.

**INSTRUCTIONS**

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

**INFORMATION**

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].
- The Periodic Table is printed in the question paper.

This document has **20** pages. Any blank pages are indicated.



1 A list of substances is shown.

aluminium  
bromine  
calcium  
carbon dioxide  
iron  
magnesium  
magnesium oxide  
neon  
oxygen  
potassium  
sulfur dioxide

Answer the following questions about these substances. Each substance may be used once, more than once or not at all.

State which substance is:

(a) an element which forms an ion with a 2– charge

..... [1]

(b) an ionic compound

..... [1]

(c) used as a catalyst

..... [1]

(d) approximately 21% of clean, dry air

..... [1]

(e) a gas needed for photosynthesis

..... [1]

(f) the most reactive metal in the list

..... [1]

(g) a gas that is tested for using acidified aqueous potassium manganate(VII)

..... [1]

(h) a noble gas

..... [1]

(i) in Group VII.

..... [1]

[Total: 9]



2 This question is about sea water and the substances found in sea water.

- (a) Table 2.1 shows the masses of some of the compounds formed when  $500\text{ cm}^3$  of sea water is evaporated.

**Table 2.1**

| compound          | formula         | mass of compound / g |
|-------------------|-----------------|----------------------|
| sodium chloride   | $\text{NaCl}$   | 7.0                  |
|                   | $\text{MgSO}_4$ | 2.5                  |
| potassium bromide | $\text{KBr}$    | 1.5                  |
| calcium carbonate | $\text{CaCO}_3$ | 1.0                  |

Answer these questions using the information from Table 2.1.

- (i) State the chemical name of  $\text{MgSO}_4$ .

..... [1]

- (ii) The total mass of compounds formed from  $500\text{ cm}^3$  of sea water is 12.0 g.

Calculate the total mass of compounds formed from  $750\text{ cm}^3$  of sea water.

mass = ..... g [1]

- (iii) State which compound in Table 2.1 reacts with an acid to produce carbon dioxide.

..... [1]

- (b) Potassium bromide is found in sea water and contains bromide ions.

Describe a test for bromide ions.

test .....

.....

observations .....

.....

[2]



(c) Calcium ions are in sea water.

Complete Fig. 2.1 to show:

- the electronic configuration of a calcium ion
- the charge on the ion.

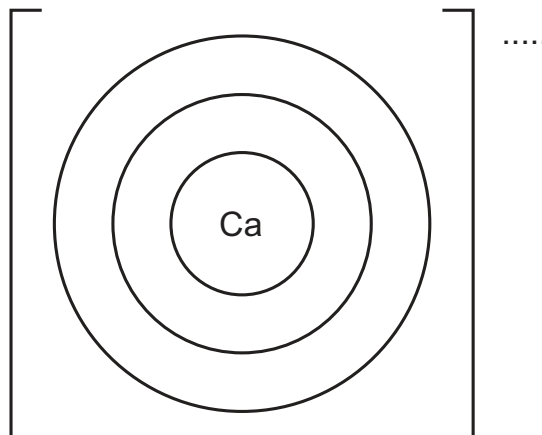


Fig. 2.1

[2]

(d) Sodium chloride is a solid at room temperature.

Describe the arrangement and motion of the particles in a solid.

arrangement .....

.....

motion .....

.....

[2]

(e) Sea water contains dissolved nitrate ions.

State **one** source of nitrate ions.

..... [1]

[Total: 10]



3 This question is about phosphorus and its compounds.

(a) (i) Phosphorus is in Group V of the Periodic Table.

Explain why phosphorus is placed in this group.

.....  
 ..... [1]

(ii) Two isotopes of phosphorus are shown in Fig. 3.1.



Fig. 3.1

Complete Table 3.1 to show the number of protons, neutrons and electrons in one atom of these isotopes.

Table 3.1

|                        | protons | neutrons | electrons |
|------------------------|---------|----------|-----------|
| ${}^{31}_{15}\text{P}$ |         |          |           |
| ${}^{32}_{15}\text{P}$ |         |          |           |

[3]

(iii) Phosphorus burns in oxygen to produce phosphorus(V) oxide.

Complete the symbol equation for this reaction.



(iv) State whether phosphorus(V) oxide is an acidic oxide or a basic oxide.

Give a reason for your answer.

.....  
 ..... [1]



- (b) (i) Phosphorus is one element in NPK fertilisers.

Draw a circle around **one other** element that is also in NPK fertilisers.

krypton

nickel

platinum

potassium

[1]

- (ii) State why farmers use fertilisers on fields where crops are grown.

..... [1]

- (c) A compound of phosphorus has the formula  $\text{Ca}_3(\text{PO}_4)_2$ .

Complete Table 3.2 to calculate the relative formula mass of  $\text{Ca}_3(\text{PO}_4)_2$ .

Table 3.2

| atom       | number of atoms | relative atomic mass |                     |
|------------|-----------------|----------------------|---------------------|
| oxygen     | 8               | 16                   | $8 \times 16 = 128$ |
| calcium    |                 | 40                   |                     |
| phosphorus |                 | 31                   |                     |

relative formula mass = ..... [2]

[Total: 11]



4 This question is about organic chemistry.

(a) (i) State the meaning of the term hydrocarbon.

.....  
..... [1]

(ii) Petroleum is a mixture of hydrocarbons.

Outline how petroleum is separated into its useful components.

Include in your answer:

- the name of the separation technique
- the property of the hydrocarbons which allows them to be separated
- a description of how this technique separates the petroleum into its useful components.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [4]

(iii) Some of the products obtained from petroleum are shown.

Draw a line from each product to its use.

| product  | use           |
|----------|---------------|
| kerosene | making roads  |
| bitumen  | fuel for cars |
| gasoline | jet fuel      |

[2]



(b) Ethanol is an organic molecule.

(i) Draw the displayed formula of a molecule of ethanol.

[2]

(ii) Ethanol is manufactured by the reaction of steam with ethene.

State **two** conditions for this process.

1 .....

2 .....

[2]

(c) Fig. 4.1 shows the displayed formula of tetramethylsilane.

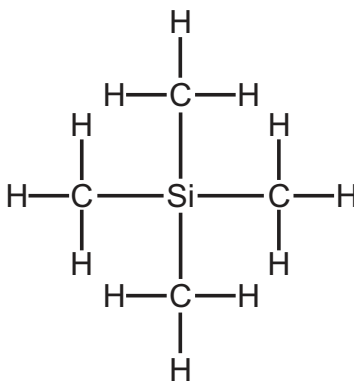


Fig. 4.1

(i) Deduce the molecular formula of tetramethylsilane.

..... [1]

(ii) Name the **two** elements in tetramethylsilane that are in the same group in the Periodic Table.

..... and ..... [1]

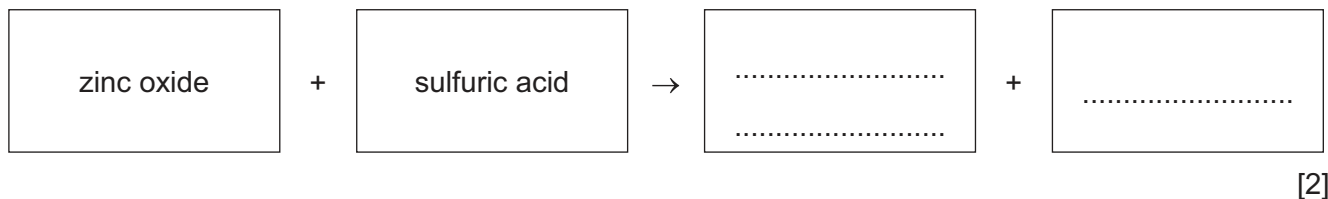
[Total: 13]



5 This question is about zinc salts.

(a) Excess solid zinc oxide is added to dilute sulfuric acid to produce a salt.

(i) Complete the word equation for this reaction.



(ii) Name the method used to remove excess solid zinc oxide from the reaction mixture.

..... [1]

(iii) Describe how crystals of the pure salt are made from an aqueous solution of the salt formed.

.....

.....

.....

..... [2]

(b) Fig. 5.1 shows the apparatus for the electrolysis of molten zinc chloride using inert electrodes.

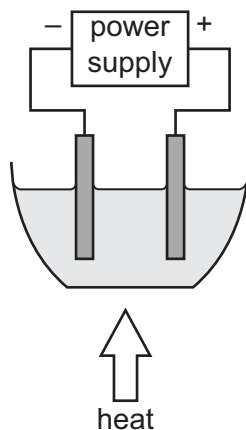


Fig. 5.1

(i) Label Fig. 5.1 to show the:

- cathode
- electrolyte.

[2]





(ii) Name a suitable material for the inert electrodes.

..... [1]

(iii) Name the products formed at the positive and negative electrodes.

positive electrode .....

negative electrode .....

[2]

(c) Zinc chloride has ionic bonds.

State the meaning of the term ionic bond.

.....

..... [2]

[Total: 12]



6 This question is about metals.

- (a) (i) A student investigates the reaction of four different metals, **A**, **B**, **C** and **D**, with dilute hydrochloric acid.

All other conditions are the same in each test-tube.

The results of the experiment are shown in Fig. 6.1.

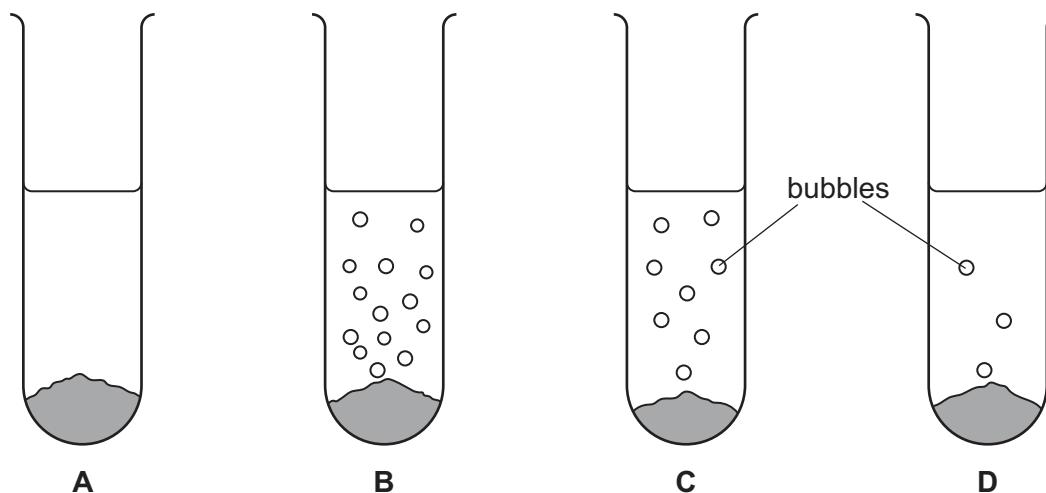


Fig. 6.1

Put the metals, **A**, **B**, **C** and **D**, in order of their reactivity.

most reactive .....



least reactive .....

[1]

- (ii) The student wants to decrease the rate of the reaction in the experiment.

State **two** ways to decrease the rate of this reaction.

1 .....

2 .....

[2]

- (b) In another experiment, a student adds potassium carbonate to dilute hydrochloric acid.

State the colour seen in the flame test for potassium ions.

..... [1]



(c) Brass is a mixture of two metals.

(i) State the name given to a mixture of metals such as brass.

..... [1]

(ii) Name the **two** metals in brass.

..... and ..... [2]

(iii) Magnalium is a mixture of magnesium and aluminium.

Suggest **one** property of magnalium that makes it more useful than pure magnesium metal.

..... [1]

[Total: 8]



- 7 (a) Select **two** processes that show a chemical change.

Tick (✓) **two** boxes.

boiling water

☐

burning methane

☐

dissolving salt

☐

mixing ink and water

☐

rusting of iron

☐

[2]

- (b) The reaction of hydrogen with nitrogen is a reversible reaction.

Write the symbol that shows a reversible reaction.

..... [1]

- (c) Table 7.1 shows the results of four experiments.

**Table 7.1**

| experiment | initial temperature / °C | final temperature / °C |
|------------|--------------------------|------------------------|
| 1          | 18                       | 23                     |
| 2          | 19                       | 17                     |
| 3          | 18                       | 14                     |
| 4          | 19                       | 29                     |

- (i) State which experiment shows the greatest temperature change.

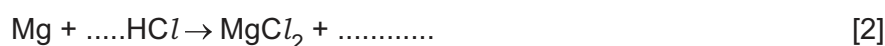
..... [1]

- (ii) State which experiment is the most endothermic.

..... [1]

- (iii) In experiment 4, magnesium was added to dilute hydrochloric acid.

Complete the symbol equation.



(iv) Fig. 7.1 shows an incomplete reaction pathway diagram for an endothermic reaction.

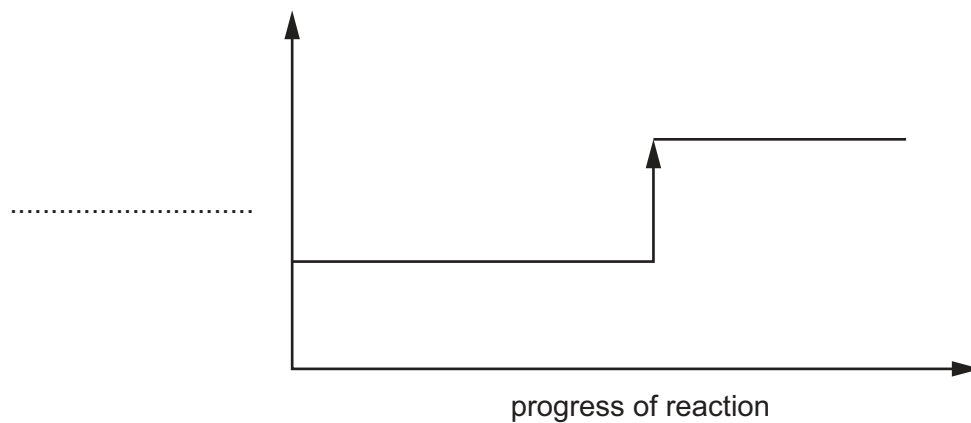


Fig. 7.1

Complete Fig. 7.1 by labelling:

- the vertical axis
- the reactants
- the products.

[2]

[Total: 9]



8 This question is about water and air.

(a) Water needs to be treated to make it safe to drink.

Draw a line from each stage in the treatment of domestic water to the reason why it is carried out.

| stage              | reason                      |
|--------------------|-----------------------------|
| addition of carbon | to kill microbes            |
| sedimentation      | to remove tastes and odours |
| chlorination       | to remove solids            |

[2]

(b) Describe how to test whether a sample of water is pure using melting point.

.....  
.....  
..... [2]

(c) Air may contain sulfur dioxide and particulates.

(i) State **one** harmful effect of each of these air pollutants.

sulfur dioxide .....  
particulates ..... [2]

(ii) Describe how flue gas desulfurisation reduces emissions of sulfur dioxide gas.

.....  
.....  
..... [2]

[Total: 8]



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The Periodic Table of Elements

| Group                      |                             |                                                                                      |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                                       |                             |                             |                              |                               |                              |                             |
|----------------------------|-----------------------------|--------------------------------------------------------------------------------------|-----------------------------|---------------------------------|------------------------------|------------------------------|------------------------------|----------------------------|------------------------------|--------------------------------|-------------------------------|---------------------------------------|-----------------------------|-----------------------------|------------------------------|-------------------------------|------------------------------|-----------------------------|
| I                          | II                          |                                                                                      |                             |                                 |                              |                              |                              |                            |                              |                                |                               | III                                   | IV                          | V                           | VI                           | VII                           | VIII                         |                             |
|                            |                             |                                                                                      |                             |                                 |                              |                              |                              |                            |                              |                                |                               | <div>1<br/>H<br/>hydrogen<br/>1</div> |                             |                             |                              |                               |                              |                             |
|                            |                             | <div>Key<br/>atomic number<br/>atomic symbol<br/>name<br/>relative atomic mass</div> |                             |                                 |                              |                              |                              |                            |                              |                                |                               |                                       |                             |                             |                              |                               |                              |                             |
| 3<br>Li<br>lithium<br>7    | 4<br>Be<br>beryllium<br>9   |                                                                                      |                             |                                 |                              |                              |                              |                            |                              |                                |                               | 5<br>B<br>boron<br>11                 | 6<br>C<br>carbon<br>12      | 7<br>N<br>nitrogen<br>14    | 8<br>O<br>oxygen<br>16       | 9<br>F<br>fluorine<br>19      | 10<br>Ne<br>neon<br>20       |                             |
| 11<br>Na<br>sodium<br>23   | 12<br>Mg<br>magnesium<br>24 |                                                                                      |                             |                                 |                              |                              |                              |                            |                              |                                |                               | 13<br>Al<br>aluminium<br>27           | 14<br>Si<br>silicon<br>28   | 15<br>P<br>phosphorus<br>31 | 16<br>S<br>sulfur<br>32      | 17<br>Cl<br>chlorine<br>35.5  | 18<br>Ar<br>argon<br>40      |                             |
| 19<br>K<br>potassium<br>39 | 20<br>Ca<br>calcium<br>40   | 21<br>Sc<br>scandium<br>45                                                           | 22<br>Ti<br>titanium<br>48  | 23<br>V<br>vanadium<br>51       | 24<br>Cr<br>chromium<br>52   | 25<br>Mn<br>manganese<br>55  | 26<br>Fe<br>iron<br>56       | 27<br>Co<br>cobalt<br>59   | 28<br>Ni<br>nickel<br>59     | 29<br>Cu<br>copper<br>64       | 30<br>Zn<br>zinc<br>65        | 31<br>Ga<br>gallium<br>70             | 32<br>Ge<br>germanium<br>73 | 33<br>As<br>arsenic<br>75   | 34<br>Se<br>selenium<br>79   | 35<br>Br<br>bromine<br>80     | 36<br>Kr<br>krypton<br>84    |                             |
| 37<br>Rb<br>rubidium<br>85 | 38<br>Sr<br>strontium<br>88 | 39<br>Y<br>yttrium<br>89                                                             | 40<br>Zr<br>zirconium<br>91 | 41<br>Nb<br>niobium<br>93       | 42<br>Mo<br>molybdenum<br>96 | 43<br>Tc<br>technetium<br>—  | 44<br>Ru<br>ruthenium<br>101 | 45<br>Rh<br>rhodium<br>103 | 46<br>Pd<br>palladium<br>106 | 47<br>Ag<br>silver<br>108      | 48<br>Cd<br>cadmium<br>112    | 49<br>In<br>indium<br>115             | 50<br>Sn<br>tin<br>119      | 51<br>Sb<br>antimony<br>122 | 52<br>Te<br>tellurium<br>128 | 53<br>I<br>iodine<br>127      | 54<br>Xe<br>xenon<br>131     |                             |
| 55<br>Cs<br>caesium<br>133 | 56<br>Ba<br>barium<br>137   | 57–71<br>lanthanoids                                                                 |                             | 72<br>Hf<br>hafnium<br>178      | 73<br>Ta<br>tantalum<br>181  | 74<br>W<br>tungsten<br>184   | 75<br>Re<br>rhenium<br>186   | 76<br>Os<br>osmium<br>190  | 77<br>Ir<br>iridium<br>192   | 78<br>Pt<br>platinum<br>195    | 79<br>Au<br>gold<br>197       | 80<br>Hg<br>mercury<br>201            | 81<br>Tl<br>thallium<br>204 | 82<br>Pb<br>lead<br>207     | 83<br>Bi<br>bismuth<br>209   | 84<br>Po<br>polonium<br>—     | 85<br>At<br>astatine<br>—    | 86<br>Rn<br>radon<br>—      |
| 87<br>Fr<br>francium<br>—  | 88<br>Ra<br>radium<br>—     | 89–103<br>actinoids                                                                  |                             | 104<br>Rf<br>rutherfordium<br>— | 105<br>Db<br>dubnium<br>—    | 106<br>Sg<br>seaborgium<br>— | 107<br>Bh<br>bohrium<br>—    | 108<br>Hs<br>hassium<br>—  | 109<br>Mt<br>meitnerium<br>— | 110<br>Ds<br>darmstadtium<br>— | 111<br>Rg<br>roentgenium<br>— | 112<br>Cn<br>copernicium<br>—         | 113<br>Nh<br>nihonium<br>—  | 114<br>Fl<br>flerovium<br>— | 115<br>Mc<br>moscovium<br>—  | 116<br>Lv<br>livermorium<br>— | 117<br>Ts<br>tennessine<br>— | 118<br>Og<br>oganesson<br>— |

|                        |                      |                           |                        |                       |                       |                       |                         |                      |                         |                        |                     |                        |                        |                       |
|------------------------|----------------------|---------------------------|------------------------|-----------------------|-----------------------|-----------------------|-------------------------|----------------------|-------------------------|------------------------|---------------------|------------------------|------------------------|-----------------------|
| lanthanoids            |                      |                           |                        |                       |                       |                       |                         |                      |                         |                        |                     |                        |                        |                       |
| 57                     | 58                   | 59                        | 60                     | 61                    | 62                    | 63                    | 64                      | 65                   | 66                      | 67                     | 68                  | 69                     | 70                     | 71                    |
| La<br>lanthanum<br>139 | Ce<br>cerium<br>140  | Pr<br>praseodymium<br>141 | Nd<br>neodymium<br>144 | Pm<br>promethium<br>— | Sm<br>samarium<br>150 | Eu<br>europium<br>152 | Gd<br>gadolinium<br>157 | Tb<br>terbium<br>159 | Dy<br>dysprosium<br>163 | Ho<br>holmium<br>165   | Er<br>erbium<br>167 | Tm<br>thulium<br>169   | Yb<br>ytterbium<br>173 | Lu<br>lutetium<br>175 |
| actinoids              |                      |                           |                        |                       |                       |                       |                         |                      |                         |                        |                     |                        |                        |                       |
| 89                     | 90                   | 91                        | 92                     | 93                    | 94                    | 95                    | 96                      | 97                   | 98                      | 99                     | 100                 | 101                    | 102                    | 103                   |
| Ac<br>actinium<br>—    | Th<br>thorium<br>232 | Pa<br>protactinium<br>231 | U<br>uranium<br>238    | Np<br>neptunium<br>—  | Pu<br>plutonium<br>—  | Am<br>americium<br>—  | Cm<br>curium<br>—       | Bk<br>berkelium<br>— | Cf<br>californium<br>—  | Es<br>einsteinium<br>— | Fm<br>fermium<br>—  | Md<br>mendelevium<br>— | No<br>nobelium<br>—    | Lr<br>lawrencium<br>— |

The volume of one mole of any gas is 24 dm<sup>3</sup> at room temperature and pressure (r.t.p.).

