

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
General Certificate of Education Ordinary Level

**COMBINED SCIENCE**

Paper 2



**5129/02**

October/November 2006

**2 hours 15 minutes**

Candidates answer on the Question Paper.  
No Additional Materials are required.

Candidate  
Name

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Centre  
Number

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Candidate  
Number

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**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.  
Write in dark blue or black pen.  
You may use a soft pencil for any diagrams, graphs or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.  
A copy of the Periodic Table is printed on page 20.  
At the end of the examination, fasten all your work securely together.  
The number of marks is given in brackets [ ] at the end of each question or part question.

**For Examiner's Use**

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1 Fig. 1.1 shows a ray of light entering and passing through a parallel-sided plastic block.

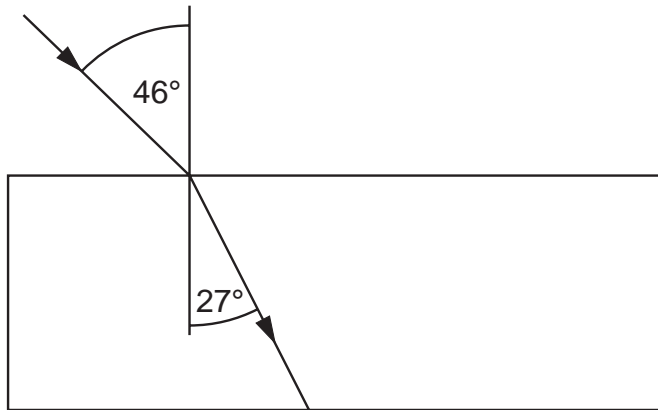


Fig. 1.1

- (a) On Fig. 1.1 draw an arrow to show the path of the ray after it has left the plastic block. [2]
- (b) Calculate the refractive index of the plastic.

[2]

2 (a) What type of substance are all enzymes?

..... [1]

(b) State the effect of the enzyme amylase on the conversion of starch to maltose.

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

(c) Explain two ways in which chewing a piece of bread helps the process of digestion.

1. ....  
.....

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

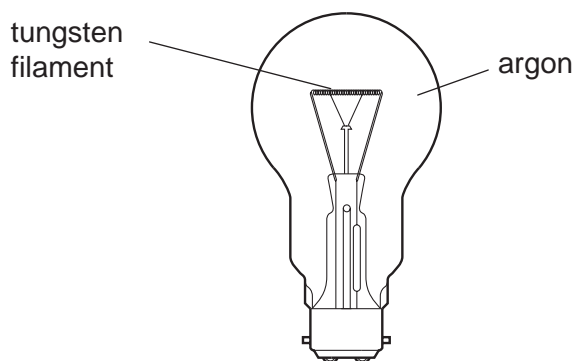
3 Air is a mixture of gases.  
This mixture includes the noble gases helium and argon.

(a) Helium is used to fill airships and balloons.

State two reasons why helium is a good choice for this use.

- 1. ....
- 2. .... [2]

(b) Argon is used to fill light bulbs.



(i) Why are light bulbs **not** filled with air?

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

(ii) Use your knowledge of the electronic structure of argon to explain why it is a good choice to fill light bulbs.

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

- 4 Fig. 4.1 represents a hydroelectric power station. Water flows from an upper lake to a lower lake to generate electrical energy.

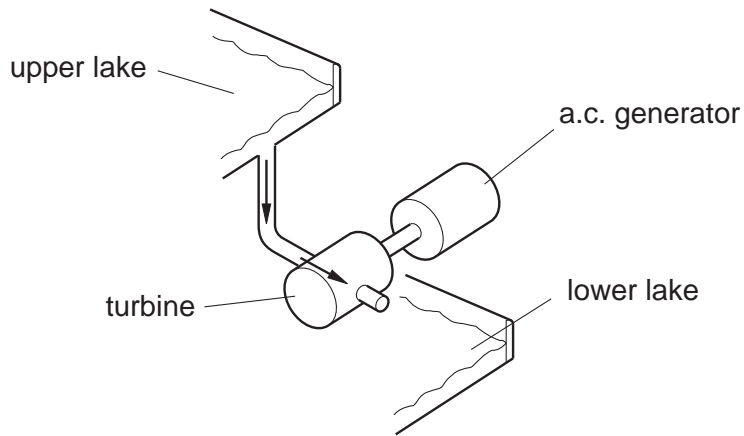


Fig. 4.1

- (a) Name the type of energy lost by the water

(i) as it falls from the upper lake,

.....energy [1]

(ii) as it slows down in the turbine.

.....energy [1]

- (b) Complete Fig. 4.2 to show how the voltage output of a simple a.c. generator varies with time.



Fig. 4.2

[2]

5

- (c) A small generator has an output of 20 W.  
Calculate how much electrical energy is produced in 3 minutes.

[3]

5 Hydrochloric acid is a strong acid which turns Universal Indicator red.

(a) (i) Name the ion present in hydrochloric acid which causes acidity.

.....[1]

(ii) Suggest the pH of hydrochloric acid.

.....[1]

(b) A student adds hydrochloric acid to calcium carbonate. The colourless gas produced passes through limewater as shown in Fig. 5.1.

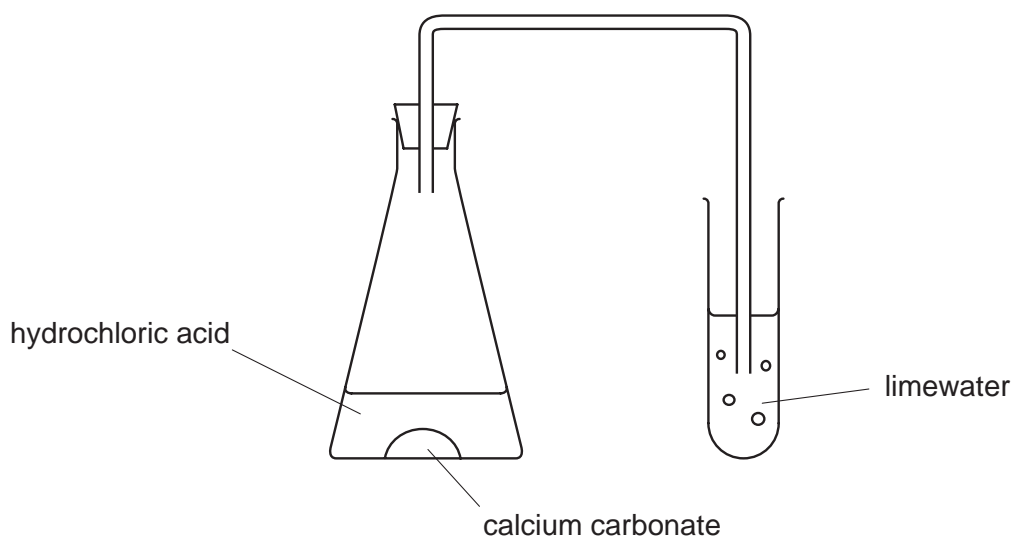


Fig. 5.1

(i) Describe the change in appearance of the limewater as the colourless gas passes through it.

.....[1]

(ii) Name this gas that is produced during the reaction of hydrochloric acid and calcium carbonate.

.....[1]

(iii) Suggest the name of the salt produced by the reaction between hydrochloric acid and calcium carbonate.

.....[1]

6 Fig. 6.1 shows an external view of the heart.

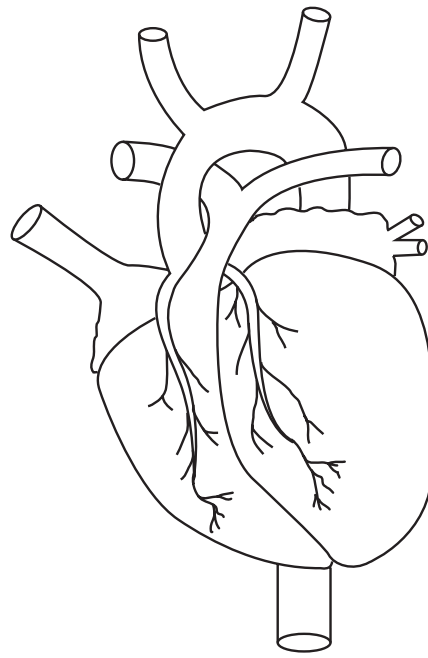
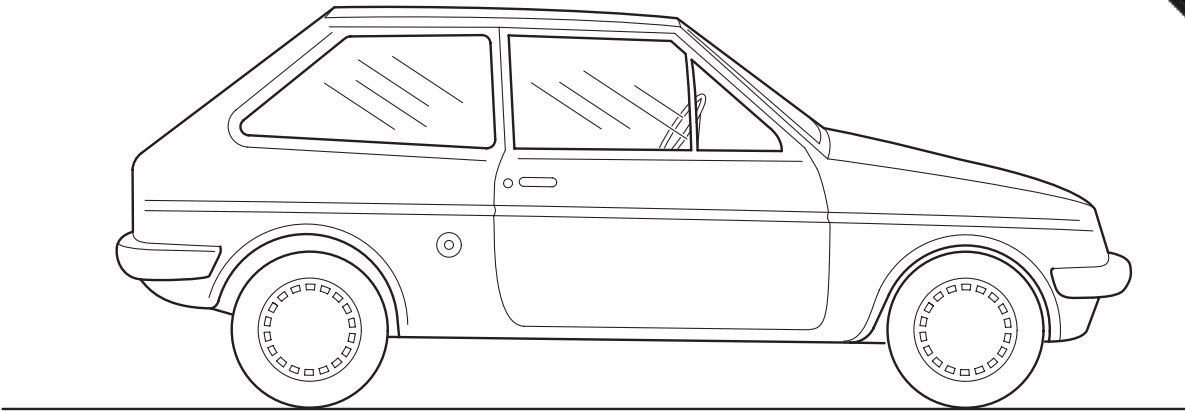


Fig. 6.1

- (a) (i) Name the tissue that is supplied with blood by the coronary arteries.  
 .....[1]
- (ii) Suggest three substances that the blood supplies to this tissue.  
 1. ....  
 2. ....  
 3. ....[3]
- (b) A person's diet may cause them to suffer from coronary heart disease.
- (i) Name a substance in a diet that may cause coronary heart disease.  
 .....[1]
- (ii) State the change in the coronary arteries that leads to coronary heart disease.  
 .....  
 .....[1]
- (iii) State **one** other cause of coronary heart disease.  
 .....  
 .....[1]

- 7 The car in Fig. 7.1 has a mass of 840 kg.



**Fig. 7.1**

- (a) The gravitational field strength  $g$  on Earth is  $10 \text{ N/kg}$ .  
Calculate the weight of the car.

[2]

- (b) The force produced by the engine that accelerates the car is  $2100 \text{ N}$ .  
Calculate the acceleration of the car.

[3]



8 Atoms are made up of three types of particle.

- (a) (i) Complete the table to show the relative mass and the relative charge of each of these three types of particle.

particle	relative mass	relative charge
proton		+1
electron	$\frac{1}{1840}$	
neutron	1	

[3]

- (ii) Define the term *nucleon number* (mass number).

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

- (b) Bromine is element 35 in the periodic table.  
 An atom of an isotope of bromine contains 35 protons, 35 electrons and 44 neutrons.  
 The atom is represented by



Deduce the values of **A** and **Z**.

**A** .....

**Z** .....

[2]

9 Fig. 9.1 is a circuit diagram for the headlamps of a car. P and Q are identical lamps.

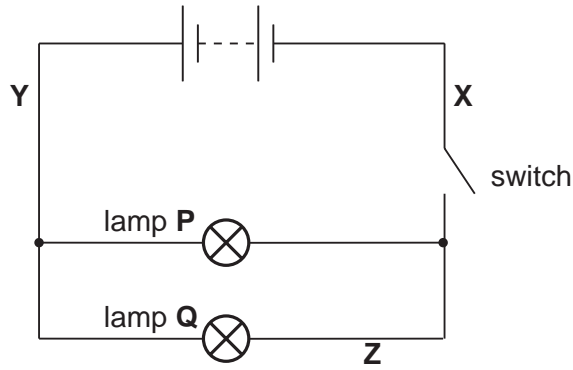


Fig. 9.1

(a) On Fig. 9.1, draw the symbol for a voltmeter that is connected into the circuit so that the voltage across lamp Q may be measured. [2]

(b) The switch is closed. The current in lamp Q is 3.0 A and the potential difference across it is 12 V.

(i) Calculate the resistance of the lamp.

[3]

(ii) Determine the current at

X, ..... A

Y, ..... A

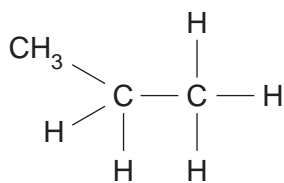
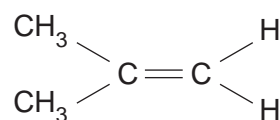
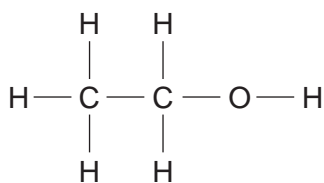
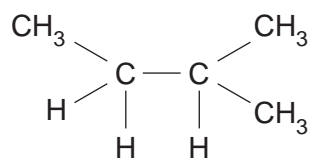
Z, ..... A

[3]

(c) Suggest why the lamps are connected in parallel rather than in series.

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

10 Fig. 10.1 shows the structures of four organic compounds, **A**, **B**, **C** and **D**.

**A****B****C****D****Fig. 10.1**

(a) Which compound is

(i) an alkene, .....

(ii) an alcohol, .....

(iii) oxidised to a carboxylic acid? .....

[3]

(b) Two of the compounds are alkanes.

Which of these two alkanes has the higher boiling point? .....

[1]

(c) All four compounds burn in excess oxygen to give the same two products.

State the names of these two products.

..... and .....

[2]

- 11 Fig. 11.1 shows a plant in a pot of damp soil on a balance. The pot and the soil are covered by a plastic bag.

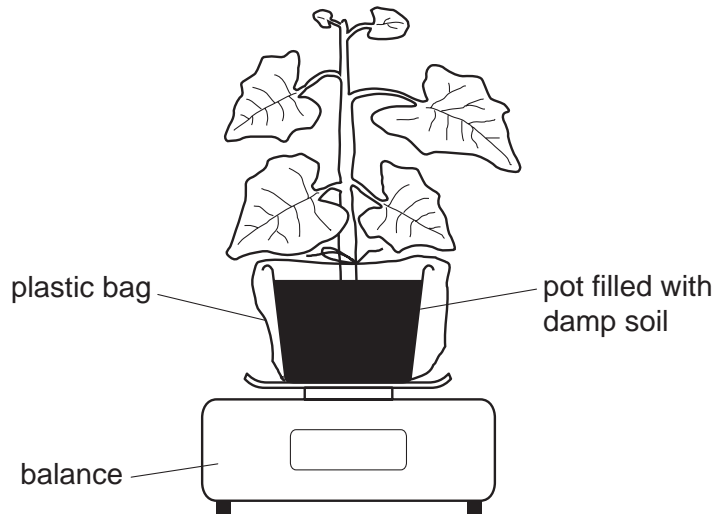


Fig. 11.1

- (a) During the next hour, the reading on the balance decreases.

- (i) Name the substance that is being lost from the plant.

.....[1]

- (ii) Name the structures in the leaves of the plant through which the substance is lost.

.....[1]

- (iii) Name the process that causes the decrease in mass.

.....[1]

- (b) (i) Describe how the appearance of the plant will alter if the apparatus in Fig. 11.1 is left on the balance for a week.

.....

.....[1]

- (ii) Explain your answer.

.....

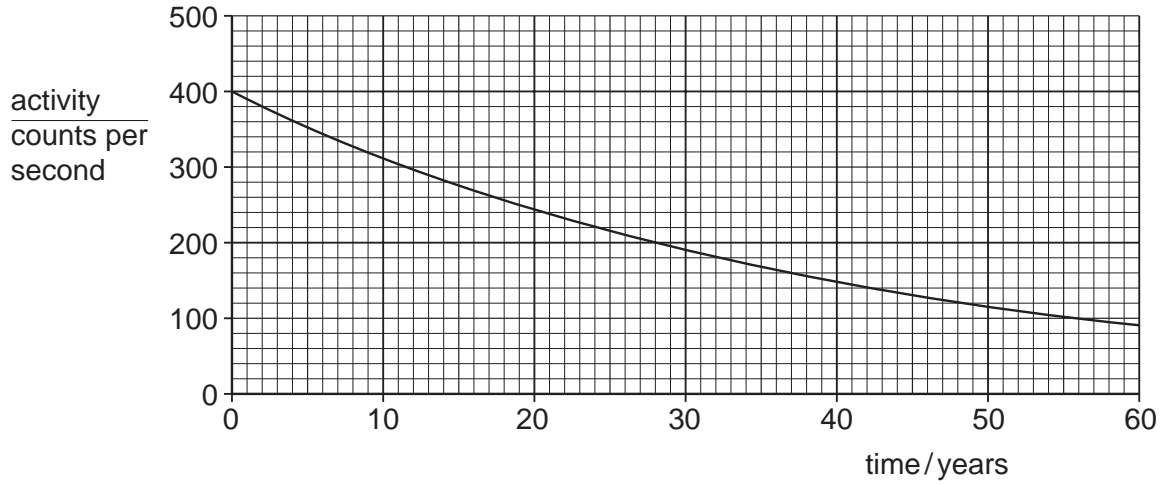
.....

.....

.....[2]

12 The radioactive isotope strontium-90 emits beta-particles.

- (a) State the nature of a beta-particle. .... [1]
- (b) State from which part of the atom the beta-particle is emitted. .... [1]
- (c) Fig. 12.1 shows how the activity of a sample of strontium-90 varies with time.



**Fig. 12.1**

Use Fig. 12.1 to determine the half-life of strontium-90.

half-life = ..... years [1]

- 13 Magnesium is in Group II of the Periodic Table.  
The electronic structure of magnesium is 2, 8, 2.

(a) (i) Draw a diagram showing the arrangement of the electrons in a magnesium ion.

[1]

(ii) Write the formula of the magnesium ion. ....[1]

- (b) Fig. 13.1 shows magnesium burning in carbon dioxide.  
The reaction produces a black solid (carbon) and a white solid (magnesium oxide).

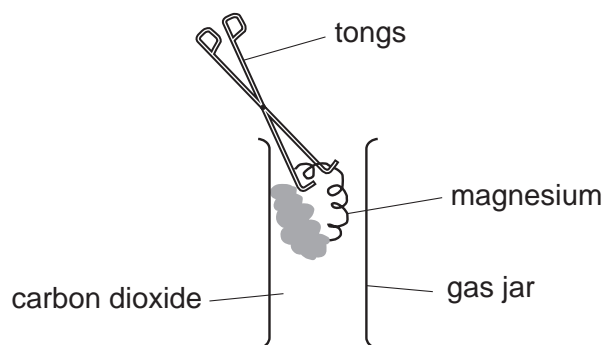
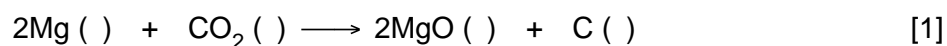


Fig. 13.1

- (i) Complete the equation for the reaction by adding the state symbols.



- (ii) Calculate the relative molecular mass of carbon dioxide.  
[ $A_r$ : C,12; O,16.]

.....[1]

- (iii) Calculate the mass of magnesium that is required to react completely with 2.2 g of carbon dioxide.  
[ $A_r$ : Mg,24.]

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

- 14 (a) (i) Name the two types of cell that form a zygote during sexual reproduction.
1. .... [2]
2. .... [2]

(ii) When these two cells meet, their nuclei fuse.

Name this process.

..... [1]

(b) Fig. 14.1 shows part of the female reproductive and urinary systems.

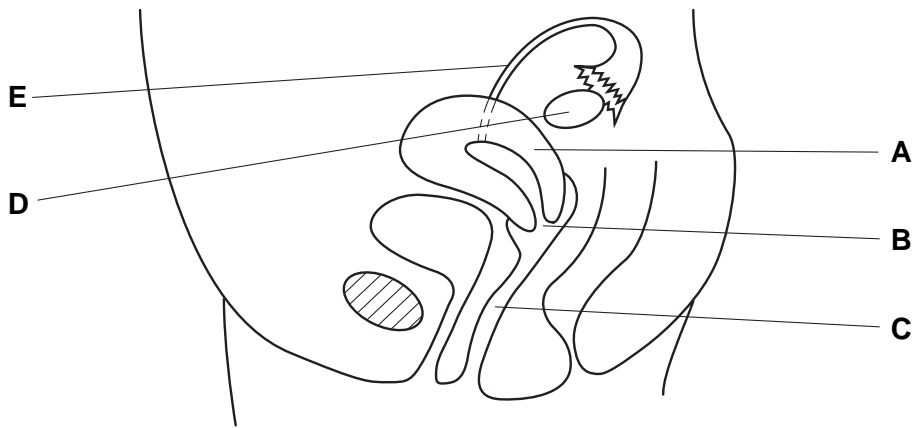


Fig. 14.1

- (i) Name the parts labelled
- A, ..... [3]
- B, ..... [3]
- C, ..... [3]

(ii) State the function of the parts labelled

D, ..... [2]

..... [2]

E, ..... [2]

..... [2]

(c) On Fig. 14.1 mark an X where a zygote will develop. [1]

15 A road is made by laying slabs of concrete with gaps between them. Fig. 15.1 shows this road at low temperature.

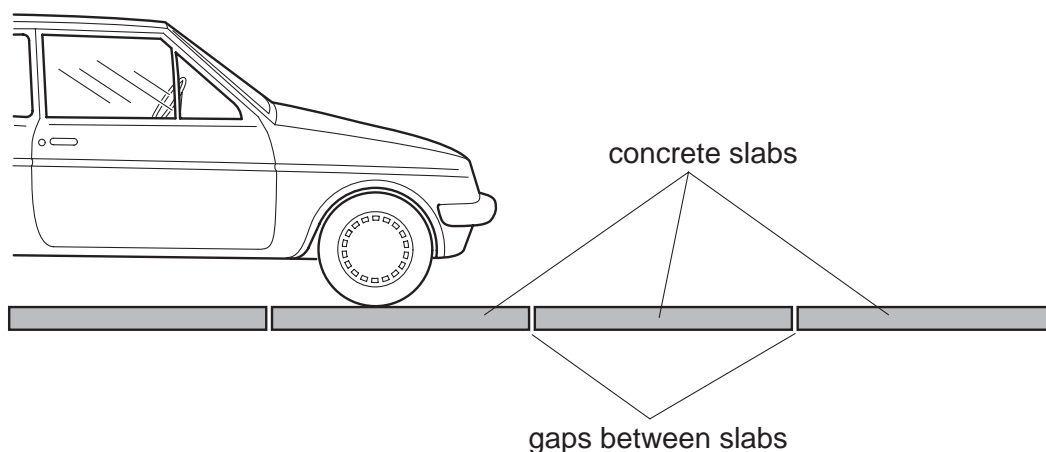


Fig. 15.1

- (a) The temperature increases.  
Suggest what happens to
  - (i) the concrete slabs, ..... [1]
  - (ii) the gaps between the slabs. .... [1]
- (b) Another road is laid on a cold day with no gaps between the concrete slabs.  
Suggest what may happen to this road on a very hot day.  
.....  
..... [1]



- 16 A small piece of each of four metals is placed in a separate test-tube containing hydrochloric acid. Results of this experiment are shown in Fig. 16.1.

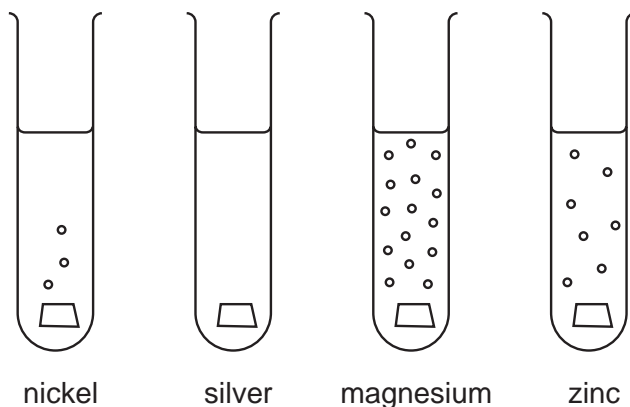


Fig. 16.1

- (a) Use Fig. 16.1 to deduce the reactivity series of these metals.

most reactive .....

.....

.....

least reactive .....

[1]

- (b) The reaction between a metal and an acid produces a salt and hydrogen.

- (i) Draw a dot and cross diagram to show the bonding in a molecule of hydrogen.

[1]

- (ii) Name the salt produced when magnesium reacts with hydrochloric acid.

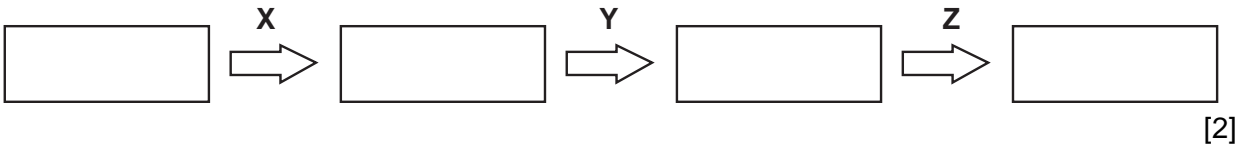
.....[1]

- (iii) State the type of bonding present in this salt. ....[1]

17 (a) The following words describe organisms found in a food chain.

**carnivore      decomposer      herbivore      producer**

Write these words in the boxes in the order in which they occur in a food chain.



(b) (i) State the original source of the energy in a food chain.  
.....[1]

(ii) Name the process that makes this energy available to the food chain.  
.....[1]

(iii) Referring to the diagram in (a), at which stage, X, Y or Z does most energy pass?  
.....[1]

(c) Carbon passes along a food chain in carbon compounds.

(i) Suggest a carbon compound in which carbon might pass from one organism to another.  
.....[1]

(ii) Name the compound in which carbon leaves the food chain.  
.....[1]

- 18 (a) Fig. 18.1 shows two magnets that are repelling each other. One of the magnets has its poles marked on it. On Fig. 18.1, label the poles on the unmarked magnet.

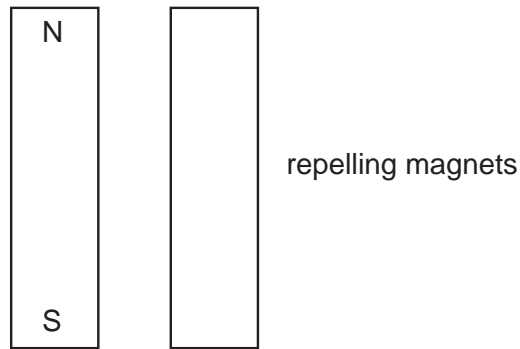


Fig. 18.1

[1]

- (b) Fig. 18.2 shows an electromagnet. The electromagnet has an iron core.

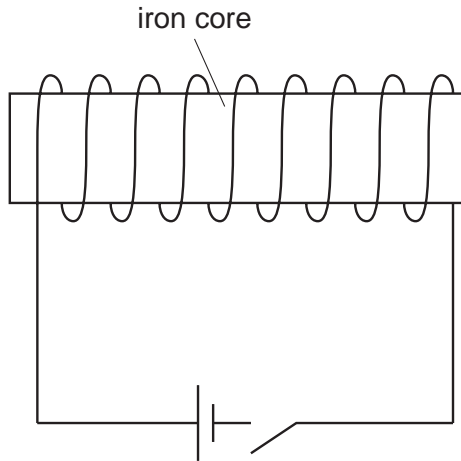


Fig. 18.2

Explain why brass and steel are **not** used for the core.

brass .....

.....

steel .....

.....[2]

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**DATA SHEET**  
**The Periodic Table of the Elements**

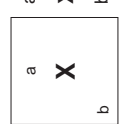
		Group																																																																																																																																
I	II	III	IV	V	VI	VII	0																																																																																																																											
7 <b>Li</b> Lithium 4	9 <b>Be</b> Beryllium 4	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <tr> <td>1 <b>H</b> Hydrogen 1</td> <td colspan="10"></td> </tr> <tr> <td>11 <b>B</b> Boron 5</td> <td>12 <b>C</b> Carbon 6</td> <td>13 <b>Al</b> Aluminium 13</td> <td>14 <b>Si</b> Silicon 14</td> <td>15 <b>P</b> Phosphorus 15</td> <td>16 <b>O</b> Oxygen 8</td> <td>17 <b>Cl</b> Chlorine 17</td> <td>18 <b>Ar</b> Argon 18</td> <td>19 <b>F</b> Fluorine 9</td> <td>20 <b>Ne</b> Neon 10</td> <td>21 <b>Sc</b> Scandium 21</td> <td>22 <b>Ti</b> Titanium 22</td> <td>23 <b>V</b> Vanadium 23</td> <td>24 <b>Cr</b> Chromium 24</td> <td>25 <b>Mn</b> Manganese 25</td> <td>26 <b>Fe</b> Iron 26</td> <td>27 <b>Co</b> Cobalt 27</td> <td>28 <b>Ni</b> Nickel 28</td> <td>29 <b>Cu</b> Copper 29</td> <td>30 <b>Zn</b> Zinc 30</td> <td>31 <b>Ga</b> Gallium 31</td> <td>32 <b>Ge</b> Germanium 32</td> <td>33 <b>As</b> Arsenic 33</td> <td>34 <b>Se</b> Selenium 34</td> <td>35 <b>Br</b> Bromine 35</td> <td>36 <b>Kr</b> Krypton 36</td> <td>37 <b>Rb</b> Rubidium 37</td> <td>38 <b>Sr</b> Strontium 38</td> <td>39 <b>Y</b> Yttrium 39</td> <td>40 <b>Zr</b> Zirconium 40</td> <td>41 <b>Nb</b> Niobium 41</td> <td>42 <b>Mo</b> Molybdenum 42</td> <td>43 <b>Tc</b> Technetium 43</td> <td>44 <b>Ru</b> Ruthenium 44</td> <td>45 <b>Rh</b> Rhodium 45</td> <td>46 <b>Pd</b> Palladium 46</td> <td>47 <b>Ag</b> Silver 47</td> <td>48 <b>Cd</b> Cadmium 48</td> <td>49 <b>In</b> Indium 49</td> <td>50 <b>Sn</b> Tin 50</td> <td>51 <b>Sb</b> Antimony 51</td> <td>52 <b>Te</b> Tellurium 52</td> <td>53 <b>I</b> Iodine 53</td> <td>54 <b>Xe</b> Xenon 54</td> <td>55 <b>Cs</b> Caesium 55</td> <td>56 <b>Ba</b> Barium 56</td> <td>57 <b>La</b> Lanthanum 57</td> <td>58 <b>Ce</b> Cerium 58</td> <td>59 <b>Pr</b> Praseodymium 59</td> <td>60 <b>Nd</b> Neodymium 60</td> <td>61 <b>Pm</b> Promethium 61</td> <td>62 <b>Sm</b> Samarium 62</td> <td>63 <b>Eu</b> Europium 63</td> <td>64 <b>Gd</b> Gadolinium 64</td> <td>65 <b>Tb</b> Terbium 65</td> <td>66 <b>Dy</b> Dysprosium 66</td> <td>67 <b>Ho</b> Holmium 67</td> <td>68 <b>Er</b> Erbium 68</td> <td>69 <b>Tm</b> Thulium 69</td> <td>70 <b>Yb</b> Ytterbium 70</td> <td>71 <b>Lu</b> Lutetium 71</td> <td>72 <b>Hf</b> Hafnium 72</td> <td>73 <b>Ta</b> Tantalum 73</td> <td>74 <b>W</b> Tungsten 74</td> <td>75 <b>Re</b> Rhenium 75</td> <td>76 <b>Os</b> Osmium 76</td> <td>77 <b>Ir</b> Iridium 77</td> <td>78 <b>Pt</b> Platinum 78</td> <td>79 <b>Au</b> Gold 79</td> <td>80 <b>Hg</b> Mercury 80</td> <td>81 <b>Tl</b> Thallium 81</td> <td>82 <b>Pb</b> Lead 82</td> <td>83 <b>Bi</b> Bismuth 83</td> <td>84 <b>Po</b> Polonium 84</td> <td>85 <b>At</b> Astatine 85</td> <td>86 <b>Rn</b> Radon 86</td> <td>87 <b>Fr</b> Francium 87</td> <td>88 <b>Ra</b> Radium 88</td> <td>89 <b>Ac</b> Actinium 89</td> <td>90 <b>Th</b> Thorium 90</td> <td>91 <b>Pa</b> Protactinium 91</td> <td>92 <b>U</b> Uranium 92</td> <td>93 <b>Np</b> Neptunium 93</td> <td>94 <b>Pu</b> Plutonium 94</td> <td>95 <b>Am</b> Americium 95</td> <td>96 <b>Cm</b> Curium 96</td> <td>97 <b>Bk</b> Berkelium 97</td> <td>98 <b>Cf</b> Californium 98</td> <td>99 <b>Es</b> Einsteinium 99</td> <td>100 <b>Fm</b> Fermium 100</td> <td>101 <b>Md</b> Mendelevium 101</td> <td>102 <b>No</b> Nobelium 102</td> <td>103 <b>Lr</b> Lawrencium 103</td> <td>104 <b>Rf</b> Rutherfordium 104</td> <td>105 <b>Db</b> Dubnium 105</td> <td>106 <b>Sg</b> Seaborgium 106</td> <td>107 <b>Bh</b> Bohrium 107</td> <td>108 <b>Hs</b> Hassium 108</td> <td>109 <b>Mt</b> Meitnerium 109</td> <td>110 <b>Ds</b> Darmstadtium 110</td> <td>111 <b>Rg</b> Roentgenium 111</td> <td>112 <b>Cn</b> Copernicium 112</td> <td>113 <b>Nh</b> Nihonium 113</td> <td>114 <b>Fl</b> Flerovium 114</td> <td>115 <b>Mc</b> Moscovium 115</td> <td>116 <b>Lv</b> Livermorium 116</td> <td>117 <b>Ts</b> Tennessine 117</td> <td>118 <b>Og</b> Oganesson 118</td> </tr> </table>										1 <b>H</b> Hydrogen 1											11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	13 <b>Al</b> Aluminium 13	14 <b>Si</b> Silicon 14	15 <b>P</b> Phosphorus 15	16 <b>O</b> Oxygen 8	17 <b>Cl</b> Chlorine 17	18 <b>Ar</b> Argon 18	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10	21 <b>Sc</b> Scandium 21	22 <b>Ti</b> Titanium 22	23 <b>V</b> Vanadium 23	24 <b>Cr</b> Chromium 24	25 <b>Mn</b> Manganese 25	26 <b>Fe</b> Iron 26	27 <b>Co</b> Cobalt 27	28 <b>Ni</b> Nickel 28	29 <b>Cu</b> Copper 29	30 <b>Zn</b> Zinc 30	31 <b>Ga</b> Gallium 31	32 <b>Ge</b> Germanium 32	33 <b>As</b> Arsenic 33	34 <b>Se</b> Selenium 34	35 <b>Br</b> Bromine 35	36 <b>Kr</b> Krypton 36	37 <b>Rb</b> Rubidium 37	38 <b>Sr</b> Strontium 38	39 <b>Y</b> Yttrium 39	40 <b>Zr</b> Zirconium 40	41 <b>Nb</b> Niobium 41	42 <b>Mo</b> Molybdenum 42	43 <b>Tc</b> Technetium 43	44 <b>Ru</b> Ruthenium 44	45 <b>Rh</b> Rhodium 45	46 <b>Pd</b> Palladium 46	47 <b>Ag</b> Silver 47	48 <b>Cd</b> Cadmium 48	49 <b>In</b> Indium 49	50 <b>Sn</b> Tin 50	51 <b>Sb</b> Antimony 51	52 <b>Te</b> Tellurium 52	53 <b>I</b> Iodine 53	54 <b>Xe</b> Xenon 54	55 <b>Cs</b> Caesium 55	56 <b>Ba</b> Barium 56	57 <b>La</b> Lanthanum 57	58 <b>Ce</b> Cerium 58	59 <b>Pr</b> Praseodymium 59	60 <b>Nd</b> Neodymium 60	61 <b>Pm</b> Promethium 61	62 <b>Sm</b> Samarium 62	63 <b>Eu</b> Europium 63	64 <b>Gd</b> Gadolinium 64	65 <b>Tb</b> Terbium 65	66 <b>Dy</b> Dysprosium 66	67 <b>Ho</b> Holmium 67	68 <b>Er</b> Erbium 68	69 <b>Tm</b> Thulium 69	70 <b>Yb</b> Ytterbium 70	71 <b>Lu</b> Lutetium 71	72 <b>Hf</b> Hafnium 72	73 <b>Ta</b> Tantalum 73	74 <b>W</b> Tungsten 74	75 <b>Re</b> Rhenium 75	76 <b>Os</b> Osmium 76	77 <b>Ir</b> Iridium 77	78 <b>Pt</b> Platinum 78	79 <b>Au</b> Gold 79	80 <b>Hg</b> Mercury 80	81 <b>Tl</b> Thallium 81	82 <b>Pb</b> Lead 82	83 <b>Bi</b> Bismuth 83	84 <b>Po</b> Polonium 84	85 <b>At</b> Astatine 85	86 <b>Rn</b> Radon 86	87 <b>Fr</b> Francium 87	88 <b>Ra</b> Radium 88	89 <b>Ac</b> Actinium 89	90 <b>Th</b> Thorium 90	91 <b>Pa</b> Protactinium 91	92 <b>U</b> Uranium 92	93 <b>Np</b> Neptunium 93	94 <b>Pu</b> Plutonium 94	95 <b>Am</b> Americium 95	96 <b>Cm</b> Curium 96	97 <b>Bk</b> Berkelium 97	98 <b>Cf</b> Californium 98	99 <b>Es</b> Einsteinium 99	100 <b>Fm</b> Fermium 100	101 <b>Md</b> Mendelevium 101	102 <b>No</b> Nobelium 102	103 <b>Lr</b> Lawrencium 103	104 <b>Rf</b> Rutherfordium 104	105 <b>Db</b> Dubnium 105	106 <b>Sg</b> Seaborgium 106	107 <b>Bh</b> Bohrium 107	108 <b>Hs</b> Hassium 108	109 <b>Mt</b> Meitnerium 109	110 <b>Ds</b> Darmstadtium 110	111 <b>Rg</b> Roentgenium 111	112 <b>Cn</b> Copernicium 112	113 <b>Nh</b> Nihonium 113	114 <b>Fl</b> Flerovium 114	115 <b>Mc</b> Moscovium 115	116 <b>Lv</b> Livermorium 116	117 <b>Ts</b> Tennessine 117	118 <b>Og</b> Oganesson 118
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| 133 **Cs** Caesium 55 | 137 **Ba** Barium 56 | 139 **La** Lanthanum 57 | 178 **Hf** Hafnium 72 | 181 **Ta** Tantalum 73 | 184 **W** Tungsten 74 | 186 **Re** Rhenium 75 | 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 | 223 **Fr** Francium 87 | 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 | 238 **Rf** Rutherfordium 104 | 238 **Db** Dubnium 105 | 238 **Sg** Seaborgium 106 | 238 **Bh** Bohrium 107 | 238 **Hs** Hassium 108 | 238 **Mt** Meitnerium 109 | 238 **Ds** Darmstadtium 110 | 238 **Rg** Roentgenium 111 | 238 **Cn** Copernicium 112 | 238 **Nh** Nihonium 113 | 238 **Fl** Flerovium 114 | 238 **Mc** Moscovium 115 | 238 **Lv** Livermorium 116 | 238 **Ts** Tennessine 117 | 238 **Og** Oganesson 118 |

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
232 <b>Th</b> Thorium 90	232 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	238 <b>Pu</b> Plutonium 94	238 <b>Am</b> Americium 95	238 <b>Cm</b> Curium 96	238 <b>Bk</b> Berkelium 97	238 <b>Cf</b> Californium 98	238 <b>Es</b> Einsteinium 99	238 <b>Fm</b> Fermium 100	238 <b>Md</b> Mendelevium 101	238 <b>No</b> Nobelium 102	238 <b>Lr</b> Lawrencium 103

8-71 Lanthanoid series  
90-103 Actinoid series

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



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

