

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International GCSE**

Centre Number

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Candidate Number

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# Chemistry

**Unit: 4CH0**

**Paper: 2C**

Wednesday 13 June 2018 – Morning

**Time: 1 hour**

Paper Reference

**4CH0/2C**

**You must have:**

Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ~~☒~~ and then mark your new answer with a cross ☒.

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P52392A

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# THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

|   |                      |                       |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|---|----------------------|-----------------------|--------------------|------------------|--------------------|------------------|-----------------------|---------------------|-----------------------|-------------------|----------------------|-------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------|------------------|--------------------|--------------------|--------------------|------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|--------------------|-----------------|----------------------|-----------------------|-------------------|-------------------|----------------------|------------------|---------------------|----------------------|----------------------|-------------------|--------------------|-------------------|--------------------|----------------------|-----------------|------------------|--------------------|------------------|--------------------|------------------|--------------------|-----------------------|-----------------------|---------------------|-----------------------|-------------------|----------------------|-------------------|----------------------|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------|------------------|--------------------|--------------------|--------------------|------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|----------------------|-----------------------|--------------------|-----------------------|---------------------|------------------------|------------------------|-----------------------|---------------------|-----------------------|--------------------|---------------------|--------------------|-----------------|----------------------|-----------------------|-------------------|-------------------|---------------------|--------------------|-----------------------|---------------------|----------------------|---------------------|---------------------|--------------------|---------------------|----------------------|------------------|---------------------|----------------------|------------------|---------------------|----------------------|----------------------|-------------------|----------------------|--------------------|----------------------|
| 1 |                      |                       |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      | 4                   |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   |                      |                       |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      | He<br>Helium<br>2   |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 2 | 7                    | 9                     |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 20                    |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | Li<br>Lithium<br>3   | Be<br>Beryllium<br>4  |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | Ne<br>Neon<br>10      |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 3 | 23                   | 24                    |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 35.5                  |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | Na<br>Sodium<br>11   | Mg<br>Magnesium<br>12 |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | Cl<br>Chlorine<br>17  |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 4 | 39                   | 40                    |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 80                    |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | K<br>Potassium<br>19 | Ca<br>Calcium<br>20   |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | Br<br>Bromine<br>35   |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 5 | 86                   | 88                    |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 127                   |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | Rb<br>Rubidium<br>37 | Sr<br>Strontium<br>38 |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | I<br>Iodine<br>53     |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 6 | 133                  | 137                   |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 210                   |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | Cs<br>Caesium<br>55  | Ba<br>Barium<br>56    |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | Po<br>Polonium<br>84  |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
| 7 | 223                  | 226                   |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | 222                   |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | Fr<br>Francium<br>87 | Ra<br>Radium<br>88    |                    |                  |                    |                  |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      | Rn<br>Radon<br>86     |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   |                      |                       | 11                 | 12               | 14                 | 16               | 19                    | 20                  | 27                    | 28                | 31                   | 32                | 35.5                 | 36                  | 40                   | 48                   | 49                  | 51                   | 54                    | 59               | 63.5               | 65                 | 70                 | 73               | 75                  | 79                    | 80                  | 84                   |                     |                     |                    |                 |                      |                       |                   |                   |                      |                  |                     |                      |                      |                   |                    |                   |                    |                      |                 |                  |                    |                  |                    |                  |                    |                       |                       |                     |                       |                   |                      |                   |                      |                     |                      |                      |                     |                      |                       |                  |                    |                    |                    |                  |                     |                       |                     |                      |                     |                     |                      |                       |                    |                       |                     |                        |                        |                       |                     |                       |                    |                     |                    |                 |                      |                       |                   |                   |                     |                    |                       |                     |                      |                     |                     |                    |                     |                      |                  |                     |                      |                  |                     |                      |                      |                   |                      |                    |                      |
|   | B<br>Boron<br>5      | C<br>Carbon<br>6      | N<br>Nitrogen<br>7 | O<br>Oxygen<br>8 | F<br>Fluorine<br>9 | Ne<br>Neon<br>10 | Al<br>Aluminium<br>13 | Si<br>Silicon<br>14 | P<br>Phosphorus<br>15 | S<br>Sulfur<br>16 | Cl<br>Chlorine<br>17 | Ar<br>Argon<br>18 | K<br>Potassium<br>19 | Ca<br>Calcium<br>20 | Sc<br>Scandium<br>21 | Ti<br>Titanium<br>22 | V<br>Vanadium<br>23 | Cr<br>Chromium<br>24 | Mn<br>Manganese<br>25 | Fe<br>Iron<br>26 | Co<br>Cobalt<br>27 | Ni<br>Nickel<br>28 | Cu<br>Copper<br>29 | Zn<br>Zinc<br>30 | Ga<br>Gallium<br>31 | Ge<br>Germanium<br>32 | As<br>Arsenic<br>33 | Se<br>Selenium<br>34 | Br<br>Bromine<br>35 | Kr<br>Krypton<br>36 | In<br>Indium<br>49 | Sn<br>Tin<br>50 | Sb<br>Antimony<br>51 | Te<br>Tellurium<br>52 | I<br>Iodine<br>53 | Xe<br>Xenon<br>54 | Tl<br>Thallium<br>81 | Pb<br>Lead<br>82 | Bi<br>Bismuth<br>83 | Po<br>Polonium<br>84 | At<br>Astatine<br>85 | Rn<br>Radon<br>86 | H<br>Hydrogen<br>1 | He<br>Helium<br>2 | Li<br>Lithium<br>3 | Be<br>Beryllium<br>4 | B<br>Boron<br>5 | C<br>Carbon<br>6 | N<br>Nitrogen<br>7 | O<br>Oxygen<br>8 | F<br>Fluorine<br>9 | Ne<br>Neon<br>10 | Na<br>Sodium<br>11 | Mg<br>Magnesium<br>12 | Al<br>Aluminium<br>13 | Si<br>Silicon<br>14 | P<br>Phosphorus<br>15 | S<br>Sulfur<br>16 | Cl<br>Chlorine<br>17 | Ar<br>Argon<br>18 | K<br>Potassium<br>19 | Ca<br>Calcium<br>20 | Sc<br>Scandium<br>21 | Ti<br>Titanium<br>22 | V<br>Vanadium<br>23 | Cr<br>Chromium<br>24 | Mn<br>Manganese<br>25 | Fe<br>Iron<br>26 | Co<br>Cobalt<br>27 | Ni<br>Nickel<br>28 | Cu<br>Copper<br>29 | Zn<br>Zinc<br>30 | Ga<br>Gallium<br>31 | Ge<br>Germanium<br>32 | As<br>Arsenic<br>33 | Se<br>Selenium<br>34 | Br<br>Bromine<br>35 | Kr<br>Krypton<br>36 | Rb<br>Rubidium<br>37 | Sr<br>Strontium<br>38 | Y<br>Yttrium<br>39 | Zr<br>Zirconium<br>40 | Nb<br>Niobium<br>41 | Mo<br>Molybdenum<br>42 | Tc<br>Technetium<br>43 | Ru<br>Ruthenium<br>44 | Rh<br>Rhodium<br>45 | Pd<br>Palladium<br>46 | Ag<br>Silver<br>47 | Cd<br>Cadmium<br>48 | In<br>Indium<br>49 | Sn<br>Tin<br>50 | Sb<br>Antimony<br>51 | Te<br>Tellurium<br>52 | I<br>Iodine<br>53 | Xe<br>Xenon<br>54 | Cs<br>Caesium<br>55 | Ba<br>Barium<br>56 | La<br>Lanthanum<br>57 | Hf<br>Hafnium<br>72 | Ta<br>Tantalum<br>73 | W<br>Tungsten<br>74 | Re<br>Rhenium<br>75 | Os<br>Osmium<br>76 | Ir<br>Iridium<br>77 | Pt<br>Platinum<br>78 | Au<br>Gold<br>79 | Hg<br>Mercury<br>80 | Tl<br>Thallium<br>81 | Pb<br>Lead<br>82 | Bi<br>Bismuth<br>83 | Po<br>Polonium<br>84 | At<br>Astatine<br>85 | Rn<br>Radon<br>86 | Fr<br>Francium<br>87 | Ra<br>Radium<br>88 | Ac<br>Actinium<br>89 |

**Key**

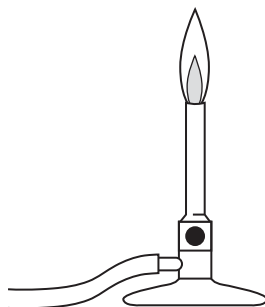
|                      |
|----------------------|
| Relative atomic mass |
| Symbol               |
| Name                 |
| Atomic number        |

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**Answer ALL questions.**

- 1 The diagram shows a Bunsen burner.



- (a) The Bunsen burner uses methane as a fuel.

Methane has the formula  $\text{CH}_4$

Give the names of the two elements in methane.

(2)

..... and .....

- (b) When methane burns it reacts with a gas in the air.

Give the name of this gas.

(1)

- (c) (i) Name the two substances that form when methane burns in plenty of air.

(2)

1 .....

2 .....

- (ii) Name the poisonous gas that forms when methane burns in a shortage of air.

(1)

**(Total for Question 1 = 6 marks)**

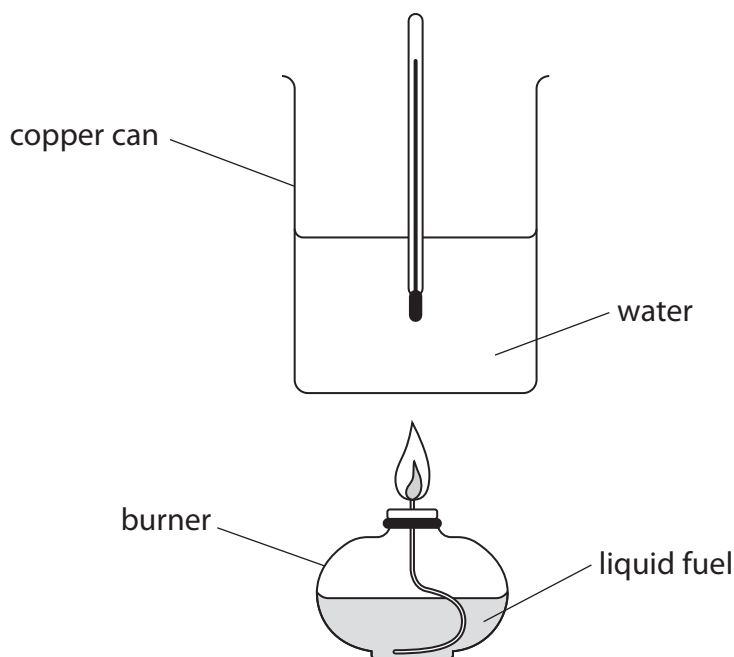
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- 2 A student uses this apparatus to investigate the burning of four different liquid fuels, W, X, Y and Z.



The table shows the student's results.

| Fuel | Initial temperature in °C | Final temperature in °C | Increase in temperature in °C |
|------|---------------------------|-------------------------|-------------------------------|
| W    | 19.0                      | 31.3                    | 12.3                          |
| X    | 18.4                      | 28.7                    |                               |
| Y    | 19.5                      | 35.4                    |                               |
| Z    | 18.7                      | 29.8                    |                               |

- (a) Complete the table by giving the increase in temperature for fuels X, Y and Z. (1)
- (b) The student uses the same mass of water and burns each fuel for the same period of time. Explain which fuel releases the most heat energy. (2)

.....

.....

.....

.....



(c) What is the name given to reactions that release heat energy?

(1)

- A decomposition
- B endothermic
- C exothermic
- D reduction

**(Total for Question 2 = 4 marks)**

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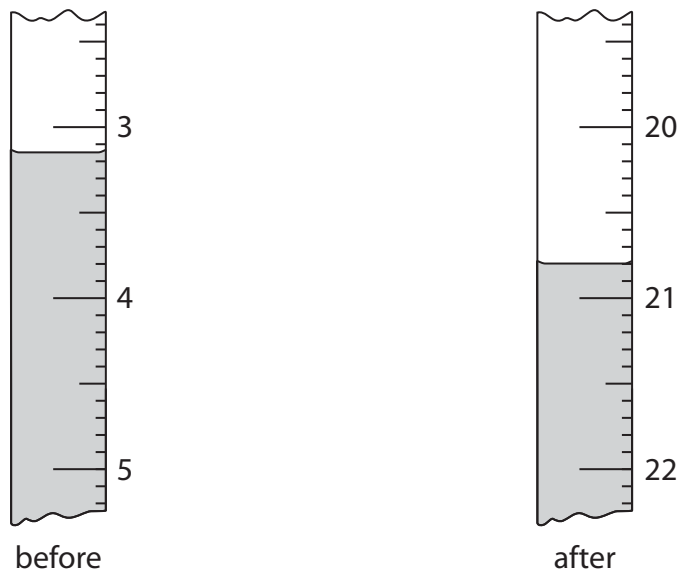
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- 3 A student makes an alkali solution by dissolving a small volume of cleaning liquid in deionised water.

He then titrates a sample of this solution with an acid until neutralisation is complete.

- (a) The diagram shows the burette readings for his titration.



Use the readings to complete the table, giving all values to the nearest  $0.05 \text{ cm}^3$ .

(2)

|   |       |
|---|-------|
| <b>Burette reading after adding the acid</b>            | 20.80 |
| <b>Burette reading before adding the acid</b>           |       |
| <b>Volume of acid added in <math>\text{cm}^3</math></b> |       |

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(b) Another student does a titration using a solution of a different cleaning liquid.

The table shows her results.

|   |       |       |       |       |       |
|---|-------|-------|-------|-------|-------|
| <b>Burette reading after adding the acid</b>  | 29.65 | 28.70 | 29.25 | 29.10 | 28.55 |
| <b>Burette reading before adding the acid</b> | 3.40  | 3.60  | 3.50  | 3.80  | 3.35  |
| <b>Volume of acid added in cm<sup>3</sup></b> | 26.25 | 25.10 | 25.75 | 25.30 | 25.20 |
| <b>Concordant results (✓)</b>                 |       |       |       |       |       |

Concordant results are those that differ by 0.20 cm<sup>3</sup> or less.

(i) Place ticks in the table to show which results are concordant.

(1)

(ii) Use the concordant results to calculate the average (mean) volume of acid added.

(1)

average volume of acid = ..... cm<sup>3</sup>

**(Total for Question 3 = 4 marks)**

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4 Bromine, chlorine, fluorine and iodine are elements in Group 7 of the Periodic Table.

(a) Which element is the most reactive?

(1)

- A bromine
- B chlorine
- C fluorine
- D iodine

(b) Which element is a solid at room temperature?

(1)

- A bromine
- B chlorine
- C fluorine
- D iodine

(c) Which element has the darkest colour at room temperature?

(1)

- A bromine
- B chlorine
- C fluorine
- D iodine

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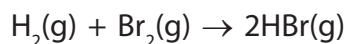
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(d) Bromine reacts with hydrogen to form hydrogen bromide.

The equation for the reaction is



The table shows some average bond energies.

|                                      |     |       |      |
|--------------------------------------|-----|-------|------|
| <b>Bond</b>                          | H—H | Br—Br | H—Br |
| <b>Average bond energy in kJ/mol</b> | 436 | 193   | 366  |

Use the values in the table to calculate the enthalpy change for the reaction between hydrogen and bromine.

(3)

enthalpy change = ..... kJ/mol

**(Total for Question 4 = 6 marks)**

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5 Ethanol can be manufactured by fermentation or by the direct hydration of ethene.

(a) In Brazil, the main source of sugar for fermentation is sugar cane.

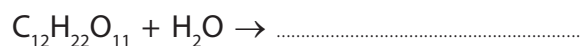
- sugar cane is added to water
- sugar cane contains sucrose ( $C_{12}H_{22}O_{11}$ ) that dissolves in the water
- during the fermentation process the sucrose is broken down into glucose ( $C_6H_{12}O_6$ )
- this glucose is then converted into ethanol ( $C_2H_5OH$ ) and carbon dioxide

(i) Name the substance that is added to the sucrose solution to allow fermentation to take place.

(1)

(ii) Complete the equation for the conversion of sucrose into glucose.

(1)



(iii) Write a chemical equation for the conversion of glucose into ethanol and carbon dioxide.

(1)

(iv) Fermentation produces a solution that is a mixture of ethanol and water.

Which of these is the most effective method of obtaining ethanol from this mixture?

(1)

- A crystallisation
- B filtration
- C fractional distillation
- D simple distillation

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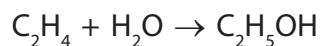
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(b) In the direct hydration method, ethene reacts with steam.

The equation for the reaction is



(i) Name the catalyst used in this reaction.

(1)

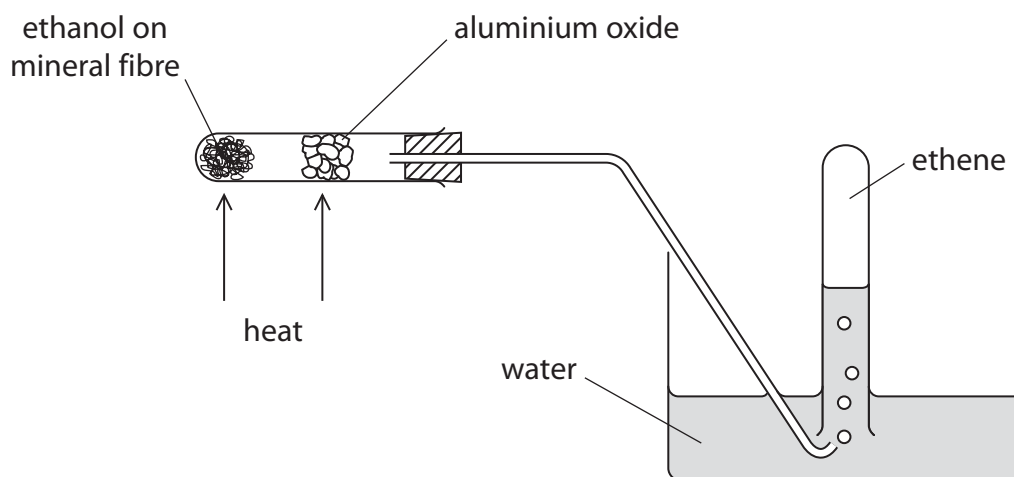
(ii) State the temperature and pressure used in this reaction.

(2)

temperature .....

pressure .....

(c) This apparatus is used to convert ethanol into ethene.



(i) Name the type of reaction taking place.

(1)

(ii) State the function of the aluminium oxide in this reaction.

(1)



(d) Ethene belongs to a homologous series of unsaturated hydrocarbons called alkenes.

(i) State what is meant by the term **unsaturated**.

(1)

(ii) State the colour change that is observed when bromine water is shaken with ethene in a test tube.

(2)

from ..... to .....

**(Total for Question 5 = 12 marks)**



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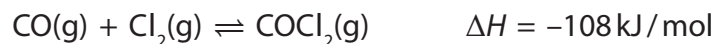
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6 Phosgene ( $\text{COCl}_2$ ) is used in industry to make polymers.

(a) Phosgene is formed when carbon monoxide reacts with chlorine.



- (i) The reaction mixture is kept at temperatures between 50 and 150 °C. If a temperature above 200 °C is used, only a small amount of phosgene is formed.

Suggest why only a small amount of phosgene is formed at temperatures above 200 °C.

(2)

- (ii) Predict how the yield of phosgene will change if the reaction is carried out at a higher pressure.

Give a reason for your answer.

[assume the reaction reaches a position of equilibrium]

(2)

(b) Phosgene reacts with water to form hydrochloric acid and carbon dioxide.

Write a chemical equation for this reaction.

(1)

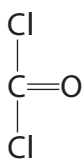
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(c) The diagram shows the displayed formula of phosgene.



Draw a dot and cross diagram to show the arrangement of all the outer electrons in a molecule of phosgene.

(3)

(Total for Question 6 = 8 marks)

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- 7 Magnesium carbonate decomposes when heated to form magnesium oxide and carbon dioxide. The equation for the reaction is



A student uses this method to investigate the reaction.

- Step 1 weigh a clean, dry crucible and record the mass  
 Step 2 add some magnesium carbonate  
 Step 3 reweigh the crucible and contents and record the new mass  
 Step 4 heat the crucible and contents for five minutes  
 Step 5 allow the crucible and contents to cool and then reweigh  
 Step 6 repeat steps 4 and 5 until the mass of the crucible and contents does not change

The student does the experiment four times.

The table shows her results.

|   | Mass in g    |              |              |              |
|---|--------------|--------------|--------------|--------------|
|   | Experiment 1 | Experiment 2 | Experiment 3 | Experiment 4 |
| mass of empty crucible  | 19.20        | 21.31        | 19.83        | 20.45        |
| mass of crucible and magnesium carbonate before heating               | 23.40        | 24.94        | 24.65        | 26.92        |
| mass of crucible and contents after heating for 5 minutes             | 22.85        | 23.21        | 22.13        | 24.02        |
| mass of crucible and contents after heating for a total of 10 minutes | 21.94        | 23.04        | 22.13        | 23.53        |
| mass of crucible and contents after heating for a total of 15 minutes | 21.60        | 23.04        | 22.13        | 23.53        |

- (a) State why the mass of the crucible and contents decreases during heating.

(1)

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(b) (i) State the reason for Step 6.

(1)

(ii) Explain in which experiment the student should have heated for a fourth period of five minutes.

(2)

**(Total for Question 7 = 4 marks)**

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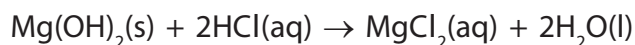
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8 Acid indigestion is caused by having too much hydrochloric acid in the stomach.

A suspension of magnesium hydroxide,  $\text{Mg}(\text{OH})_2$ , in water, can be used to cure acid indigestion.

The equation for the reaction between magnesium hydroxide and hydrochloric acid is



A student investigates how much magnesium hydroxide is needed to neutralise  $100 \text{ cm}^3$  of hydrochloric acid with a concentration of  $0.0968 \text{ mol/dm}^3$ .

He uses  $0.29 \text{ g}$  of magnesium hydroxide to neutralise the hydrochloric acid.

(a) Calculate the amount, in moles, of HCl in the hydrochloric acid.

(2)

amount of HCl ..... mol

(b) Calculate the amount, in moles, of  $\text{Mg}(\text{OH})_2$  used by the student.

$[M_r \text{ of } \text{Mg}(\text{OH})_2 = 58]$

(2)

amount of  $\text{Mg}(\text{OH})_2$  ..... mol

(c) Explain whether the student used the right amount of magnesium hydroxide to neutralise the hydrochloric acid.

(2)

.....

.....

.....

.....

**(Total for Question 8 = 6 marks)**

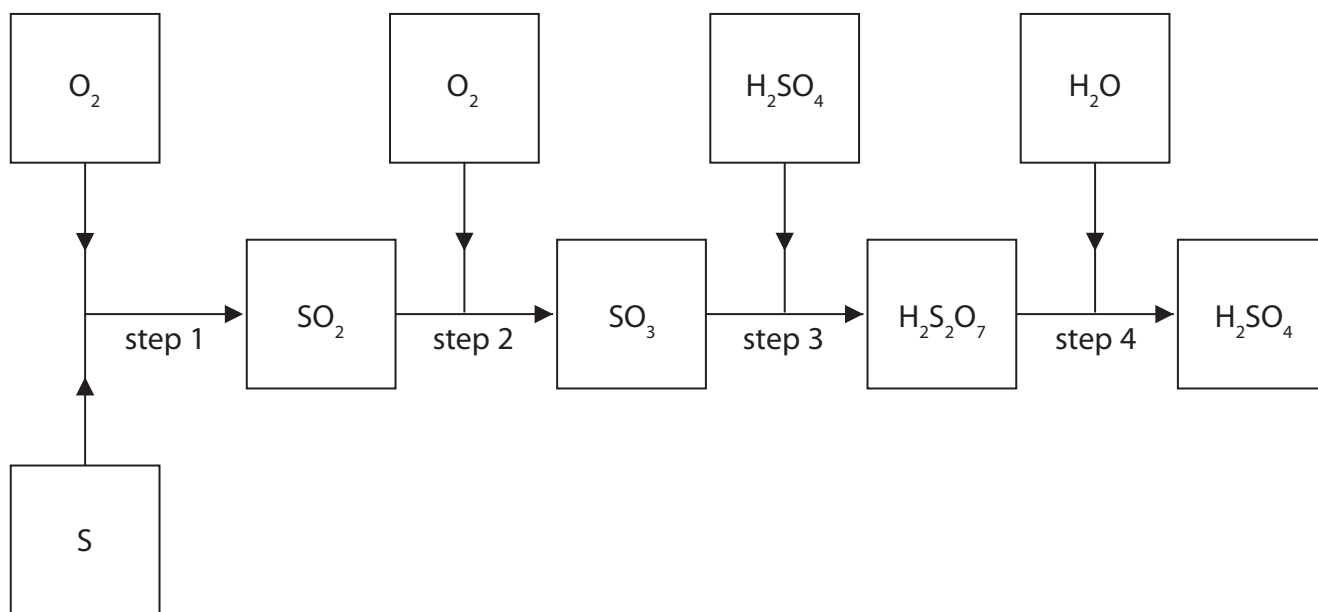
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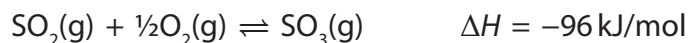
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9 The flow chart shows the steps in the manufacture of sulfuric acid.



(a) The equation for the reaction in step 2 is



(i) State what the symbols  $\rightleftharpoons$  and  $\Delta H$  represent.

(2)

$\rightleftharpoons$  .....

$\Delta H$  .....

(ii) Name the catalyst used in step 2.

(1)

(iii) State the temperature and pressure used in the reaction in step 2.

(2)

temperature .....

pressure .....

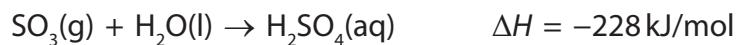
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- (b) Sulfur trioxide reacts with water to form sulfuric acid.  
This reaction is very exothermic.



- (i) State why the sulfur trioxide is not dissolved in water to form sulfuric acid in step 3. (1)

- (ii) Write chemical equations for the reactions that take place in step 3 and step 4. (2)

step 3.....

step 4.....

- (c) Give two industrial uses for sulfuric acid. (2)

1.....

2.....

**(Total for Question 9 = 10 marks)**

**TOTAL FOR PAPER = 60 MARKS**



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