

# Cambridge IGCSE™

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**COMBINED SCIENCE****0653/41**

Paper 4 Theory (Extended)

**October/November 2024****MARK SCHEME**Maximum Mark: 80

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**Published**

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| Question | Answer                                                                                                                                                                                             | Marks |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1(a)(i)  | B ;<br>D ;                                                                                                                                                                                         | 2     |
| 1(a)(ii) | <i>any two from:</i><br>exchange / transfer, of (dissolved) nutrients ;<br>exchange / transfer, of (dissolved) gases ;<br>transfer / removal, of excretory products ;<br>barrier to toxins ;       | 2     |
| 1(b)     | flagellum ;<br>(presence of) enzymes ;                                                                                                                                                             | 2     |
| 1(c)     | <i>any two from:</i><br>humans have sperm (cells) AND plants have pollen (grains) ;<br>humans have eggs/ova AND plants have ovules ;<br>takes place in, oviducts in humans AND ovaries in plants ; | 2     |
| 1(d)     | insect / animal / bird ;<br>spikes to help them stick (to pollinators) ;                                                                                                                           | 2     |

| Question             | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Marks          |                   |                    |                     |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------|--------------------|---------------------|--------------------|---------------------|---------|---|---|---|---|---|----------------------|----|----|----|----|----|---|
| 2(a)(i)              | idea that:<br>both have one <u>electron</u> in their outer shell so are in Group 1 ;<br>K is lower in group because it has <b>one</b> more electron shell than Na ;                                                                                                                                                                                                                                                                                                                                                        | 2              |                   |                    |                     |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| 2(a)(ii)             | 23 ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1              |                   |                    |                     |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| 2(b)                 | <table><tr><th></th><th>proton number</th><th>nucleon number</th><th>number of protons</th><th>number of neutrons</th><th>number of electrons</th></tr><tr><td>Li atom</td><td>3</td><td>7</td><td>3</td><td>4</td><td>3</td></tr><tr><td>Cu<sup>2+</sup> ion</td><td>29</td><td>64</td><td>29</td><td>35</td><td>27</td></tr></table><br>number of protons column correct ;<br>number of neutrons column correct ;<br>number of electrons for Li atom correct ;<br>number of electrons for Cu <sup>2+</sup> ion correct ; |                | proton number     | nucleon number     | number of protons   | number of neutrons | number of electrons | Li atom | 3 | 7 | 3 | 4 | 3 | Cu <sup>2+</sup> ion | 29 | 64 | 29 | 35 | 27 | 4 |
|                      | proton number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | nucleon number | number of protons | number of neutrons | number of electrons |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| Li atom              | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 7              | 3                 | 4                  | 3                   |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| Cu <sup>2+</sup> ion | 29                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 64             | 29                | 35                 | 27                  |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| 2(c)(i)              | <b>high</b> density / malleable / <b>good</b> conductors of heat / <b>good</b> conductors of electricity ;                                                                                                                                                                                                                                                                                                                                                                                                                 | 1              |                   |                    |                     |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |
| 2(c)(ii)             | form coloured compounds ;<br>act as catalysts ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2              |                   |                    |                     |                    |                     |         |   |   |   |   |   |                      |    |    |    |    |    |   |

| Question | Answer                                                                                                                                         | Marks |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 3(a)     | evidence of, $W = mg$ ;<br>$24.1 \div 2.45 = 9.84$ ;<br>N / kg ;                                                                               | 3     |
| 3(b)     | evidence of, $GPE = mgh / W \times d / 24.1 \times 1.48$ ;<br>$35.7 / 36$ (J) ;                                                                | 2     |
| 3(c)     | (calculation of area $A = 0.64 \times 0.25 / 0.16$ (m <sup>2</sup> ) ;<br>evidence of, $p = F \div A / 24.1 \div 0.16$ ;<br>$150 / 151$ (Pa) ; | 3     |

| Question | Answer                                                                                                                                                                                                                                                   | Marks |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 4(a)     | <i>any three from:</i><br>increasing humidity causes decrease in transpiration rate ;<br>concentration / percentage of water outside leaf <b>increases</b> ;<br>reduces (water) concentration gradient ;<br>reduces (rate of), diffusion / evaporation ; | 3     |
| 4(b)     | $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2$<br>correct formula for glucose ;<br>equation correctly balanced dependent on glucose formula ;                                                | 2     |
| 4(c)     | unequal / AW ;<br><u>elongation</u> ;<br>tip / AW ;                                                                                                                                                                                                      | 3     |

| Question  | Answer                                                                       | Marks |
|-----------|------------------------------------------------------------------------------|-------|
| 5(a)      | s ;                                                                          | 1     |
| 5(b)(i)   | 2HCl ;<br>H <sub>2</sub> O ;                                                 | 2     |
| 5(b)(ii)  | from 1 – 3 to 4 – 7 ;<br>the idea that acid is being neutralised / used up ; | 2     |
| 5(c)(i)   | bromine ;                                                                    | 1     |
| 5(c)(ii)  | bromine is less reactive than chlorine ORA ;                                 | 1     |
| 5(c)(iii) | bonding pair shown ;<br>6 non-bonding electrons in each atom ;               | 2     |

| Question        | Answer                                                                                                                                                                                                                                                                                                                                               | Marks    |        |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|---------|-------|--------------|---|-----|---|-------------|---|---|-----|-----------------|---|-----|---|---|
| 6(a)            | the <u>temperature</u> at which a substance changes state from solid to liquid / AW ;                                                                                                                                                                                                                                                                | 1        |        |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| 6(b)(i)         | highest pitch = highest frequency / 4186 Hz ;<br>evidence of $v = f\lambda$ / $340 \div 4186$ ;<br>0.081(2) (m) ;                                                                                                                                                                                                                                    | 3        |        |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| 6(b)(ii)        | <b>oscillations / vibrations</b> (of the air / particles / molecules) ;<br>(motion of air / particles / molecules is) parallel to the direction of, energy transfer / travel / the wave ;                                                                                                                                                            | 2        |        |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| 6(c)            | refraction ;<br>caused by change in speed / medium / density (of medium) ;<br>sound wave moves faster in water / liquid / denser medium / ORA ;                                                                                                                                                                                                      | 3        |        |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| 6(d)            | <table><tr><td>property</td><td>solids</td><td>liquids</td><td>gases</td></tr><tr><td>fixed volume</td><td>✓</td><td>(✓)</td><td>×</td></tr><tr><td>fixed shape</td><td>✓</td><td>×</td><td>(X)</td></tr><tr><td>ability to flow</td><td>×</td><td>(✓)</td><td>✓</td></tr></table><br>solids column correct ;<br>liquids AND gases columns correct ; | property | solids | liquids | gases | fixed volume | ✓ | (✓) | × | fixed shape | ✓ | × | (X) | ability to flow | × | (✓) | ✓ | 2 |
| property        | solids                                                                                                                                                                                                                                                                                                                                               | liquids  | gases  |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| fixed volume    | ✓                                                                                                                                                                                                                                                                                                                                                    | (✓)      | ×      |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| fixed shape     | ✓                                                                                                                                                                                                                                                                                                                                                    | ×        | (X)    |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |
| ability to flow | ×                                                                                                                                                                                                                                                                                                                                                    | (✓)      | ✓      |         |       |              |   |     |   |             |   |   |     |                 |   |     |   |   |

| Question | Answer                                                                                              | Marks |
|----------|-----------------------------------------------------------------------------------------------------|-------|
| 7(a)(i)  | eagle ;<br>daisy ;                                                                                  | 2     |
| 7(a)(ii) | <i>any two from:</i><br>respiration ;<br>movement ;<br>excretion ;<br>egestion ;<br>decomposition ; | 2     |
| 7(b)(i)  | <i>substrate</i> starch ;<br><i>enzyme</i> protease ;<br><i>product</i> fatty acids AND glycerol ;  | 3     |
| 7(b)(ii) | to kill bacteria ;<br>to provide, acid pH / low pH, <b>for enzymes</b> ;                            | 2     |

| Question                                                                                                                                           | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks                                                                                                                                              |                   |  |         |      |                 |         |                   |                   |                   |                   |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--|---------|------|-----------------|---------|-------------------|-------------------|-------------------|-------------------|---|
| 8(a)                                                                                                                                               | <u>enhanced</u> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1                                                                                                                                                  |                   |  |         |      |                 |         |                   |                   |                   |                   |   |
| 8(b)                                                                                                                                               | <table border="1"> <tr> <td rowspan="5">           reaction that makes carbon dioxide<br/><br/>           complete combustion of a gaseous compound<br/><br/>           a solid with a dilute acid<br/><br/>           thermal decomposition         </td><td colspan="2">compound</td></tr> <tr> <td>formula</td><td>name</td></tr> <tr> <td>CH<sub>4</sub></td><td>methane</td></tr> <tr> <td>CaCO<sub>3</sub></td><td>calcium carbonate</td></tr> <tr> <td>CaCO<sub>3</sub></td><td>calcium carbonate</td></tr> </table> <p>one mark for each correct row ;;;</p> | reaction that makes carbon dioxide<br><br>complete combustion of a gaseous compound<br><br>a solid with a dilute acid<br><br>thermal decomposition | compound          |  | formula | name | CH <sub>4</sub> | methane | CaCO <sub>3</sub> | calcium carbonate | CaCO <sub>3</sub> | calcium carbonate | 3 |
| reaction that makes carbon dioxide<br><br>complete combustion of a gaseous compound<br><br>a solid with a dilute acid<br><br>thermal decomposition | compound                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                    |                   |  |         |      |                 |         |                   |                   |                   |                   |   |
|                                                                                                                                                    | formula                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                    | name              |  |         |      |                 |         |                   |                   |                   |                   |   |
|                                                                                                                                                    | CH <sub>4</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                    | methane           |  |         |      |                 |         |                   |                   |                   |                   |   |
|                                                                                                                                                    | CaCO <sub>3</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                    | calcium carbonate |  |         |      |                 |         |                   |                   |                   |                   |   |
|                                                                                                                                                    | CaCO <sub>3</sub>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | calcium carbonate                                                                                                                                  |                   |  |         |      |                 |         |                   |                   |                   |                   |   |
| 8(c)(i)                                                                                                                                            | (similar) size / chain length ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1                                                                                                                                                  |                   |  |         |      |                 |         |                   |                   |                   |                   |   |
| 8(c)(ii)                                                                                                                                           | <i>any two from:</i><br>high temperature ;<br>high pressure ;<br>catalyst ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2                                                                                                                                                  |                   |  |         |      |                 |         |                   |                   |                   |                   |   |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Marks |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 9(a)     | battery ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1     |
| 9(b)     | correct symbol for voltmeter ;<br>connected in parallel across the fixed resistor <b>only</b> ;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2     |
| 9(c)(i)  | evidence of, $R = V \div I$ / $6.0 \div 0.25$ ;<br>= 24 ( $\Omega$ );                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 2     |
| 9(c)(ii) | <p>determination of total resistance of three-lamp combination,<br/>e.g. by subtraction of fixed resistor from total resistance of circuit / <math>24 - 15 / 9</math> ;</p> <p>evidence / use of formula to calculate resistance of two lamps in parallel,<br/> <math display="block">\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \quad / \quad R_T = \frac{R_1 R_2}{R_1 + R_2} \quad / \quad \frac{R \times R}{R + R} = \frac{R^2}{2R} = \frac{6 \times 6}{6 + 6} = \frac{36}{12} ;</math> </p> <p>calculation of resistance of three-lamp combination,<br/> <math display="block">R + \frac{R \times R}{R + R} = \frac{R^2}{2R} + \frac{R}{2} = \frac{R^2}{2R} + \frac{1.5R}{2} = \frac{R}{2} + \frac{1.5R}{2} = \frac{2.5R}{2} = \frac{6 \times 6}{6 + 6} = \frac{36}{12} = 3</math> </p> <p>AND<br/> <math>R = 6 (\Omega) ;</math> </p> | 3     |