



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

CHEMISTRY (US)

0439/41

Paper 4 Extended Theory

October/November 2016

MARK SCHEME

Maximum Mark: 80

Published

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| Question | Answer | Marks |
|-----------------|--|----------------------------------|
| 1(a) | H | 1 |
| 1(b) | G | 1 |
| 1(c) | filtration | 1 |
| 1(d) | fractional distillation | 1 1 |
| 1(e) | add / mix / stir / dissolve / shake / heat with water filter / decant heat (filtrate) or (leave filtrate to) evaporate | 1 1 1 |
| 1(f) | electrons (electrons) move / flow (throughout structure) | 1 1 |

| Question | Answer | Marks |
|-----------------|--|--------------|
| 2(a)(i) | melt(ing) | 1 |
| 2(a)(ii) | sublimation / sublime | 1 |
| 2(a)(iii) | condensing / condensation | 1 |
| 2(b) | overcome / break the attractive forces | 1 |
| 2(c) | E AND particles hit the walls (of the container) more often | 1 |

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| Question | Answer | Marks |
|-----------------|---|----------------------------------|
| 3(a)(i) | heated / evaporated / boiled | 1 |
| 3(a)(ii) | any 2 from: (O is) more viscous / thicker (O is) darker (O has) longer / bigger molecules / more carbon atoms (O has a) higher boiling point OR melting point (O is) less flammable | 2 |
| 3(b) | any 2 from: similar / same chemical properties same functional group trend / pattern in physical properties (neighbouring members) differ by CH ₂ common methods of preparation | 2 |
| 3(c) | any 2 structures from: pentane methylbutane dimethylpropane | 2 |
| 3(d) | correct structure with any number from 1 to 6 of the hydrogen atoms replaced by chlorine atoms | 1 |
| 3(e)(i) | (ends in) ene | 1 |
| 3(e)(ii) | M1 88.24 / 12 AND 11.76 / 1 M2 7.353 / 7.353 (= 1) AND 11.76 / 7.353 = (1.6) M3 C ₅ H ₈ | 1 1 1 |
| 3(e)(iii) | relative molecular mass | 1 |

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| Question | Answer | Marks |
|-----------------|---|----------------------------------|
| 4(a)(i) | $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ M1 formulae M2 balancing | 2 |
| 4(a)(ii) | (nitrogen) air / atmosphere (hydrogen) steam / water / hydrocarbons / natural gas | 1 1 |
| 4(a)(iii) | (temperature) answer in range 370–470 °C (pressure) answer in range 150–300 atm | 1 1 |
| 4(b)(i) | M1 forward and reverse reactions (occur) M2 amounts / moles / concentrations (of reagents and products) constant OR M2 rate of forward and reverse reactions equal | 1 1 |
| 4(b)(ii) | <u>endothermic</u> AND yield increases as temperature increases | 1 |
| 4(b)(iii) | M1 yield decreases (as pressure increases) M2 because more moles / molecules (of gas) on the right M3 so position of equilibrium moves left | 1 1 1 |

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| Question | Answer | Marks |
|-----------------|--|--------------|
| 5(a) | (gas) oxygen (test) glowing splint (result of test) relights | 1 1 1 |
| 5(b) | reference to ions / ionic ions cannot move in solid OR are in fixed positions in solid ions can move when in solution | 1 1 1 |
| 5(c)(i) | copper ions / Cu^{2+} gain of electrons / oxidation number decreases | 1 1 |
| 5(c)(ii) | any 3 from: anode decreases (in mass) copper removed (from anode) / solid (copper from anode) becomes aqueous cathode increases (in mass) copper deposited / added / Cu^{2+} deposited as Cu (on cathode) | 3 |
| 5(c)(iii) | copper is both added and removed (at same rate) OR the concentration (of copper ions) does not change | 1 |

| Question | Answer | Marks |
|-----------------|---|--------------|
| 6(a) | large / big molecule made from (many) monomers (joined together) | 1 1 |
| 6(b)(i) | amide / peptide | 1 |
| 6(b)(ii) | (can be) broken down by microbes / bacteria | 1 1 |
| 6(b)(iii) | starch / cellulose / DNA / RNA / polysaccharides / | 1 |

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| Question | Answer | Marks |
|----------|---|----------|
| 6(c)(i) | M1 at least one correct ester linkage between boxes | 1 |
| | M2 at least two boxes shown and sufficient correct C and O atoms to make two correct ester linkages | 1 |
| | M3 continuation bond(s) AND if more than one repeat unit is shown, the repeat unit must be correctly identified | 1 |

| Question | Answer | Marks |
|----------|---------------------------------------|----------|
| 7(a) | 0.025 | |
| | M1 50 / 1000 (=0.05) | 1 |
| | M2 $(0.05 \times 0.5) = 0.025$ | 1 |
| 7(b) | 0.0125 | 1 |
| 7(c) | 0.55 | |
| | M1 44 | 1 |
| | M2 0.55 | 1 |
| 7(d) | 0.3 | 1 |

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| Question | Answer | Marks |
|-----------------|--|--------------|
| 8(a)(i) | any 4 from: slowed down acid became less concentrated OR fewer particles per unit volume fewer collisions per second OR lower collision rate (then the reaction) stopped all the hydrochloric acid reacted | 4 |
| 8(a)(ii) | any 4 from: faster (reaction) (powder has) larger surface area more collisions per second OR higher collision rate same volume of gas amount / moles hydrochloric acid is not changed | 4 |
| 8(b) | any 5 from: temperature increased particles have more energy (particles) move faster more collisions per second OR higher collision rate more particles have sufficient energy to react / activation energy more of the collisions are successful | 5 |