

Question Number	Answer	Mark
3(a)	<p>The only correct answer is B (C₁₀H₁₆)</p> <p><i>A is not correct because there are 6 too few hydrogen atoms</i> <i>C is not correct because there are 2 extra hydrogen atoms</i> <i>D is not correct because there are 6 extra hydrogen atoms</i></p>	<p>(1)</p> <p>Computer</p>

Question Number	Answer	Mark
3(b)	<p>The only correct answer is D (CH₂)</p> <p><i>A is not correct because the wrong formula of limonene was used</i> <i>B is not correct because this is the empirical formula of C₁₀H₁₈</i> <i>C is not correct because this is the empirical formula of C₁₀H₁₆</i></p>	<p>(1)</p> <p>Computer</p>

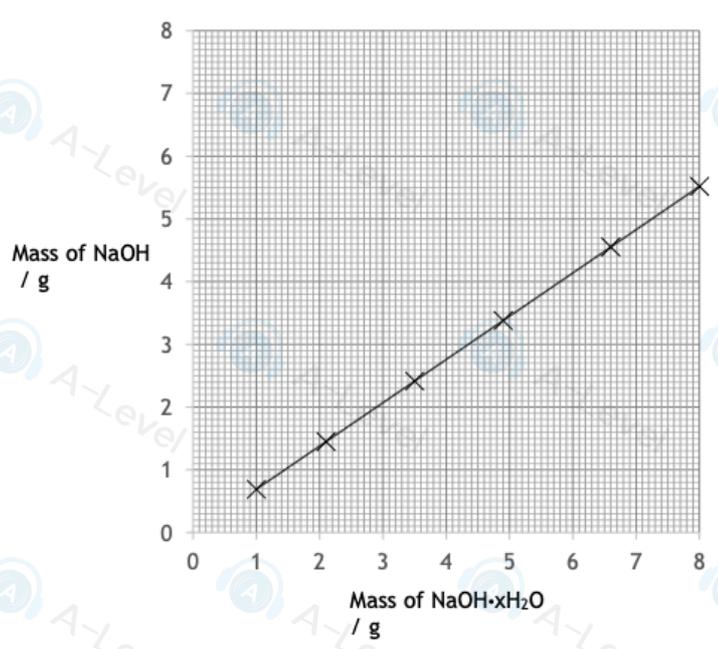
Question Number	Answer	Mark
5(a)	<p>The only correct answer is D (51.1%)</p> <p><i>A is not correct because they have worked out the atom economy for 1 mol of carbon dioxide</i> <i>B is not correct because only allowed for 1 mol of ethanol</i> <i>C is not correct because they have worked out the atom economy for 2 mol of carbon dioxide</i></p>	<p>(1)</p> <p>Computer</p>

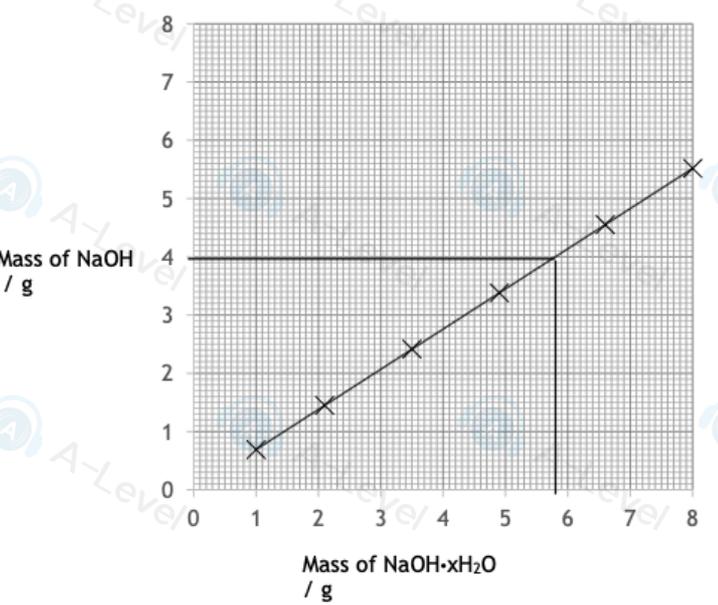
Question Number	Answer	Mark
5(b)	<p>The only correct answer is D (100%)</p> <p><i>A is not correct because this is the atom economy based on 1 mol of water and ethanol</i> <i>B is not correct because this is the atom economy based on ethene and ethanol</i> <i>C is not correct because this is the atom economy based on 2 mol of water and ethanol</i></p>	<p>(1)</p> <p>Computer</p>

Question Number	Answer	Mark
4	<p>The only correct answer is A (argon)</p> <p><i>B is incorrect because this would have a mass of 176 mg</i> <i>C is incorrect because this would have a mass of 16 mg</i> <i>D is incorrect because neon is monatomic not diatomic</i></p>	<p>(1)</p>

Question Number	Answer	Mark
7	<p>The only correct answer is B (2.65 g)</p> <p><i>A is incorrect because they have used the atomic numbers to calculate the M_r</i></p> <p><i>C is incorrect because they have used 500 cm^3 not 250 cm^3.</i></p> <p><i>D is incorrect because they have used 1000 cm^3 not 250 cm^3.</i></p>	(1)

Question Number	Answer	Mark
10	<p>The only correct answer is A (1.167 g)</p> <p><i>B is incorrect because they have used a 1:2 ratio not 1:1.</i></p> <p><i>C is incorrect because they have used the wrong concentration or volume of the barium chloride</i></p> <p><i>D is incorrect because they have used the wrong concentration or volume of the barium chloride and used a 1:2 ratio not 1:1.</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
17(a)(i)	<ul style="list-style-type: none"> • six points plotted correctly within a square (1) • axes labelled including units (1) • straight line passing through all points (1) 	<p>Example of graph</p>  <p>Allow line of best fit going through 0,0 Allow axes reversed. Allow "(g)" instead of "/ g" for units</p>	(3)

Question Number	Answer	Additional Guidance	Mark
17(a)(ii)	<p>An answer that makes reference to the following point:</p> <ul style="list-style-type: none"> • mass of NaOH·xH₂O read from the graph (using a line on the graph) 	 <p>Expected value is 5.8 g (± 0.1) but value should be from the graph. Allow TE on the line of best fit Allow correct reading of value from graph with axes reversed.</p>	(1)

Question Number	Answer	Additional Guidance	Mark
17(a)(iii)	EITHER <ul style="list-style-type: none"> • calculation of moles of NaOH in 4 g • calculation of molecular mass of NaOH·xH₂O • calculation of x OR <ul style="list-style-type: none"> • a subtraction either Mr or mass • two mole calculations • mole ratio and final answer must be a whole number 	<p><u>Example of calculation</u></p> <p>(1) $4.0 \div 40 = 0.1$ (mol)</p> <p>(1) $5.8 \div 0.1 = 58$ (g mol⁻¹)</p> <p>(1) $58 - 40 = 18$ Therefore x = 1</p> <p>Allow calculation from any other point on the graph max (2) Allow TE on (a)(ii)</p> <p>(1) Correct answer with no working 1 mark only</p>	(3)

Question Number	Answer	Additional Guidance	Mark
17(b)	<ul style="list-style-type: none"> • calculation of molar mass NaOH·7H₂O • calculation of mass of 0.150 mol of NaOH·7H₂O • calculation of mass needed for 250 cm³ OR <ul style="list-style-type: none"> • calculation of moles in 250cm³ • calculation of molar mass • calculation of mass 	<p><u>Example of calculation</u></p> <p>$23 + 16 + 1 + (7 \times 18) = 166$ (g mol⁻¹)</p> <p>$0.150 \times 166 = 24.9$ (g)</p> <p>$24.9 \div 4 = 6.225/6.23$ (g)</p> <p>Ignore SF except 1 SF</p> <p>Correct answer without working scores 2</p> <p>$0.15 \times 0.250 = 0.0375$</p> <p>$23 + 16 + 1 + (7 \times 18) = 166$ (g mol⁻¹)</p> <p>$0.0375 \times 166 = 6.225 / 6.23$</p>	(2)

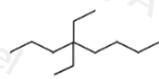
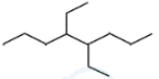
(Total for Question 17 = 9 marks)

Question Number	Answer	Additional Guidance	Mark
20(a)	Method <ul style="list-style-type: none"> • convert °C to K • kPa to Pa and 415 cm³ to m³ • substitution into $pV = nRT$ and rearrangement • evaluation 	Example of calculation (1) $20 + 273 = 293$ (1) $101 \times 1000 = 101000$ and $415 \div 1000000 = 415 \times 10^{-6} / 4.15 \times 10^{-4}$ (1) $n = 101000 \times 415 \times 10^{-6} \div 8.31 \times 293$ (1) $n = 0.0172$ mol Ignore SF except 1 SF TE on M1 and M2 but no TE from M3 to M4 Correct answer with no working scores (4)	(4)

Question Number	Answer	Additional Guidance	Mark
20(b)(i)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • (burned / reacted) in sufficient / excess oxygen 	Allow a reaction in which all of the atoms in the fuel are fully oxidised. Ignore any reference to carbon dioxide and water	(1)

Question Number	Answer	Additional Guidance	Mark
20(b)(ii)	An answer that makes reference to the following point: <ul style="list-style-type: none"> • correctly balanced equation • state symbols correct 	(1) $C_{12}H_{26}(l) + 18.5O_2(g) \rightarrow 12CO_2(g) + 13H_2O(l)$ (1) Accept $13H_2O(g)$ Allow multiples	(2)

Question Number	Answer	Additional Guidance	Mark
20(b)(iii)	<p>Method</p> <ul style="list-style-type: none"> • calculation of litres of fuel used (1) • calculation of mass of fuel used (1) • calculation of mol of fuel used (1) • calculation of mol of carbon dioxide (1) • calculation of mass of carbon dioxide (1) • calculation of mass (kg) of carbon dioxide/passenger and to 3SF (1) 	<p>Example of calculation</p> <p>$(11400) \times 9.25 = 105\,450$ (1.0545×10^5)</p> <p>$(105\,450) \times 0.749 (\times 1000) = 78\,982\,000$ (7.8982×10^7)(g)</p> <p>$(78\,982\,000) \div 170 = 464\,600$ (4.6460×10^5) (mol)</p> <p>$(464\,600) \times 12 = 5\,575\,200$ (5.5752×10^6) (mol) (check mole ratio from 20bii)</p> <p>$(5\,575\,200) \times 44 = 245\,310\,000$ (2.4531×10^8) (g)</p> <p>$(245\,310\,000) \div 800 (\div 1000) = 306\,640$ (3.0664×10^5) (g)</p> <p>307 (kg) Allow 306 (kg) Allow 307000 / 306000 g</p> <p>If all six operations have not been carried out ignore SF</p> <p>Allow TE throughout</p>	(6)

Question Number	Answer	Additional Guidance	Mark
20(b)(iv)	<ul style="list-style-type: none"> •  (1) •  (1) 	<p>Ignore any names even if incorrect</p> <p>Allow 1 mark for two correct non skeletal formulae</p>	(2)

(Total for Question 20 = 15 marks)