

Benzene

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Chemistry Lab Skills 2
Sub Topic	Benzene
Booklet	Mark Scheme

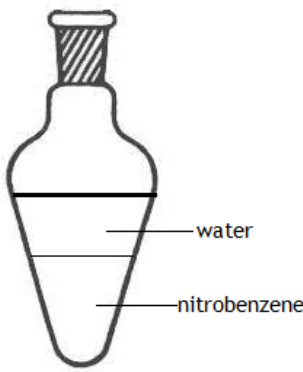
Time Allowed: 50 minutes
Score: /41
Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Acceptable Answer	Reject	Mark
1(a)(i)	(boiling) water / H ₂ O OR water /H ₂ O to produce steam OR Distilled / deionised water	Just 'steam'	1

Question Number	Acceptable Answer	Reject	Mark
1(a)(ii)	Prevents pressure building up (by allowing gases / vapours to escape). ALLOW To prevent explosion 'air' for gases / vapours IGNORE To allow gases / vapours to escape		1

Question Number	Acceptable Answer	Reject	Mark
1(a)(iii)	 <p>Two layers labelled water /H₂O & nitrobenzene / C₆H₅NO₂ (1) Water on top OR nitrobenzene on bottom (1)</p>	Just 'Oily /organic layer' (for nitrobenzene)	2

Question Number	Acceptable Answer	Reject	Mark
1(b)	Use a separating funnel to remove the nitrobenzene ALLOW Dropping funnel / teat pipette (1) Dry the nitrobenzene (1) Using (anhydrous) calcium chloride / CaCl ₂ OR magnesium sulfate / MgSO ₄ OR sodium sulfate / Na ₂ SO ₄ OR calcium sulfate / CaSO ₄ (1) IGNORE decanting / distillation	dehydrate copper(II) sulfate cobalt(II) chloride silica gel	3

Question Number	Acceptable Answer	Reject	Mark
1c(i)	Toxic and flammable ALLOW Poisonous / poison for toxic and inflammable for flammable	Corrosive Hazardous	1

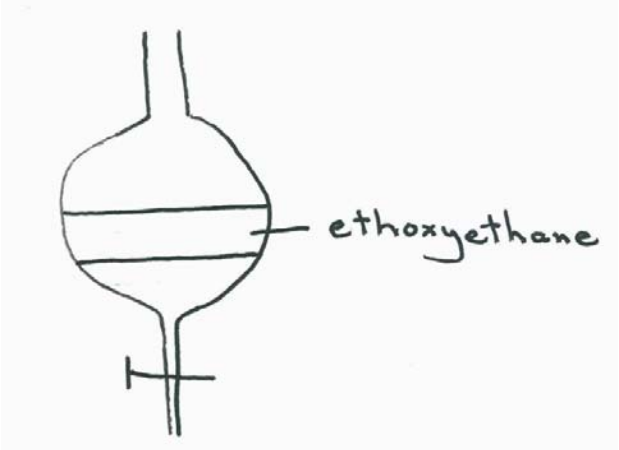
Question Number	Acceptable Answer	Reject	Mark
1c(ii)	Vent B into a fume cupboard / to the outside / through an (open) window / down the drain IGNORE Vent into another container ALLOW Put the apparatus in fume cupboard / carry out in fume cupboard Fume hood / chamber IGNORE water bath / electrical heater / anti bumping granules / gloves		1

(Total for Question 1 = 9 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)	<p>Mass of bromine = 6.0×3.1 (1) (= 18.6 (g))</p> <p>Number of moles of bromine = $\frac{6.0 \times 3.1}{2 \times 79.9}$ = 0.116(40) = 0.12 (1)</p> <p>ALLOW Number of moles of bromine = $\frac{18.6}{2 \times 80}$ = 0.11625 = 0.12</p> <p>Correct answer no working scores (2)</p> <p>IGNORE</p> <p>SF except 1 SF</p>	$\frac{6.0 \times 3.1}{1000}$	2

Question Number	Acceptable Answers	Reject	Mark
2(b)	<p>Mark Independently</p> <p>$2\text{Fe} + 3\text{Br}_2 \rightarrow 2\text{FeBr}_3$</p> <p>OR multiples (1)</p> <p>$\text{Br}_2 + \text{FeBr}_3 \rightarrow \text{Br}^{\delta+} \dots \text{Br}^{\delta-} \text{FeBr}_3$ Allow any attachment between the centre bromine atom and the iron and / or the other bromine atom. e.g. $\text{Br}^{\delta+} - \text{Br}^{\delta-}$ $\cdot \text{FeBr}_3$</p> <p>OR</p> <p>$\text{Br}_2 + \text{FeBr}_3 \rightarrow \text{Br}^+ + \text{FeBr}_4^-$ (1)</p> <p>Ignore states even if incorrect</p>	$\rightarrow \text{Br}^- + \text{FeBr}_4^+$	2

Question Number	Acceptable Answers	Reject	Mark
2(c)	To neutralize / react with HBr (formed) ALLOW To neutralize / react with acid OR To remove / react with bromine	To neutralize (the solution)	1

Question Number	Acceptable Answers	Reject	Mark
2(d)	 <p>Separating funnel which must have narrower neck than the container (capable of taking a stopper) and a tap (1)</p> <p>Upper layer ethoxyethane (1)</p>	Burette Filter funnel	2

Question Number	Acceptable Answers	Reject	Mark
2(e)	(Concentrated) nitric acid/ HNO ₃ and (concentrated) sulfuric acid/ H ₂ SO ₄	Dilute sulfuric acid Any additional chemicals like Ammonia/NH ₃ Bromine/Br ₂ Sodium hydroxide/NaOH	1

Question Number	Acceptable Answers	Reject	Mark
2(f)	(0.75 x 0.70 x 0.70 x100 =) 36.75 / 36.8 / 37 (%) Correct answer with no working	Any other answers e.g. 36.7 / 37.0 / 40	1

Question Number	Acceptable Answers	Reject	Mark
2(g) (i)	(While rotating the tube) heat one end of the tube in a Bunsen flame (until the glass starts to melt) ALLOW Heat in a flame OR Heat (one end of the) tube		1

Question Number	Acceptable Answers	Reject	Mark
2(g)(ii)	<p>By gently tapping or dropping the tube / rubbing the open end with a milled coin</p> <p>ALLOW</p> <p>Hit / flick tube with finger</p> <p>OR</p> <p>Use (very small) dry crystals</p> <p>IGNORE</p> <p>Shaking / use of wire / sticks / pins / needles</p>	Heat	1

Question Number	Acceptable Answers	Reject	Mark
2(g)(iii)	<p>Any two from</p> <p>High boiling temperature/ point (compared with sample melting temperature) OR not volatile</p> <p>Does not decompose / oxidize (at high temperature)</p> <p>Mobile / non-viscous / non-sticky</p> <p>IGNORE</p> <p>Any reference to thermal conductivity and heat capacity</p> <p>ALLOW</p> <p>Clear liquid (ignore colourless)</p> <p>High ignition temperature/non-(in)flammable</p> <p>Non-toxic</p> <p>IGNORE</p> <p>Unreactive alone / safety aspects</p>	<p>High melting temperature</p> <p>Just 'does not react with the crystals'</p>	2

Question Number	Acceptable Answers	Reject	Mark
2(g) (iv)	<p>fore recrystallization</p> <p>185 – 201°C</p> <p>A range of at least 5°C</p> <p>ALLOW 180 - 205 °C</p> <p>A range of at least 5°C (1)</p> <p>After recrystallization</p> <p>199 – 201°C</p> <p>ALLOW 197 - 203°C</p> <p>A range of no more than 4°C (1)</p>	<p>Single temperature</p> <p>Single temperature</p>	2

(Total for Question 2 = 15 marks)

Question Number	Acceptable Answers	Reject	Mark
3(a)	Syringe / (graduated) pipette / burette / micro-pipette / auto pipette / any pipette with a volume of 5cm ³ or less ALLOW Calculate the mass and use a balance Recognisable spelling of pipette / burette but not biuret.	Measuring cylinder	1

Question Number	Acceptable Answers	Reject	Mark
3(b)	Toxic/poisonous (1) Ignore harmful Corrosive/causes burns (1) Ignore harmful	Corrosive/causes burns/irritant/dangerous Oxidising/toxic/poisonous/irritant	2

Question Number	Acceptable Answers	Reject	Mark
3(c) (i)	Penalise rounding errors once only in parts (i) and (ii) Number of moles of cholesterol = $\frac{1.0}{386.7}$ = 2.58598 x 10 ⁻³ (1) = 2.59 x 10 ⁻³ Note 2.58 x 10 ⁻³ loses this mark as a rounding error but 2.6 x 10 ⁻³ is fine Mass of benzoyl chloride = 0.4 x 1.21 = 0.484 (g) (1) Number of moles of benzoyl chloride = $\frac{0.484}{140.6}$ = 3.4424 x 10 ⁻³ AND So benzoyl chloride is in excess / cholesterol is the limiting factor (1)		3

Question Number	Acceptable Answers	Reject	Mark
3(c)(ii)	<p>Number of moles of cholesteryl benzoate $= \frac{0.65}{490.8}$ $= 1.3244 \times 10^{-3}$ (1)</p> <p>Yield = $\frac{1.32 \times 10^{-3}}{2.59 \times 10^{-3}} \times 100$ $= 51(.1)\%$ Or = 51(.2) ignore SF (1)</p> <p>OR</p> <p>Expected/maximum mass of cholesteryl benzoate = $2.59 \times 10^{-3} \times 490.8 = 1.27$ g (1)</p> <p>Yield = $\frac{0.65}{1.27}$ $= 51(.1)\%$ Or = 51(.2) ignore SF (1)</p> <p>Correct answer no working (2)</p>	50.9%	2

Question Number	Acceptable Answers	Reject	Mark
3(d)	<p>Place flask in running cold water</p> <p>OR</p> <p>(in an) ice bath / beaker of cold / cool water</p>	<p>Add ice / Put in the fridge</p> <p>Washing with / adding cold water / ice</p>	1

Question Number	Acceptable Answers	Reject	Mark
3(e)	To react with / remove (any residual) benzoyl chloride	<p>Acts as a solvent</p> <p>Removes impurities</p>	1

Question Number	Acceptable Answers	Reject	Mark
3(f)	<p>Dissolve / add / put crystals in minimum (volume / amount) (1) of hot ethyl ethanoate (1)</p> <p>Penalise incorrect solvent e.g. water once only.</p> <p>Filter (hot) and allow to cool (1)</p> <p>Filter and wash with small amount of / cold solvent.</p> <p>Note notice if 'solvent' used here and in second marking point, this mark can be given (1)</p> <p>Note If ethyl ethanoate mentioned here can score second mark above and The wrong solvent may be used here e.g. water with the correct initial solvent. This should be separately penalised here.</p> <p>Dry between filter papers / dry in a desiccator ALLOW Keep suction filtration going until crystals are dry Dry in warm oven or below 100 °C (1)</p>	<p>Wash...</p> <p>...to remove soluble impurities</p> <p>...cold solution</p> <p>...to remove insoluble impurities but only penalise soluble / insoluble once</p> <p>Dry in oven alone</p>	5

Question Number	Acceptable Answers	Reject	Mark
3(g)	<p>Method 1</p> <p>First Mark (The crystals from) step 6 / pure crystals have a sharp (at 150°C / 423 K) melting temperature / melt over 1-2°C OR (The crystals from) step 6 / pure crystals melt within 2°C of / close to the data book value / at 150°C / 423 K (1)</p> <p>Second Mark (The crystals from) step 5 would melt over a larger temperature range OR Would melt (significantly) more / more than 2°C and below the data book value / 150°C / 423 K (1)</p> <p>Method 2 Comparative answers Can score both marks if it clear which step the crystals are prepared in.</p> <p>Two Examples</p> <p>Both melting points measured and the pure sample / step 6 has a sharper melting temperature (2)</p> <p>Both melting points measured and the pure sample / step 6 has a melting temperature clos(er) to than data book value / 150°C / 423 K (1)</p> <p>The impure sample melts at a temperature below that of the pure sample (1)</p> <p>Allow reverse arguments for step 5</p>		2

Total for Question 3 = 17 marks