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ANSWER BOOK

Apparatus, techniques and safety: the twelve required practicals in outline

Working in the laboratory · Unit C00

AQA Practical skills 8 (AT a, b, d, e, g, h, k) · OCR A 1.1

15 questions · 53 marks

NAVY EDITION

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SECTION A · Short, 1 to 2 marks

A1 ATS-Q8

B1 cyclohexane is flammable, and its vapour can spread to a flame some distance away. **B1** a water bath or heating mantle has no naked flame, so the vapour cannot be ignited by the heat source. [2]

A2 ATS-Q15

B1 simple distillation, collecting the fraction that comes over close to 56 °C. **B1** the product boils at a much lower temperature, so it vaporises and condenses in the receiver while the starting material stays in the flask. [2]

SECTION B · Standard, 3 to 5 marks

B1 ATS-Q1

B1 a 25.0 cm^3 volumetric pipette, used with a pipette filler; reject a measuring cylinder or a burette. **B1** rinse the pipette with distilled water and then with the solution it will hold. **B1** draw solution above the line, then release it until the bottom of the meniscus is on the line at eye level. **B1** run the solution into the flask and touch the tip on the inside of the flask, leaving the last drop in the tip. [4]

B2 ATS-Q3

B1 water entering at the bottom fills the outer jacket completely. **B1** water entering at the top would drain straight through, leaving part of the condenser uncooled so vapour could escape. **B1** heating a closed apparatus builds up pressure from the vapour. **B1** the pressure could make the apparatus burst, so the top is left open to the air. [4]

B3 ATS-Q5

B1 shake the product with sodium hydrogencarbonate solution in a separating funnel, opening the tap often to release carbon dioxide. **B1** let the layers settle and run off the lower layer through the tap, keeping the organic layer. **B1** dry the organic layer with an anhydrous salt such as magnesium sulfate until the liquid is clear, then filter or decant. **B1** distil the liquid and collect the fraction that boils within a degree or two of the product's boiling point. [4]

B4 ATS-Q6

B1 dissolve the solid in the minimum volume of hot solvent. **B1** filter the hot solution through a warmed funnel to remove insoluble impurities. **B1** let the filtrate cool so the product crystallises while soluble impurities stay in solution. **B1** collect the crystals by filtration under reduced pressure, wash them with a little cold solvent and leave them to dry. [4]

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B5 ATS-Q7

B1 too much hot solvent was used, so the solution was not saturated when it cooled. **B1** much of the benzoic acid stayed dissolved in the cold solution and was lost in the filtrate, lowering the yield; allow washing with warm solvent. **B1** the crystals melt below 122 °C, so impurities are still present, since impurities lower a melting point. **B1** they melt over a range of 3 °C instead of sharply, which also shows the solid is impure. [4]

B6 ATS-Q14

B1 a hazard is a substance, object or activity with the potential to cause harm: the concentrated acid is corrosive wherever it is. **B1** a risk is the likelihood that the harm will occur in the way the activity is done, together with its severity. **B1** the acid is added slowly to water, never water to acid, because the heat released would boil water dropped onto the acid and spatter it. **B1** small volumes are used, wearing goggles and gloves, which lowers the chance and the severity of harm. [4]

B7 ATS-Q16

B1 under reflux the butanal formed stays in the flask, in contact with the oxidising agent. **B1** it is oxidised further to butanoic acid, so the plan gives the acid and little or no aldehyde. **B1** the butanal should be distilled off as it forms, adding the oxidising agent slowly to the warm alcohol in a distillation apparatus. **B1** butanal boils well below the alcohol and the acid, so the fraction collected near 75 °C is the aldehyde; the plan as written is unsuitable. [4]

B8 ATS-Q4

B1 ethanol and the intermediate ethanal are volatile, and the reaction is slow, so the mixture must be heated for a long time. **B1** the vertical condenser condenses the vapours and returns them to the flask, so no reactant or product is lost. **B1** ethanal stays in contact with the oxidising agent until it is oxidised completely to ethanoic acid. [3]

B9 ATS-Q10

B1 filtration under gravity uses a fluted filter paper in a funnel, whereas reduced pressure uses a flat paper in a Büchner funnel on a side-arm flask connected to a pump. **B1** filtration under reduced pressure is much faster and leaves the solid almost dry. **B1** gravity filtration is chosen when the filtrate is wanted, reduced pressure when the solid is wanted. [3]

B10 ATS-Q11

M1 mass transferred = 17.62 - 15.48 = 2.14 g. **M1** the mass is the difference of two readings, each ±0.01 g, so its uncertainty is ±0.02 g. **A1** percentage uncertainty = 0.02 ÷ 2.14 × 100 = 0.93%. [3]

B11 ATS-Q13

B1 liquid bromine is very volatile and its vapour is toxic, damaging the lungs. **B1** the fume cupboard draws the vapour away from the user and out of the room. **B1** bromine water is a dilute solution that gives the same colour change with an alkene at a much lower risk. [3]

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B12 ATS-Q17

B1 a recrystallisation solvent must dissolve the compound well when hot and poorly when cold, and the twenty-fold change between 20 °C and 95 °C gives exactly that. **B1** the impure solid is dissolved in the minimum volume of near-boiling water, so the solution is saturated and crystals form as it cools, while soluble impurities stay in the small volume of cold solution. **B1** only about 2.9 g dm^{-3} stays dissolved at 20 °C, so most of the benzoic acid is recovered; insoluble impurities are removed by filtering the hot solution before it cools. [3]

SECTION C · Long, 6 marks or more

C1 ATS-Q12

Indicative content [6]

B1 concentrated sulfuric acid is corrosive to skin and eyes, so it is dispensed in small volumes wearing goggles and gloves. **B1** diluting the concentrated acid releases a great deal of heat, so the acid is added slowly to the water and never water to the acid. **B1** ethanol is flammable and its vapour spreads along a bench, so the flask is heated with a water bath or electric heater and no naked flame. **B1** potassium dichromate(VI) is a carcinogen and an oxidising agent, so it is handled in small amounts with gloves and any spill is cleared at once. **B1** a sealed apparatus that is heated builds up pressure and can burst, so the top of the reflux condenser is left open to the air. **B1** anti-bumping granules make the mixture boil smoothly, preventing sudden surges that could throw hot acidic liquid out of the flask.

Levels

Level 3 (5–6 marks) all the hazards are identified with a control measure for each: the corrosive concentrated acid and the order of dilution, the flammable ethanol and the heat source, the toxic dichromate(VI), the open top of the reflux condenser and the anti-bumping granules; each control is matched to its hazard rather than listed separately.

Level 2 (3–4 marks) three or four hazards each have a sensible control; the order of dilution, the open top of the condenser, or the flammability of ethanol is left out or matched to the wrong control.

Level 1 (1–2 marks) one or two hazards such as the corrosive acid are named, with controls no more specific than 'wear goggles', or with water poured into the concentrated acid to dilute it.

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