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1  
(a) ethanol and aluminium oxide boxes correctly labelled [1]  

(b) arrow towards wool (1) arrow towards solid (1) [2]  

(c) to prevent suck back or description of suck back owtte (1)  
effect of suck back e.g. crack tube (1) [2]  

[Total: 5]  

2  
(a) to speed up the reaction [1]  

(b) solid visible owtte e.g. no more solid will dissolve [1]  

(c) filtration / centrifuge  not decant [1]  

(d) to make sure water (of crystallisation) is not lost / stop dehydration /  
so crystals do not turn into powder / does not decompose  not crystals break [1]  

(e) no heat needed / not necessary to warm acid (1)  
carbonates react with acid at room temperature (1)  
no bubbles would indicate that carbonate is in excess (1) [max 2]  

[Total: 6]  

3  
(a) idea of fair test / only one variable [1]  

(b) nitric acid [1]  

(c) (i) points plotted (3), –1 for each incorrect smooth curve (1) [4]  

(ii) value from graph 18 s (1) indication on graph (1) [2]  

(d) times would be less / reaction quicker (1)  
particles have more energy / increased collisions (1) [2]  

[Total: 10]
4 total volume of water boxes correctly completed (1)
10, 11, 12, 13, 14
temperature boxes completed (4) –1 each incorrect
68, 63, 59, 55, 51

(a) appropriate scale for y-axis (1)
points plotted correctly (4), –1 for each incorrect
best fit straight line graph (1)

(b) clear liquid formed / no solid visible owtte

(c) value from graph for 9 cm$^3$ of water, around 72 °C (1)
extrapolation of straight line shown (1)

(d) temperatures at which crystals appear lower (1)
solution more dilute in same volume of water / less saturated owtte (1)

(e) sketch graph below line (1) label (1)

(f) one improvement from e.g.
don’t use a beaker of cold water to cool solution /
do not remove thermometer from the solution /
use second person or IT method to note formation of crystals /
repeat
linked explanation
different rate of heat losses /
loss of solid on thermometer /
observing formation of first crystals may vary /
average
mean more accurate / increases reliability not just accurate

[Total: 20]

5 (a) (i) blue (1)
(ii) blue (1) precipitate (1)
(iii) blue precipitate (1)
deep / royal blue (1) solution (1) or precipitate dissolves

(c) sulfuric acid (2) acid or sulfate only (1)

[Total: 8]
6  (a) bubbles / fizzing / effervescence [1]

   (b) alkali formed [1]

   (c) (i) chlorine [1]

   (ii) indicator bleached / decolourised allow yellow [1]

   [Total: 4]

7  (a) universal indicator / pH paper (1) not litmus
   pH of 4–6 / yellow / orange (1) not red [2]

   (b) sodium hydroxide / carbonate / oxide [1]

   (c) marks can be obtained from diagram
   chromatography (1) description of applying E110 to paper (1)
   use of solvent (1) results / number of spots (1) [4]

   [Total: 7]