Further analysis and quantitative chemistry

Mark scheme

1. Any series of chemical tests that work should be given credit

each mark is for test + result + inference

identifying all 4 substances unambiguously with no errors gains **5** marks
e.g.

- Flame test: yellow / orange ⇒ Na^+ ⇒ sodium sulphate 1

  ignore incorrect flame test colours for other compounds

- Add NaOH to remaining 3 samples: no (white) ppt / ammonia ⇒ 1

  no need to test for ammonia

  NH_4^+ ⇒ ammonium sulphate(white) ppt ⇒ magnesium ions or aluminium ions 1

- add excess NaOH to the 2 samples which gave a (white) ppt:
  ppt dissolves ⇒ aluminium sulphate 1
  ppt insoluble ⇒ magnesium sulphate 1

or

- Add NaOH:

  no ppt: ammonia =>NH_4^+ ⇒ (1)
  ammonium sulphate
  the other one is sodium sulphate (1)

  (damp red) litmus goes blue*
  ⇒ NH_3⇒ ammonium sulphate
  the other one is sodium sulphate

- Add excess NaOH to the 2 samples which gave the white ppt (1)
  ppt dissolves ⇒ aluminium sulphate (1)
  ppt insoluble ⇒ magnesium sulphate (1)

  (*) or UI/pH indicator goes blue/purple

[5]

2. (a) **must** be description of a titration no titration = no marks

NaOH in <u>burette</u> 1

*do **not** accept biuret etc*

add NaOH until (indicator) changes colour 1

*if specific colour change mentioned, must be correct – colourless to pink / red **or** 'goes pink / red'*
*do **not** accept 'clear' for colourless*

note (burette) volume used **or** final reading 1

accept 'work out the volume'

one other point: eg repeat 1

*accept:(white) tile **or** add dropwise / slowly **or** white background **or** swirling / mix **or** read meniscus at eye level **or** wash apparatus*

(b) 0.054 2

*for **2** marks*
*(0.1 × 13.5)/25 for **1** mark*

(c) don't know – insufficient evidence to decide *owtte*

any sensible answer

or depends on whether acid level is considered safe or unsafe

yes, safe – acid level low / weak acids / low compared with stomach acid *owtte*

any sensible answer

no, unsafe – acid level (too) high / other substances or bacteria may be present / insufficient evidence to decide *owtte* 1

any sensible answer

(d) (methyl orange) would have changed colour (well) before the end-point / pH7 / neutral *owtte* 1

weak acid present 1

weak acid-strong base (titration)
allow methyl orange used for strong acid-weak base titration

[9]

3. (a) (i) e.g. moles NaOH = moles of acid

or formula:

$0.2 \times \frac{45}{1000} = 0.009$ 1

$15M_1 = 0.2 \times 45$

rounding to 0.01 loses mark

$= 0.009 \times \frac{1000}{15} = 0.6(M)$ 1

$M_1 = 0.6(M)$

ecf for arithmetical error

*correct answer **2** marks*

(ii) 36 2

ecf – (a)(i) × 60
*correct answer **2** marks*
*0.6 × 60 gets **1** mark*
*relative formula mass of ethanoic acid = 60 for **1** mark*
0.6 × incorrect molar mass gains second mark only

(b) (i) A = hydrogen / H_2 1

B = sodium hydroxide / NaOH **or** sodium oxide / Na_2O 1

(iii) C = ethyl ethanoate (acetate) / $CH_3COOC_2H_5$ / $CH_3CO_2C_2H_5$ 1

(iv) D = (concentrated) sulphuric acid /H_2SO_4 1

*do **not** accept dilute sulphuric acid*

E = sodium ethanoate (acetate) / CH_3COONa / CH_3CO_2Na 1

[9]