OCR
RECOGNISING ACHIEVEMENT

GCSE

CHEMISTRY A

H

A323/02

Chemistry A Unit 3 Ideas in Context plus C7

Specimen Paper

1 hour

Candidates answer on the question paper:

Additional materials: ruler (cm/mm), calculator

Candidate Name	

Centre Number						Candidate Number				

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers on the dotted lines unless the question says otherwise.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- There is a space after most questions. Use it to do your working. In many questions marks will be given for a correct method even if the answer is incorrect.
- Do not write in the bar code. Do not write in the grey area between the pages.
- DO NOT WRITE IN THE AREA OUTSIDE THE BOX BORDERING EACH PAGE. ANY WRITING IN THIS AREA WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **55.**

This specimen paper consists of 24 printed pages.

Registered Charity Number: 1066969

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Answer all questions.

1. This newspaper article is about a food scare that occurred in February 2005.

Carcinogenic dye causes food scare

More than 400 well-known processed foods have been removed from sale because they are contaminated with an illegal red dye which can cause cancer.

The bright red carcinogenic dye, Sudan 1 had been used to colour a batch of chilli powder used as an ingredient in a brand of Worcester sauce. The sauce in turn was sold on to hundreds of food companies for manufacture into famous brands of food and supermarket ready meals.

The Food Standards Agency warned that the crisis was likely to get worse, as it came under attack for failing to prevent the lapse in food safety and for taking too long to make the information public.

Some flavours of crisps were removed from supermarket shelves

This table shows how the crisis developed.

28 January 2005	Sudan 1 contamination of chilli powder is discovered by a laboratory in Italy.
1 February 2005	Sudan 1 is found in a brand of Worcester sauce. Environmental health officers are notified.
7 February 2005	Further tests finally confirm presence of the dye.
10 February 2005	The FSA demands a list of companies supplied the Worcester Sauce for use in other products.
14 February 2005	The list of 200 companies is received by the FSA. The FSA begins ringing the companies.
15 February 2005	The FSA begins telling the companies and supermarkets that they are planning a recall.
18 February 2005	Britain's largest food recall is launched, with more than 400 products withdrawn from supermarket shelves.

Banned in 2003 under European Union rules, the harmful Sudan dye, also known as ‘scarlet red’, has been found in a range of chilli powders and curry powders, as well as more than 200 food products ranging from pesto sauce to chicken tikka masala.

The FSA said that over 300 food companies were involved in the effort to trace how far the Worcester sauce had spread. Companies involved include all of the leading supermarkets, and top brand owners such as crisp makers. The FSA said it could not guarantee that there was not more adulterated chilli in circulation.

“The big supermarkets are all using the same manufacturers, so if there is a problem it spreads very quickly, ” said a leading food critic.

The food chain is now both highly industrialised and highly centralised. The main supermarket groups depend on a handful of suppliers to provide the ingredients for their processed meals. The use of sauces containing additives to bolster the flavour of factory food is widespread. The result is not just that many ready meals taste the same but also that any breakdown in safety is instantly multiplied.

Sudan 1 is an azo dye, which has been shown to cause liver cancer in animal tests. It has not been shown to cause cancer in humans. It was first used in the US in 1918 but withdrawn from food use the same year. Sudan 1 is not permitted as a dye for foods in the EU but is meant to be used as a colour for boot polish, industrial solvents and petrol.

“At the levels present the risk is likely to be very small but it is sensible to avoid eating any more. There is no risk of immediate ill-health,” said the chief executive of the FSA.

A further difficulty is that by the time the contaminated chilli has been used in other ingredients such as Worcester sauce it is present only in parts per billion making it virtually undetectable. Public analysts have had to devise new tests to detect it, according to one food safety officer.

(a) From the discovery of Sudan 1 in a brand of Worcester sauce to the recall of contaminated food from UK supermarkets took 17 days.

Suggest and explain why this took so long.

.....

.....

.....[2]

(b) Over 400 food products were removed from supermarket shelves.

Explain how modern methods of manufacture, distribution and marketing of food enabled Sudan 1 contamination to get into so many food products?

One mark will be for a clear ordered answer.

.....

.....

.....

..... [3 + 1]

(c) The chief executive of the FSA says that the risk from eating these foods contaminated with Sudan 1 is very small.

(i) Suggest why the risk is small.

.....

.....[1]

(ii) Use the idea of a 'risk benefit analysis' to explain why the contaminated foods were removed from supermarket shelves.

.....

.....

.....

.....[2]

(iii) The FSA said it could not guarantee that there was not more adulterated chilli in circulation.

Use ideas about level of risk to explain how this is an acceptable situation.

.....

.....[1]

(d) Scientists test a brand of meat pie for the presence of Sudan 1.

They test samples from two different supermarkets.

Results of their tests are shown in the table.

	Sudan 1 content in ppm							
sample	1	2	3	4	5	6	range	average
supermarket **A**	16	13	19	15	12	14	12 to 16	14
supermarket **B**	12	10	13	14	12	11	11 to 14	12

(i) The scientists test several samples from each supermarket.

Suggest why.

.....

.....[2]

(ii) The scientists work out the range and average for the samples from supermarket **A**. They ignore the value for sample 3.

Suggest why.

.....

.....[1]

(iii) The scientists conclude that there is not a real difference between the content of Sudan 1 in this brand of meat pie from these two supermarkets.

Explain how the data in the table show this.

.....

.....

.....[2]

[Total: 15]

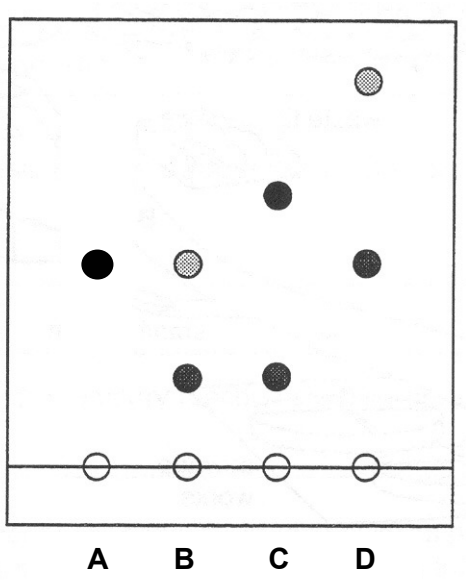
2. Scientists test three orange drinks to see if they contain a banned colour additive.

They use the technique of paper chromatography.

This is a description of what the scientists do.

Step 1	They draw a pencil line 2 cm from the bottom of a piece of absorbent paper.
Step 2	They put a spot of the banned colour additive and each of three orange drinks on the pencil line. They use a pencil to label the banned colour additive **A** and the orange drink spots **B**, **C** and **D**.
Step 3	They place the bottom of the paper into 1cm depth of water in a beaker.
Step 4	They cover the beaker with a sheet of glass and leave it until the water has soaked almost to the top of the paper.
Step 5	They remove the paper from the beaker and leave it to dry.

This is what the paper looks like at the end of this process.



(a) Explain how the colours in the orange drink samples became separated on the chromatography paper.

.....

.....

.....[2]

(b) The scientists decide that only one of the three orange drinks contains any of the three banned colour additives.

Explain how their results show this.

(One mark is for spelling, punctuation and grammar.)

.....

.....

.....

.....

..... [2+1]

(c) Scientists also test a permanent felt tip pen ink to see if it contains a prohibited dye. For this test they use thin layer chromatography.

(i) Describe one similarity and one difference between thin layer chromatography and paper chromatography.

Similarity: .....

.....

Difference:.....

.....[2]

(ii) Suggest why the scientists use thin layer chromatography instead of paper chromatography for this test.

.....

.....[1]

(iii) The scientists find that one spot from the felt tip pen ink and the spot from the prohibited dye look similar and seem to have travelled the same distance on the chromatogram.

The scientists measure the distance travelled by each of these two spots, and the distance travelled by the solvent front above each spot.

	distance travelled in mm	
	solvent front	spot
felt tip pen ink	96	44
prohibited dye	98	45

Calculate the R_f value for the felt tip pen ink and for the prohibited dye. You are advised to show how you work out your answer.

R_f value for felt tip pen = ... R_f value for prohibited dye = ...[2]

(iv) Suggest why the scientists might want to calculate R_f values.

.....

.....[1]

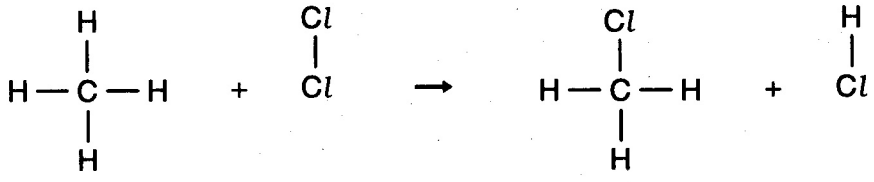
[Total: 11]

3. This table shows the average energy required to break some bonds (average bond energies). The number of bonds broken is the same in each case.

bond	energy required in kJ
C–H	435
Cl–Cl	243
C–Cl	346
H–Cl	452

The energy required to break a bond is the same as the energy given out when the bond is made.

In the presence of sunlight, methane reacts with chlorine.



(a) (i) Use data from the table to show that the energy change for this reaction is –120 kJ.

[3]

(ii) State and explain whether this reaction is exothermic or endothermic.

.....

.....[1]

(b) A scientist measures the energy change for this reaction.

He obtains the value of 125 kJ.

(i) Suggest why the measured value is not **exactly** the same as the calculated value.

.....

.....[1]

(ii) State and explain whether a comparison of these measured and calculated values supports the use of average bond energies to calculate the energy change for a reaction.

(One mark is for a clear, ordered answer.)

.....

.....

.....

..... [2+1]

[Total: 8]

4. Esters are chemicals that are responsible for many of the flavours in foods.

(a) Which **two** types of organic compound react together to make an ester?

..... and ..... [2]

(b) The ester butyl butanoate has a pineapple flavour.

(i) Few esters used to flavour foods are extracted from fruits.
Most of these esters are produced by chemical synthesis.
Suggest why.

.....

.....

.....

.....

.....[3]

(ii) Butyl butanoate can be made by reacting butanol with butanoic acid.
Here are the formulae of some compounds.

A	C_4H_{10}	**B**	C_4H_8
C	C_4H_3OH	**D**	C_4H_3COOH

Which **one** of these formulae represents butanol?

.....[1]

(iii) The reaction between butanol with butanoic acid in acidic conditions reaches an equilibrium.

What will be present in the reaction vessel when equilibrium is reached?

.....

.....[1]

(c) Esters are also used in perfumes. They give the characteristic pleasant smell.

A typical perfume may contain just 1% esters and 99% ethanol.

Suggest why ethanol is present in the perfume.

(One mark is for the use of correct scientific words.)

.....

.....

..... [2+1]

(d) Fats and oils are esters of glycerol and fatty acids.

Animal fats and vegetable oils have some difference in structure and properties.

Describe **one** difference in structure and **one** difference in properties.

Structure:.....

.....

Properties:.....

.....[2]

[Total: 11]

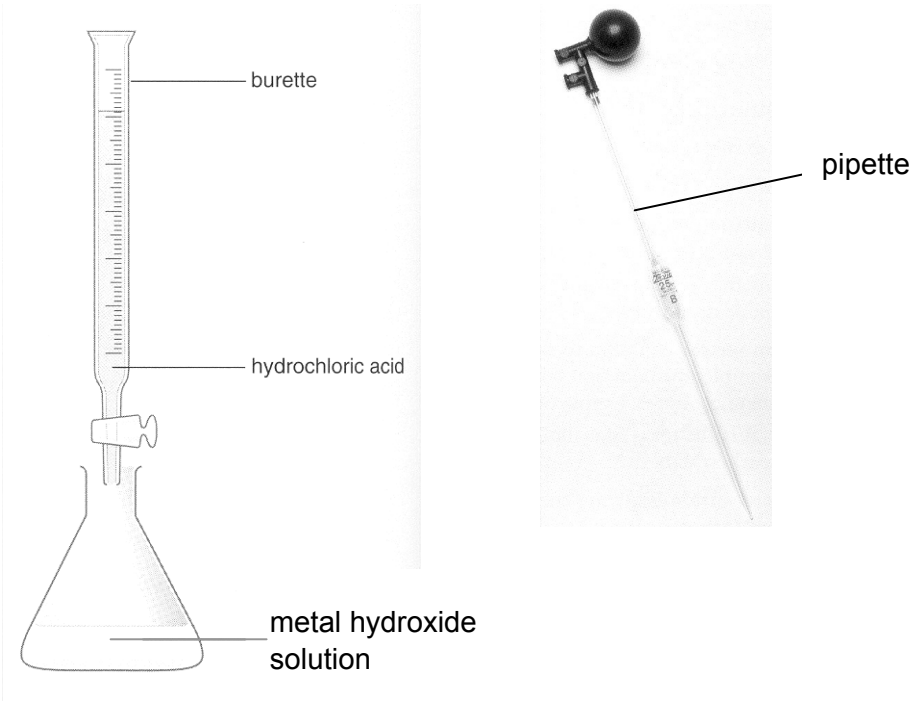
5. Alice carries out a titration to find the formula mass of a metal hydroxide.

She makes a solution containing 5.0 g of the metal hydroxide in 1.0 dm^3.

She uses a pipette to measure out 25.0 cm^3 of this solution into a conical flask.

She adds a few drops of indicator to this solution.

She then adds from a burette a solution containing 3.65 g hydrochloric acid in each dm^3.



(a) (i) To make the metal hydroxide solution, Alice dissolves 5.0 g of the metal hydroxide in water and adds more water to make the final volume of 1.0 dm^3 of solution.

Suggest why Alice does **not** simply add 5.0 g of metal hydroxide to 1.0 dm^3 water.

.....

.....[1]

(ii) Before she adds any hydrochloric acid, Alice adds a few drops of an indicator to the metal hydroxide solution.

What is the purpose of the indicator?

.....

.....[2]

(b) Alice repeats her titration several times.

Here are her results.

titration number	1	2	3	4	5
final burette reading in cm^3	32.4	52.6	31.1	51.3	31.3
initial burette reading in cm^3	0	21.4	0	20.1	0
volume of acid used in cm^3	32.4	31.2	31.1	31.2	31.3

Alice works out that the average for her results is 31.2 cm^3.

Why did Alice carry out the titration several times and work out an average?

.....

.....

.....[2]

(c) This is the equation for the reaction in Alice's titration. M represents the metal.

$$MOH + HCl \rightarrow MCl + H_2O$$

(i) Calculate the formula mass of the metal hydroxide.

Use the following information:

Alice's average titration value = 31.2 cm^3,

The concentration of the hydrochloric acid she used = 3.65 g/dm^3,

The solution she used contained 5.0 g metal hydroxide per dm^3.

You are advised to show how you work out your answer.

(Relative atomic masses: H = 1, Cl = 35.5, O = 16.)

formula mass = ...[2]

(ii) Calculate the atomic mass of metal M.

You are advised to show how you work out your answer.

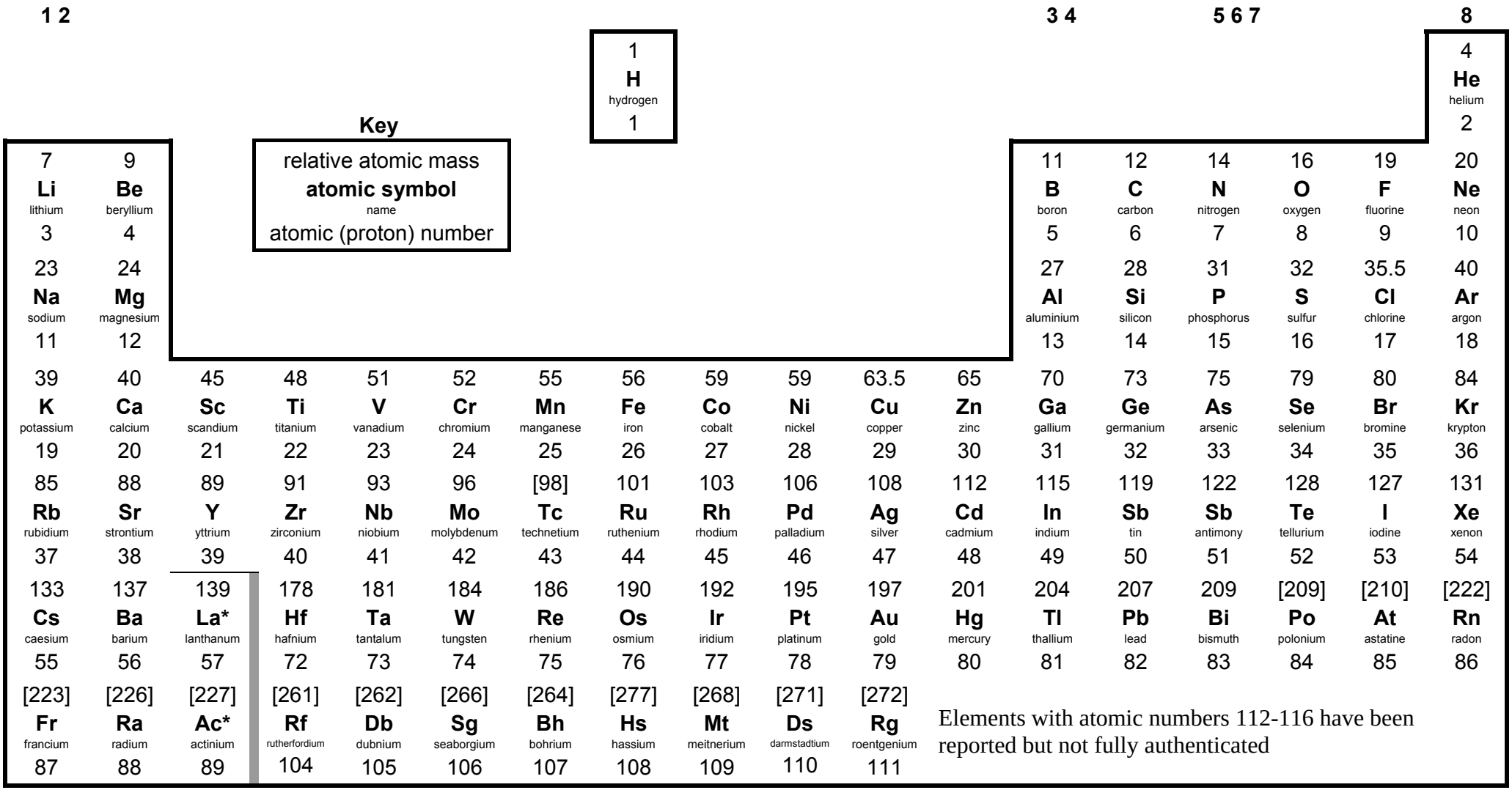
atomic mass = ...[2]

(iii) What is the name of this metal?

Use the Periodic Table to help you.

.....[1]

[Total: 10]



*The Lanthanides (atomic numbers 58-71) and the Actinides (atomic numbers 90-103) have been omitted

Cu and Cl have not been rounded to the nearest whole number

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CHEMISTRY A

H **A323/02**

Chemistry A Unit 3 Ideas in Context plus C7

Specimen Mark Scheme

1 hour

Maximum mark for this paper is [55]

This specimen mark scheme consists of 4 printed pages.

Registered Charity Number: 1066969

Question Number	Answer	Max Mark
1(a)	**Any two:** contamination had to be confirmed; had to be sure before starting a scare; many different organisations were involved; analysis was difficult/involved new techniques/very small amounts had to be detected	[2]
1(b)	all supermarkets use the same manufacturers/suppliers; food chain is centralised; use of sauces to bolster flavour is widespread;	[3]
	QWC – The candidate has attempted to answer the question using statements which are ordered in a logical way. Generally there will be at least three statements.	[1]
1(c)i	the amount of Sudan 1 in food products is very small/is in parts per billion / Sudan 1 has not been shown to cause cancer in humans / Sudan 1 has been shown to cause cancer only in animals.	[1]
1(c)ii	although the risk is small a large number of people are involved; using Sudan 1 gives little/no benefit	[2]
1(c)iii	the risk is ALARA / the risk is as low as reasonably achievable / it is not possible to ensure that all contaminated food has been recalled	[1]
1(d)i	**Any two:** to increase reliability; to get an average/mean; to identify/discard outliers; because content in sample varies; to avoid a one-off error	[1]
1(d)ii	It is an outlier	[1]
1(d)iii	the mean/average/best estimate for A is within the range of B; the mean/average/best estimate for B is within the range of A **the mean/average/best estimate of each is within the range of the other = 2**	[2]
	Total marks	**[14]**

2(a)	solute/colour is distributed between mobile and stationary phases;	**[1]**
	each solute/colour has different distribution and is therefore carried further/less by solvent	**[1]**
2(b)	only spot in D travels same distance;	**[1]**
	and is same colour (as spot in A)	**[1]**
	QWC one mark is for correct spelling, punctuation and grammar	**[1]**
2(c)i	**similarity**, any one of: spots are placed on a medium; solvent is allowed to soak up medium; different solutes travel different distances; separation is by differences in distribution between mobile and stationary phases;	**[1]**
	difference, any one of: medium is different/kieselguhr not paper; medium is spread on a glass/plastic/acetate support; solvent is different/not water;	**[1]**
2(c)ii	permanent felt tip pen ink does not dissolve in water / different solvent was required / separation is better	**[1]**
2(c)iii	felt tip pen ink R_f = 44/96 = 0.46;	**[1]**
	prohibited dye R_f = 45/98 = 0.46; **allow: 0.458 and 0.459**	**[1]**
2(c)iv	to be certain whether spots are the same/different / to allow more accurate comparison between spots / to make accurate measurements	**[1]**
	Total marks	**[11]**

3(a)i	energy for bonds broken = 435 + 243 = 678;	**[1]**
	energy for bonds made = 452 + 346 = 798;	**[1]**
	energy change = 678 – 798 = –120 kJ **unit required for final answer only**	**[1]**
3(a)ii	exothermic because value is negative	**[1]**
3(b)i	bond energies in the table are averages / experimental error	**[1]**
3(b)ii	(Yes, because)	
	the values are close / there is only a small difference;	**[1]**
	they are close enough to be considered the same / difference is small enough to be ignored;	**[1]**
	QWC one mark is for a clear link between the size of the difference and how significant this is in deciding whether the two values are equivalent	**[1]**
	Total marks	**[8]**

4(a)	alcohol;	**[1]**
	carboxylic acid **either order**	**[1]**
4(b)i	**Any three:** synthesis is cheaper; extraction from fruit is more complex; synthesis is quicker/fruit take a long time to grow; land is needed to grow food crops	**[3]**
4(b)ii	C	**[1]**
4(b)iii	butanol, butanoic acid, butyl butanoate, (acid)	**[1]**
4(c)	ethanol is a solvent (for the esters);	**[1]**
	ethanol is volatile/evaporates quickly (to leave esters on skin)	**[1]**
	QWC one mark is for correct use of **two** of the scientific words solvent; volatile; evaporate(s)	**[1]**
4(d)	**structure**, one of: animal fat is (mostly) saturated, vegetable oil is (mostly) unsaturated / animal fat contains more double bonds	**[1]**
	properties, one of: animal fat is solid, vegetable oil is liquid (at room temperature) / animal fat has a higher mp than vegetable oil	**[1]**
	Total marks	**[12]**
5(a)i	final volume would be more than 1.0 dm^3 / solute has volume	**[1]**
5(a)ii	change colour;	**[1]**
	to show neutral point / to show when to stop adding acid	**[1]**
5(b)	to obtain a more reliable value;	**[1]**
	to overcome limitations in the technique	**[1]**
5(c)i	3.65 x 31.2/1000 g HCl Ξ 5.0 x 25/1000 g MOH;	**[1]**
	36.5 g HCl reacts with 5.0 x 25 x 10/31.2 g MOH = 40.1	**[1]**
5(c)ii	OH = 16 + 1 = 17;	**[1]**
	40 – 17 = 23	**[1]**
5(c)iii	Sodium **allow ecf from (d)i**	**[1]**
	Total marks	**[10]**
	Overall marks	**[55]**