

1: Experimental techniques – Topic questions

Paper 3

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
3	2016	June	31
4	2016	November	33
5	2016	June	32

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

3 The table shows some properties of the Group I metals.

metal	density in g / cm ³	melting point / °C	boiling point / °C
lithium	0.53	181	1342
sodium		98	883
potassium	0.86	63	760
rubidium	1.53	39	686
caesium		29	669

(a) (i) Describe the trend in boiling points of the Group I metals.

..... [1]

(ii) Predict the density of caesium.

..... [1]

(iii) Deduce the state of caesium at 20 °C.

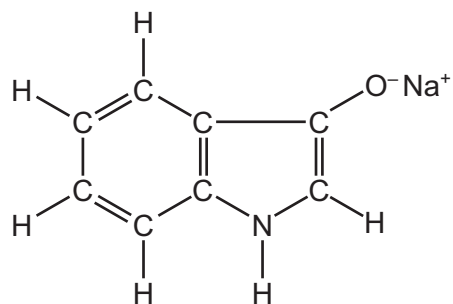
Explain your answer.

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

(b) Complete the word equation for the reaction of rubidium with water.

rubidium + water → + [2]

- (c) The dye, indigotin, is formed when compound **F** is exposed to air.
The structure of compound **F** is shown below.



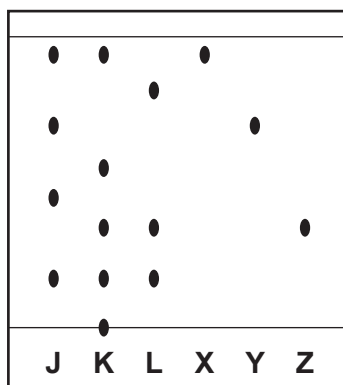
Complete the table and calculate the relative molecular mass of compound **F**.

type of atom	number of atoms	atomic mass	
carbon	8	12	$8 \times 12 = 96$
hydrogen			
nitrogen	1	14	$1 \times 14 = 14$
oxygen	1	16	$1 \times 16 = 16$
sodium			

relative molecular mass = [2]

- (d) Three dye mixtures, **J**, **K** and **L**, were spotted onto a piece of chromatography paper. Three pure dyes, **X**, **Y** and **Z**, were also spotted onto the same piece of paper.

The diagram shows the results of this chromatography.



- (i) Suggest why the base line was drawn in pencil and **not** in ink.

..... [1]

- (ii) Which dye mixture, **J**, **K** or **L**, contains a dye which did **not** move during this chromatography?

..... [1]

- (iii) Which dye mixture, **J**, **K** or **L**, contains both dye **X** and dye **Y**?

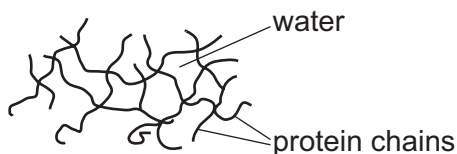
..... [1]

- (iv) Which dye mixture, **J**, **K** or **L**, does **not** contain dye **Z**?

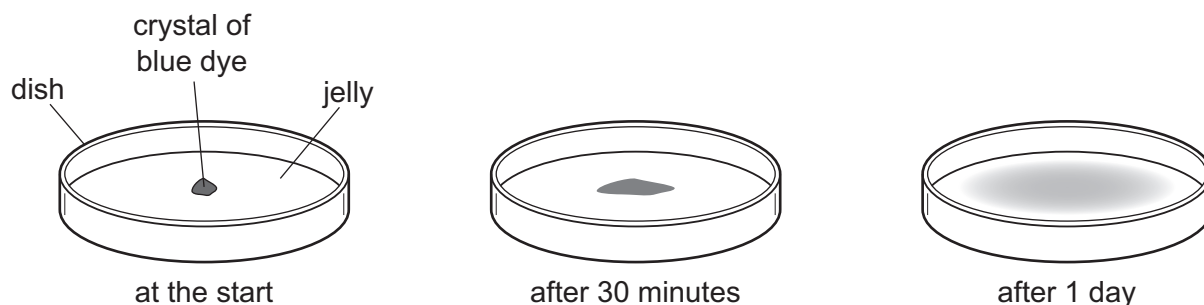
..... [1]

[Total: 12]

- 4 Jelly is a mixture of water and protein chains.



- (a) A crystal of blue dye was placed on top of some jelly.
After 30 minutes some of the blue colour could be seen in the jelly.
After 1 day the blue colour had spread out further into the jelly.



Use the kinetic particle model of matter to explain these observations.

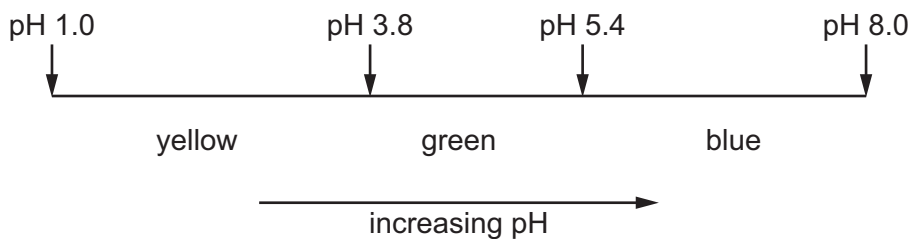
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.....

.....

..... [3]

- (b) The diagram shows the colour changes of the indicator bromocresol green at different pH values.



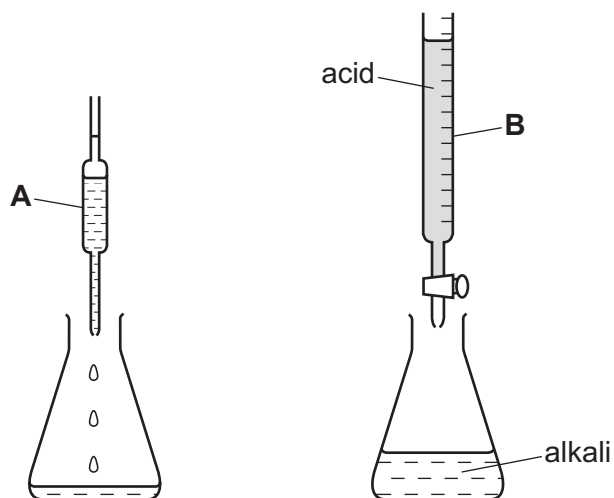
Predict the colour of bromocresol green

in pure water,

in a strongly acidic solution.

[2]

- (c) The concentration of an alkali can be found by titrating it with an acid using the apparatus shown.



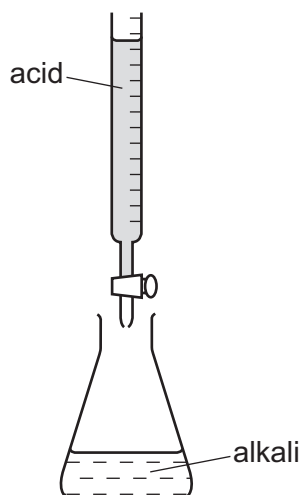
- (i) State the names of the pieces of glassware labelled **A** and **B**.

A

B

[2]

- (ii) Describe how you would carry out a titration using the apparatus shown.



.....

.....

.....

.....

.....

..... [3]

[Total: 10]

5 Chlorine, bromine and iodine are halogens.

(a) The melting point of bromine is -7°C . The boiling point of bromine is $+59^{\circ}\text{C}$.

Deduce the state of bromine at $+6^{\circ}\text{C}$. Explain your answer.

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

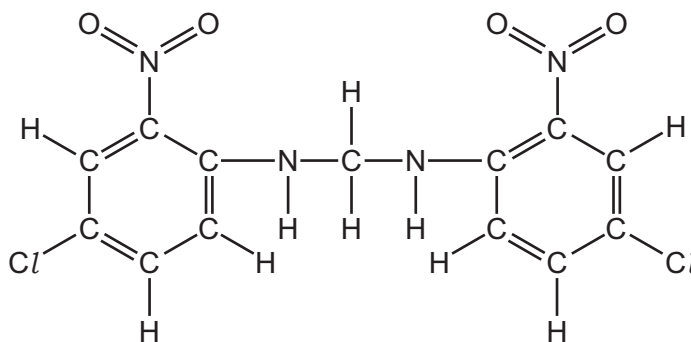
(b) (i) Complete the word equation for the reaction of chlorine with potassium iodide.

chlorine + potassium iodide \rightarrow + [2]

(ii) Suggest why iodine does **not** react with aqueous potassium bromide.

.....
..... [1]

(c) The structure of the dye Lithol fast yellow is shown.



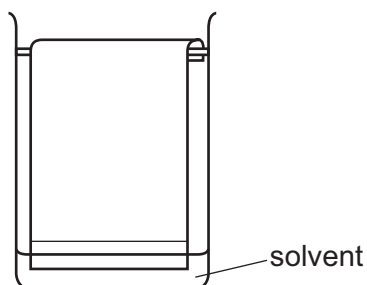
Complete the table and calculate the relative molecular mass of Lithol fast yellow.

type of atom	number of atoms	atomic mass	
carbon	13	12	$13 \times 12 = 156$
hydrogen	10	1	$10 \times 1 = 10$
nitrogen	4	14	$4 \times 14 = 56$
oxygen			
chlorine			

relative molecular mass = [2]

(d) Chromatography is used to separate a mixture of dyes.

- (i)** Draw a cross on the diagram to show where the mixture of dyes is placed at the start of the chromatography.



[1]

- (ii)** Suggest a suitable solvent that could be used.

..... [1]

- (iii)** Describe what you would observe as the experiment proceeds.

.....
..... [1]

[Total: 10]

Question	Answer	Marks
3 (a) (i)	decreases down the Group I / increases up the Group I;	1
3 (a) (ii)	1.88 (1.60–2.50) (g/cm ³)	1
3 (a) (iii)	solid; 20 °C is below the melting point / the melting point is above 20 °C	1 1
3 (b)	rubidium hydroxide; hydrogen;	1 1
3 (c)	155; (1 mark for hydrogen = (6 × 1) = 6 / sodium = (1 × 23) = 23)	2
3 (d) (i)	pencil will not smear / pencil line will not move / ink will smear / ink will undergo chromatography / ink would spread / ink would travel upwards / pencil mark would not spread;	1
3 (d) (ii)	K;	1
3 (d) (iii)	J;	1
3 (d) (iv)	J;	1
		Total: 12
4 (a)	any 3 from: <ul style="list-style-type: none"> • diffusion • particles move / motion of particles • (movement is) random / in any direction / in all directions • particles spread out / particles mix • particles move from high to low concentration 	3
4 (b)	<i>in pure water:</i> blue <i>in a strongly acidic solution:</i> yellow	1 1
4 (c) (i)	A (volumetric) pipette B burette	1 1
4 (c) (iii)	add (a few drops of) indicator to the flask slowly add acid (from the burette) into the alkali (until indicator) changes colour / until (alkali) neutralised / until neutral	1 1 1
		Total: 10

Continues on next page ...

Question	Answer	Marks
5 (a)	liquid; 6 °C is higher than the melting point and lower than the boiling point / 6 °C is between the melting point and the boiling point;	2 1 1
5 (b) (i)	potassium chloride; iodine;	2 1 1
5 (b) (ii)	<u>iodine</u> is less reactive than <u>bromine</u> / <u>bromine</u> is more reactive than <u>iodine</u> ;	1
5 (c)	357 (1 mark for 1 correct row, e.g. (4 × 16 =) 64 or (2 × 35.5) = 71)	2
5 (d) (i)	cross shown on baseline;	1
5 (d) (ii)	ethanol / other organic solvent	1
5 (d) (iii)	dyes <u>move up</u> the paper and <u>separate</u> ;	1
		Total: 10