2.27 Chromatography and Instrumental Analysis: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A tin of white gloss paint has a mass of 5.0 kg. The table shows the formulation of the paint by percentage mass.

Component	Percentage of mass
Titanium dioxide pigment	18%
Resin (binder)	45%
Solvent	30%
Additives	7%

(a) Calculate the mass of titanium dioxide pigment in the tin. **(2)**

.....

(b) Calculate the mass of solvent in the tin. **(2)**

.....

(Total for Question 1 is 4 marks)

© Revision Library | revisionlibrary.co.uk

2 Required practical. Answer the following questions about the paper chromatography practical.

(a) Explain why the baseline should be drawn in pencil rather than in ink. **(1)**

(b) Explain why the level of solvent in the beaker must be below the pencil baseline. **(1)**

(c) Explain why a lid is placed on the beaker during the experiment. **(1)**

(Total for Question 2 is 3 marks)

---

3 Chemists can identify substances using either simple chemical tests or instrumental methods of analysis.

(a) State three advantages of using instrumental methods of analysis, rather than chemical tests, to identify substances. **(3)**

(b) Give one disadvantage of using instrumental methods compared with simple chemical tests. **(1)**

(Total for Question 3 is 4 marks)

---

4 Higher tier only (Chemistry triple award). Flame emission spectroscopy is an instrumental method used to identify metal ions in solution.

(a) Describe how flame emission spectroscopy is used to analyse a sample. **(4)**

(Total for Question 4 is 4 marks)

© Revision Library | revisionlibrary.co.uk

5 Higher tier only (Chemistry triple award). The table shows the wavelength of the main emission line produced by four metal ions during flame emission spectroscopy.

Metal ion	Wavelength of main line (nm)
Lithium, Li^+	671
Sodium, Na^+	589
Potassium, K^+	767
Calcium, Ca^{2+}	422

A student analyses an unknown solution using flame emission spectroscopy. The spectrum produced has a single strong line at 589 nm.

(a) Identify the metal ion present in the unknown solution. Give a reason for your answer. **(2)**

(b) A second, unknown solution produces a spectrum with two lines: one at 589 nm and one at 671 nm. Suggest what this tells you about the composition of the second solution. **(2)**

(Total for Question 5 is 4 marks)

© Revision Library | revisionlibrary.co.uk

6 Higher tier only (Chemistry triple award). Flame tests and flame emission spectroscopy can both be used to identify metal ions in a solution.

(a) Give two advantages of using flame emission spectroscopy, rather than a flame test, to identify the metal ions present in a solution. **(2)**

(Total for Question 6 is 2 marks)

---

7 A student thinks a white solid might be a pure sample of compound X, which has a known melting point of 122°C. She heats a sample of the solid slowly and finds that it starts to melt at 116°C and is completely melted by 121°C.

(a) Use the data to determine whether the solid is pure compound X. Explain your answer. **(3)**

(Total for Question 7 is 3 marks)

© Revision Library | revisionlibrary.co.uk

Mark scheme · 2.27 Chromatography and Instrumental Analysis: 30-minute Pack

Question 1

(a) 5.0 x 0.18, oe correct method **M1**

(a) 0.90 kg cao (allow 900 g) **A1**

(a) Answer: 0.90 kg (900 g)

(b) 5.0 x 0.30, oe correct method **M1**

(b) 1.5 kg cao **A1**

(b) Answer: 1.5 kg

Question 2

(a) pencil is insoluble in the solvent, so it does not dissolve and move up the paper (and so cannot be mistaken for a dye spot); ink would dissolve and run, oe **B1**

(a) Answer: Pencil does not dissolve in the solvent, so the baseline stays in place and is not confused with a dye spot; ink would dissolve and run up the paper with the solvent.

(b) if the solvent covered the baseline, the spots would dissolve directly into the solvent bath rather than being carried up the paper, so no separation would take place, oe **B1**

(b) Answer: If the solvent were above the baseline, it would dissolve the spots straight into the solvent instead of carrying them up the paper, so the substances could not be separated.

(c) it keeps the atmosphere inside the beaker saturated with solvent vapour, which stops the solvent evaporating, so the chromatogram runs consistently/reliably, oe **B1**

(c) Answer: The lid keeps the atmosphere inside saturated with solvent vapour, which stops the solvent evaporating and helps give reliable, repeatable results.

Question 3

(a) any one of: faster than chemical tests **B1**

(a) any other one of: more sensitive (can detect very small amounts/low concentrations) **B1**

(a) any other one of: more accurate; needs only a very small sample; less reliant on the skill or subjective judgement of the person carrying out the test (accept any three distinct correct advantages) **B1**

(a) Answer: Any three of: faster; more sensitive; more accurate; needs a smaller sample; less reliant on the skill or judgement of the analyst.

(b) the equipment is expensive to buy and maintain, and specially trained staff are needed to operate it and interpret the results, oe **B1**

(b) Answer: The equipment is expensive to buy and maintain, and needs trained staff to operate it and interpret the data.

Question 4

(a) a small sample of the solution is put into a flame, oe **B1**

(a) the light given out (emitted) by the flame is passed through a spectroscope, oe **B1**

(a) the spectroscope produces a line spectrum, a pattern of coloured lines at specific wavelengths, oe **B1**

(a) the line spectrum produced is compared with reference spectra of known ions, to identify which metal ion(s) are present in the sample, oe **B1**

(a) Answer: A sample is placed in a flame; the light emitted is passed through a spectroscope, which produces a line spectrum. This spectrum is compared with reference spectra to identify the metal ion(s) present.

Question 5

(a) sodium, Na^+ **B1**

(a) because the spectrum shows a line at 589 nm, which matches the reference wavelength for sodium, oe **B1**

(a) Answer: Sodium (Na^+). The line at 589 nm matches the reference emission wavelength for sodium ions.

(b) the solution contains a mixture of (at least) two different metal ions, oe **B1**

(b) sodium ions, Na^+ (line at 589 nm), and lithium ions, Li^+ (line at 671 nm), are both present **B1**

(b) Answer: The solution is a mixture containing both sodium ions (589 nm) and lithium ions (671 nm).

Question 6

(a) any one of: it is more accurate/objective, since it does not rely on an observer judging a flame colour by eye **B1**

(a) any other one of: it can also determine the concentration of the ion present, not just confirm which ion is present; it can identify ions in a mixture, even if their flame colours would overlap or mask each other when viewed by eye; it is more sensitive (can detect lower concentrations) **B1**

(a) Answer: Any two of: it is more accurate/objective than judging a flame colour by eye; it can determine the concentration of the ion, not just its identity; it can identify ions in a mixture whose flame colours might otherwise be masked or overlap.

Question 7

(a) the sample melts over a range of temperatures (116°C to 121°C) rather than sharply at one exact temperature, oe **B1**

(a) a pure substance melts sharply at one fixed temperature (its melting point); here that would be 122°C, oe **B1**

(a) so the solid is not pure compound X / it is impure, since it melts over a range and below the known melting point of the pure compound (ecf from the first two marking points) **B1**

(a) Answer: The solid is impure. It melts over a range of temperatures (116 to 121°C), and below the known melting point of pure compound X (122°C), instead of sharply at 122°C.

© Revision Library | revisionlibrary.co.uk