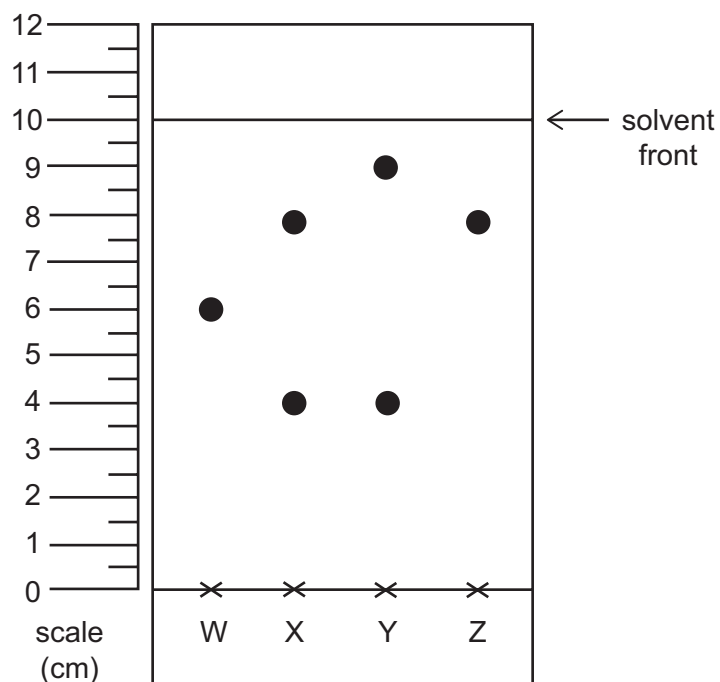


- 39 Four samples, labelled W, X, Y and Z, were investigated using paper chromatography with a solvent that caused any mixtures present to be fully separated. The results are shown in the chromatogram.

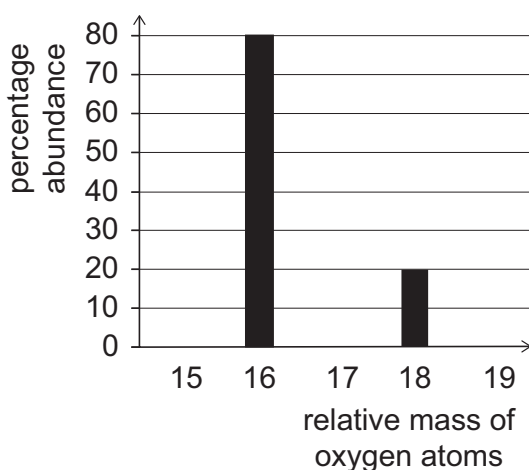
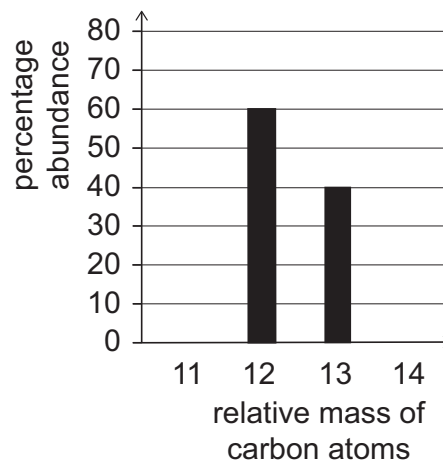
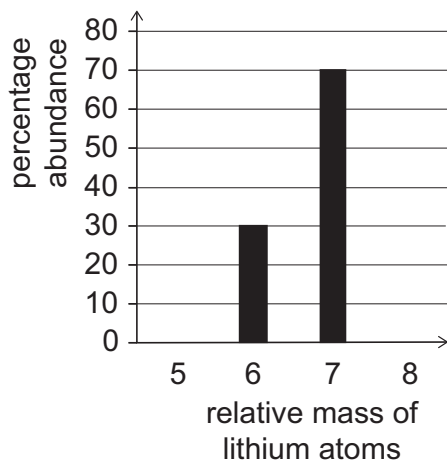


What is the R_f value of the spot with the strongest attraction to the mobile phase relative to the stationary phase **and** that is from a sample containing only one substance?

- A 0.50
- B 0.60
- C 0.67
- D 0.75
- E 0.80
- F 0.90

- 40** A mass spectrometer is a device that can measure the mass of isotopes. It shows this data as a spectrum, giving both the relative mass and the percentage abundance of each isotope.

The charts indicate the relative mass and percentage abundance for lithium atoms, carbon atoms and oxygen atoms found in a sample taken from a nuclear reactor.



Using this data, what is the largest possible relative molar mass of lithium carbonate?

- A** 35
- B** 38
- C** 45
- D** 67
- E** 74
- F** 75
- G** 81

41 The following information about metals labelled P, Q, R and S is given.

- Metals P and S can be extracted by electrolysis, but not by reaction with carbon.
- Metals Q and R can be extracted by reaction with carbon.
- Metal S forms positive ions more readily than metal P.
- Metal R reacts with the oxide of metal Q.

What is the order of reactivity of these four metals, starting with the most reactive?

- A** P, S, Q, R
B P, S, R, Q
C Q, R, P, S
D Q, R, S, P
E R, Q, P, S
F R, Q, S, P
G S, P, Q, R
H S, P, R, Q

42 A simple ion of an element with atomic number x has a mass number of $(2x + 2)$.

The ion has a charge of -2 .

How many protons, neutrons and electrons are present in this ion?

	<i>protons</i>	<i>neutrons</i>	<i>electrons</i>
A	$x - 2$	$x + 4$	$x - 2$
B	$x - 2$	$x + 4$	x
C	$x - 2$	$x + 4$	$x + 2$
D	x	$x + 2$	$x - 2$
E	x	$x + 2$	x
F	x	$x + 2$	$x + 2$

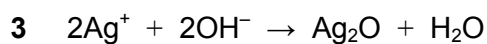
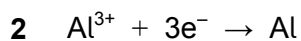
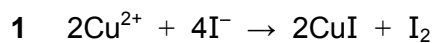
- 43** A 116 g sample of an oxide of iron contains 84 g of iron.

Which of the following is the empirical formula of this oxide of iron?

(A_r values: O = 16; Fe = 56)

- A** FeO
- B** Fe₂O₂
- C** Fe₃O₂
- D** Fe₂O₃
- E** Fe₃O₄

- 44** Which of the following chemical equations represent(s) a redox reaction?



- A** none of them
- B** 1 only
- C** 2 only
- D** 3 only
- E** 1 and 2 only
- F** 1 and 3 only
- G** 2 and 3 only
- H** 1, 2 and 3

- 45** X is an anhydrous salt of iron containing one type of cation and one type of anion.

An aqueous solution of X gives a white precipitate when aqueous barium chloride is added in the presence of hydrochloric acid.

On adding aqueous sodium hydroxide to an aqueous solution of X, a brown precipitate formed immediately.

The relative atomic mass of iron is 56, and its atomic number is 26.

What is the relative molar mass of X?

(A_r values: C = 12; N = 14; O = 16; S = 32; Cl = 35.5; Br = 80)

- A** 127
- B** 152
- C** 162.5
- D** 208
- E** 264
- F** 272
- G** 360
- H** 400

- 46** In the electrolysis of dilute sulfuric acid, hydrogen gas is formed at the negative electrode (cathode) and oxygen gas is formed at the positive electrode (anode).

If 100 g of hydrogen gas is formed in the electrolysis of dilute sulfuric acid, what mass of oxygen gas is also formed?

(A_r values: H = 1; O = 16)

- A** 50 g
- B** 100 g
- C** 200 g
- D** 800 g
- E** 1600 g

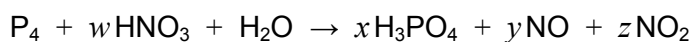
- 47** 0.005 mol of a chloride of element X was dissolved in water and then reacted with excess silver nitrate solution to form a precipitate of silver chloride, AgCl. This precipitate is the only product of this reaction that contains chlorine.

After filtering, washing and drying, the mass of the precipitate was recorded to be 1.435 g.

Which of the following could be the formula of the chloride of X?

(M_r value: AgCl = 143.5)

- A** X_5Cl
 - B** X_2Cl
 - C** XCl
 - D** XCl_2
 - E** XCl_5
- 48** A chemical equation that represents the reaction of phosphorus with concentrated nitric acid is:

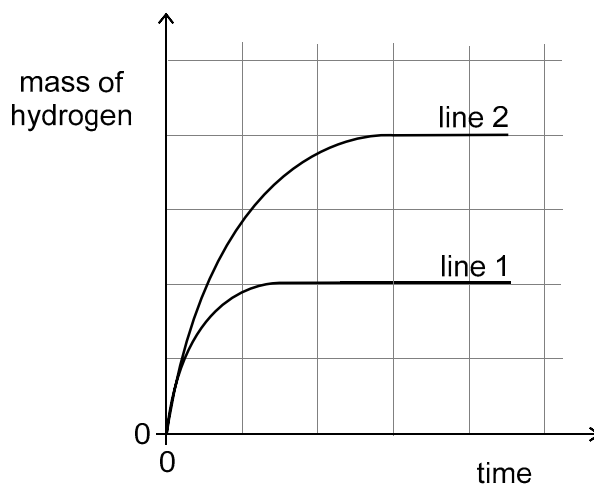


What is the value of the sum $w + x + y + z$?

- A** 24
- B** 28
- C** 30
- D** 32
- E** 36

- 49** A 2.40 g lump of magnesium was added to 500 cm³ of a 2.00 mol dm⁻³ solution of HCl in a conical flask that was on an electronic balance. The neck of the flask was plugged with cotton wool, and the decrease in mass of the flask and its contents was recorded at regular intervals.

The mass of the hydrogen released (equal to the mass loss recorded) was plotted against time. The result is line 1 on the graph.



Which of the following experiments performed under the same conditions would give line 2?

(A_r value: Mg = 24.0)

- A** a 2.40 g lump of magnesium added to 500 cm³ of 2.00 mol dm⁻³ H₂SO₄
- B** 2.40 g of magnesium powder added to 500 cm³ of 2.00 mol dm⁻³ HCl
- C** a 2.40 g lump of magnesium added to 1000 cm³ of 2.00 mol dm⁻³ HCl
- D** a 4.80 g lump of magnesium added to 500 cm³ of 2.00 mol dm⁻³ HCl
- E** 4.80 g of magnesium powder added to 500 cm³ of 2.00 mol dm⁻³ HCl

- 50** A technician needs to separate three liquids (X, Y and Z) which have been accidentally mixed together. None of the liquids react with each other.

<i>liquid</i>	X	Y	Z
<i>boiling point / °C</i>	65	51	100
<i>density / g cm⁻³</i>	0.79	0.68	1.00

X and Z are miscible, but Y is immiscible with both X and Z.

The technician uses a separating funnel to separate the upper and lower layers of the mixture.

What should the technician do next to maximise separation of the three liquids?

- A** distil the lower layer at 51 °C
- B** distil the lower layer at 65 °C
- C** distil the lower layer at 100 °C
- D** distil the upper layer at 51 °C
- E** distil the upper layer at 65 °C
- F** distil the upper layer at 100 °C

- 51** In each of the following procedures an excess of the metal is added to 1.0 dm³ of a 1.0 mol dm⁻³ solution of the acid.

copper added to sulfuric acid

iron added to hydrochloric acid

magnesium added to sulfuric acid

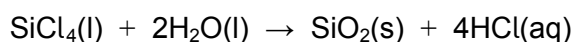
zinc added to hydrochloric acid

Which row in the following table identifies combinations of metal and acid that will react and produce the largest, and the smallest, theoretical mass of anhydrous salt?

(M_r values: $\text{CuSO}_4 = 160$; $\text{FeCl}_2 = 127$; $\text{MgSO}_4 = 120$; $\text{ZnCl}_2 = 136$)

	<i>reaction that produces the largest mass of salt</i>	<i>reaction that produces the smallest mass of salt</i>
A	Cu and H ₂ SO ₄	Fe and HCl
B	Cu and H ₂ SO ₄	Mg and H ₂ SO ₄
C	Fe and HCl	Zn and HCl
D	Mg and H ₂ SO ₄	Fe and HCl
E	Mg and H ₂ SO ₄	Zn and HCl
F	Zn and HCl	Mg and H ₂ SO ₄

- 52** 3.4 g of an impure sample of silicon tetrachloride is reacted with water. The mixture is then filtered and the resulting solution made up to 250 cm³.



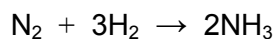
12.5 cm³ of this solution is neutralised exactly by 20.0 cm³ of 0.100 mol dm⁻³ sodium hydroxide.

What is the percentage purity of the silicon tetrachloride?

(M_r value: $\text{SiCl}_4 = 170$. Assume that the impurity does not react.)

- A** 1.7%
- B** 2.5%
- C** 10%
- D** 32%
- E** 50%

- 53** The Haber process is represented by the following chemical equation:

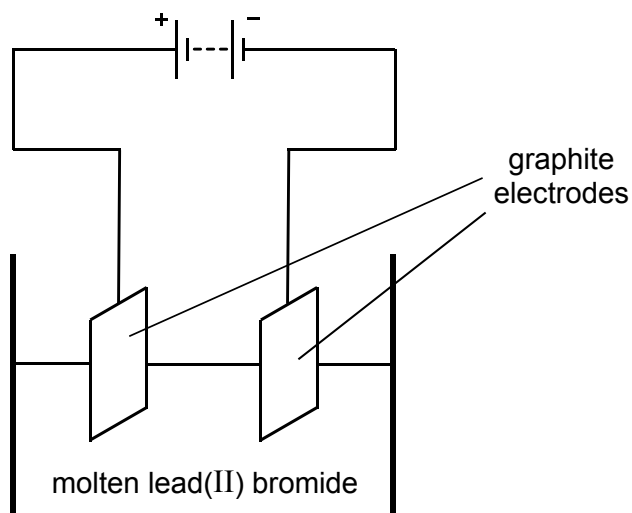


What is the overall enthalpy change for the reaction?

(Bond enthalpies: $\text{N} \equiv \text{N} = 945 \text{ kJ mol}^{-1}$; $\text{H}-\text{H} = 435 \text{ kJ mol}^{-1}$; $\text{N}-\text{H} = 390 \text{ kJ mol}^{-1}$)

- A** $+90 \text{ kJ mol}^{-1}$
- B** -90 kJ mol^{-1}
- C** $+990 \text{ kJ mol}^{-1}$
- D** -990 kJ mol^{-1}
- E** $+1080 \text{ kJ mol}^{-1}$
- F** $-1080 \text{ kJ mol}^{-1}$

- 54 The diagram shows the electrolysis of molten lead(II) bromide, PbBr_2 , using graphite electrodes to separate the compound into its elements.



Which of the following statements about this electrolysis is/are correct?

- 1 Lead is formed at the negative electrode.
 - 2 Electrons flow through the external circuit away from the positive electrode towards the negative electrode.
 - 3 Bromine molecules and lead are produced in a 2 : 1 molar ratio.
- A** none of them
- B** 1 only
- C** 2 only
- D** 3 only
- E** 1 and 2 only
- F** 1 and 3 only
- G** 2 and 3 only
- H** 1, 2 and 3

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