Past-paper walk-through

Transition elements ▪ 8.4

eXercise

Questions in this set

- 0620/23 N25 Q26 ▪ 1 mark
- 0620/21 J25 Q23 ▪ 1 mark
- 0620/23 J25 Q24 ▪ 1 mark
- 0620/42 M25 Q5 ▪ 17 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 26

0620/23 N25 ▪ Q26 ▪ 1 mark

26 Which row identifies a transition element?

	melting point	density at r.t.p.
A	high	high
B	high	low
C	low	high

C	low	high
D	low	low

Solution 26

Answer: **A**

Why

- Transition elements have strong metallic bonding, giving high melting points.
- Their atoms are heavy and closely packed, giving high densities.
- Group I metals are the opposite – low melting point and low density.

Question 23

0620/21 J25 ▪ Q23 ▪ 1 mark

23 Some properties of elements are listed.

1 They have good electrical conductivity.

2 They have high melting points.

3 They are malleable.

4 They have ions with variable oxidation numbers.

Which properties are correct for **both** iron and lithium?

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

Solution 23

Answer: **A**

Why

- Both iron and lithium are metals, so both conduct electricity well and both are malleable.
- Lithium's melting point is low (about $180\,^{\circ}\mathrm{C}$), so statement 2 fails.
- Only the transition metal iron shows variable oxidation numbers, so statement 4 fails.

Question 24

0620/23 J25 ▪ Q24 ▪ 1 mark

24 Which element is a transition element?

	melting point in °C	density at r.t.p. in g/cm^3	colour of oxide at r.t.p.
A	98	1.0	white
B	328	11.3	yellow
C	651	1.7	white
D	1907	7.2	green

Question 24

Solution 24

Answer: **D**

Why

- Transition elements have high melting points, high densities and coloured compounds.
- A melting point of $1907\,^{\circ}\text{C}$ with a density of $7.2\ \text{g/cm}^3$ fits a transition metal.
- The green oxide clinches it – Group I and Group II oxides are white.

Question 5

0620/42 M25 ▪ Q5 ▪ 17 marks

5 Manganese is the element with atomic number 25 in the Periodic Table.
Calcium is the element with atomic number 20 in the Periodic Table.

(a) Complete Table 5.1 to show the number of protons, neutrons and electrons in the ^{55}Mn atom and the $^{42}Ca^{2+}$ ion.

Table 5.1

	^{55}Mn	$^{42}Ca^{2+}$
protons		
neutrons		
electrons		

[2]

Question 5

[3]

(b) Manganese forms several oxides. The formulae of some of these oxides are shown.

MnO

Mn_2O_3

Mn_3O_4

MnO_2

Mn_2O_7

(i) Suggest why manganese is expected to form coloured oxides.

Question 5

(ii) State which other property of manganese is shown by the formation of several oxides.

Question 5

(iii) State the formula of manganese(II) oxide.

Question 5

(c) Mn_3O_4 is found in an ore of manganese. Manganese metal can be extracted from Mn_3O_4 using aluminium as the reducing agent.

(i) Define the term reducing agent.

Question 5

(ii) Complete the symbol equation by inserting the formula of the missing product and balancing the equation.

Question 5

[2]

(d) MnO_2 reacts with dilute hydrochloric acid as shown in the equation.

$$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$$

(i) Calculate the volume of chlorine gas formed, in cm^3, at r.t.p. when excess MnO_2 reacts with $50.0\,cm^3$ of $0.200\,mol/dm^3$ HCl.

Use the following steps.

- Calculate the number of moles of HCl used.

Question 5

- Determine the number of moles of Cl_2 formed.

Question 5

- Calculate the volume of Cl_2 formed.

Question 5

[3]

(ii) Describe a test for chlorine gas.

Question 5

[1]

(iii) Explain, in terms of collision theory, why decreasing the temperature decreases the rate of this reaction.

Question 5

[Total: 17]

Solution 5

(a) Mark scheme

- 55Mn
- 42Ca2+
- protons
- 25
- 20
- neutrons
- 30
- 22

Solution 5

- electrons
- 25
- 18
- Each row
- 3

Solution 5

(b)(i)

Mark scheme

- (Mn is a) transition element
- 1

(b)(ii)

Mark scheme

- variable oxidation state
- 1

Solution 5

(b)(iii)

Mark scheme

- MnO
- 1

Solution 5

(c)(i)

Mark scheme

- a substance that reduces another substance and is itself oxidised M1
- 'a substance' reduces another substance M2
- is itself oxidised
- 2

Solution 5

(c)(ii)

Mark scheme

- $3Mn_3O_4 + 8Al \rightarrow 4Al_2O_3 + 9Mn$ M1
- Al_2O_3 M2
- correct equation
- 2

Solution 5

(d)(i)

Mark scheme

- M1 $50 \times 0.200 \div 1000 = 0.01(00)$ M2
- $0.01 \div 4 = 0.0025(0) \,/\, 2.5(0) \times 10\text{–}3$ M3
- $= 0.0025 \times 24000 = 60(.0)$
- 3

Solution 5

(d)(ii)

Mark scheme

- (damp) litmus (paper)
- and
- is bleached / goes white
- 1
- 0620/42
- February/March 2025

Solution 5

(d)(iii)

Mark scheme

- M1 kinetic energy of particles decreases M2
- frequency of collisions between particles decreases M3
- lower percentage / proportion / fraction of collisions / particles have energy greater than / equal to activation energy
- OR
- Fewer of the collisions / particles have energy greater than / equal to activation energy