2.3 Periodic Table: Organisation and Predicting Properties: 30-minute Pack

EDEXCEL 4CH1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Describe, using periodic table position, how metals and non-metals are broadly separated and where metals are found compared with non-metals.

(Total for Question 1 is 1 mark)

2 Describe what a group is in the periodic table and state what property elements in the same group share that affects chemical reactions.

(Total for Question 2 is 2 marks)

3 A lab compares element V, with electron arrangement 2,8,2, with element W, with arrangement 2,8,6. Deduce which element is expected to be more metallic and explain your choice using its outer-shell information.

(Total for Question 3 is 2 marks)

4 A period 3 comparison uses the general decrease in atomic radius from left to right. Element P is in group 4 and element Q is in group 6. An unknown element X in the same period has a radius smaller than P but larger than Q. There is only one main-group column between P and Q. Deduce the group of X and explain using the radius order.

(Total for Question 4 is 2 marks)

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5 Deduce the group number for an element that has the outer-shell electron arrangement of 2,8,1, giving a brief reason based on outer electrons and periodic table structure.

(Total for Question 5 is 2 marks)

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6 A student is told an element X is in group 7 and period 3 of the periodic table. Predict the number of electron shells and the number of electrons in the outer shell for element X, stating both numbers.

(Total for Question 6 is 2 marks)

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7 Explain, in about four lines, why elements in the same group of the periodic table show similar chemical properties. Include a clear reference to electrons.

(Total for Question 7 is 4 marks)

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8 An unfamiliar element Z is listed in group 1, period 3. A student makes three predictions: Z is metallic; Z conducts electricity; Z has exactly the same melting point as every other group 1 element. For each prediction, state whether periodic table position supports it and give a reason.

(Total for Question 8 is 3 marks)

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9 Levels response: Explain how you could use an element's position in the periodic table to predict its physical properties and likely chemical behaviour. In your answer include reference to period number, group number, electron shells, and whether it is metal or non-metal. Give examples of the kinds of properties you would predict.

(Total for Question 9 is 6 marks)

10 All temperatures are in degrees Celsius. Two group 7 elements have these data: U in period 3 has melting point -101 and boiling point -34; V in period 4 has melting point -7 and boiling point 59. Deduce the state of V at 20, with a reason. Predict whether the next element down the group would have a higher or lower melting point if this trend continues. Explain why these data cannot give its exact melting point.

(Total for Question 10 is 3 marks)

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Mark scheme · 2.3 Periodic Table: Organisation and Predicting Properties: 30-minute Pack

Question 1

metals are on the left and centre of the table; non-metals are on the right **B1**

Answer: Metals are on the left and centre of the table; non-metals are on the right

Question 2

a group is a vertical column of elements **B1**

elements in the same group have the same number of outer-shell electrons **B1**

Answer: A group is a vertical column; elements in the same group have the same number of outer-shell electrons

Question 3

element V **B1**

V has two outer electrons and is on the metallic side of the period, whereas W has six and is on the non-metal side **B1**

Answer: Element V, because it has two outer electrons and is on the metallic side of the period; W has six and is on the non-metal side.

Question 4

group 5 **B1**

the radius order puts X to the right of group 4 and to the left of group 6, in the intervening column **B1**

Answer: Group 5. Its smaller radius than P places it to the right of group 4, and its larger radius than Q places it to the left of group 6, so it occupies the intervening column.

Question 5

group 1 **B1**

reason: it has 1 outer-shell electron so it is in group 1 **B1**

Answer: Group 1, because it has one electron in its outer shell

Question 6

3 electron shells **B1**

7 electrons in outer shell **B1**

Answer: Three shells; seven electrons in the outer shell

Question 7

states that elements in the same group have the same number of outer-shell electrons **B1**

explains that chemical reactions involve gaining, losing or sharing outer-shell electrons **B1**

links same outer electron number to similar tendencies in electron transfer or sharing **B1**

concludes that this leads to similar chemical properties among group members **B1**

Answer: Elements in a group have the same number of outer electrons. Chemical behaviour depends on how atoms gain, lose or share their outer electrons. If group members have the same valence electron count they tend to form similar ions or bonds. Therefore they display similar chemical properties.

Question 8

metallic prediction supported because group 1, period 3 is on the metallic left side **B1**

conductivity prediction supported because metals typically conduct electricity **B1**

identical melting point prediction not supported because group membership does not mean identical physical properties **B1**

Answer: The metallic prediction is supported: Z is on the metallic left side. The electrical conductor prediction is supported: metals typically conduct electricity. The identical melting point prediction is not supported: group membership does not mean identical physical properties.

Question 9

Level 1 Simple statements linking one or two periodic table features to a general property, limited development. **1-2**

Level 2 Clear explanation using period and group to predict one or two properties, with reference to electron shells and outer electrons, and at least one specific prediction. **3-4**

Level 3 Detailed explanation using period number, group number, electron configuration and table position to predict multiple physical and chemical properties. Uses examples and explains the underlying electronic reasons, showing evaluation or comparison of predictions. **5-6**

Indicative content:

- Period number tells how many electron shells are present and so relates to atomic size and shell-related properties
- Group number tells number of outer-shell electrons and so predicts tendency to lose, gain or share electrons and likely ionic charge for main-group elements
- Position left or right of the staircase indicates metal or non-metal and predicts physical properties such as conductivity, malleability and appearance
- Across a period, atomic radius and metallic character change so elements to the left are more metallic and to the right more non-metallic
- Examples: an element in group 1 will have 1 outer electron and tend to form positive ions and be metallic; an element in period 4 will have four shells and larger atomic radius than period 2 elements
- Use of these predictions to infer likely bonding type, electrical conductivity and reactivity trends without stating specific group reaction details

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Question 10

V is liquid because 20 degrees Celsius is above its melting point and below its boiling point	**B1**
higher melting point, following the increase from -101 degrees Celsius to -7 degrees Celsius down the group	**B1**
the data establish no fixed numerical rule or amount of increase for the next element; allow two points are insufficient to specify an exact next value	**B1**

Answer: V is liquid because 20 degrees Celsius is between -7 degrees Celsius and 59 degrees Celsius. A higher melting point is predicted because the melting point increases down this pair. The exact value cannot be deduced because no fixed size of increase or numerical rule is established.

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