

## ATOMIC STRUCTURE MCQ

### Paper 1

- 1 An element E forms a negative ion,  $E^{2-}$ , with the electronic structure 2,8,8. What is the proton number of E?

A 16  
B 17  
C 18  
D 20

- 2 Deuterium (chemical symbol D) is an isotope of hydrogen. An atom of deuterium contains one neutron.

Which of the following statements is **not** true?

A An atom of deuterium is heavier than an atom of hydrogen.  
B An atom of deuterium has a relative atomic mass of 1.  
C An atom of deuterium has one valence electron.  
D The formula of the compound formed between deuterium and oxygen is  $D_2O$ .

- 3 Three elements, **X**, **Y** and **Z** have consecutive increasing atomic numbers.

If element **Y** is a noble gas, what will be the symbol for the ions formed by elements **X** and **Z** in their compounds?

A  $X^-$  and  $Z^+$   
B  $X^{2-}$  and  $Z^{2+}$   
C  $X^+$  and  $Z^-$   
D  $X^{2+}$  and  $Z^{2-}$

- 4 Potassium has 2 major isotopes. They are  $^{39}K$  and  $^{41}K$ .

If the relative atomic mass of naturally occurring potassium is 39.14, what are the relative abundance of  $^{39}K$  and  $^{41}K$ ?

	$^{39}K$	$^{41}K$
A	7%	93%
B	25%	75%
C	75%	25%
D	93%	7%

5 The table shows the number of neutrons and electrons in the following four particles.

particle	number of neutrons	number of electrons
P	18	8
Q <sup>+</sup>	12	10
R <sup>2-</sup>	16	10
S	13	11

Which particle is an isotope of P?

- A Q<sup>+</sup>
- B R<sup>2-</sup>
- C S
- D none of the above

6 An element X has two isotopes of 16 and 18. Its relative atomic mass is 16.4. Which statement correctly states the proportion of isotope-16 in the sample?

- A 20 %
- B 40 %
- C 60 %
- D 80 %

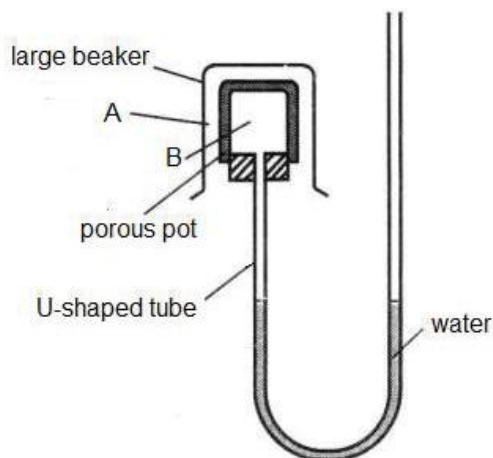
7 Elements X, Y and Z have consecutive, increasing proton numbers.

If element X is a noble gas, what is the symbol for the ion of element Z in its compounds?

- A Z<sup>+</sup>
- B Z<sup>2+</sup>
- C Z<sup>2-</sup>
- D Z<sup>3+</sup>

8 The following diagram shows a set up.

Which pair of gases would cause a fall in the water level at the right side of the U shaped tube?



	Gas A	Gas B
<b>A</b>	Nitrogen dioxide	Chlorine
<b>B</b>	Carbon Monoxide	Nitrogen
<b>C</b>	Oxygen	Neon
<b>D</b>	Fluorine	Argon

9 The table gives data about three different particles.

particle	nucleon number	number of protons	number of neutrons	number of electrons
Xe	131	54	T	54
Se <sup>2-</sup>	79	U	45	36
Be <sup>2+</sup>	9	4	5	V

What are the correct values of T, U and V?

	T	U	V
<b>A</b>	54	36	4
<b>B</b>	54	34	2
<b>C</b>	77	36	4
<b>D</b>	77	34	2

10 The table shows details of the particles present in the following 4 atoms or ions.

atoms/ ions	number of neutrons	number of electrons
J <sup>-</sup>	17	18
K	16	16
L <sup>2+</sup>	20	18
M	20	17

Which of the following atoms is an isotope of J?

- A** K
- B** L
- C** M
- D** None of the above

11 A table listing the atomic numbers of 4 elements P, Q, R and S is given below.

element	P	Q	R	S
atomic Number	5	12	15	18

Using the above information only, it can be deduced that

- A** one atom of Q is heavier than one atom of R.
- B** the number of neutrons in one atom of R is more than that in one atom of Q.
- C** R can be converted into Q by removing three electrons from each atom of R.
- D** Q has a higher tendency to lose electrons than R.

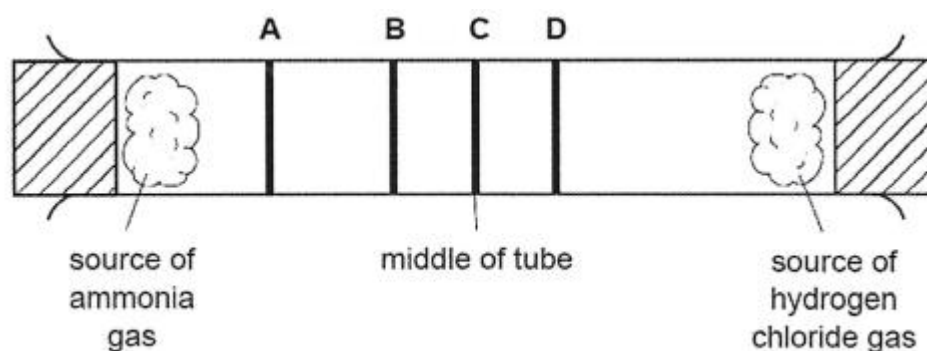
12 The formulae of the ions of some elements are shown below:



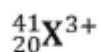
Which of the following statements about these ions is correct?

- A All have stable noble gas configuration
- B All have the same number of electron shells.
- C All have the same number of neutrons in their nuclei.
- D All have more electrons than protons.

13 Ammonia gas and hydrogen chloride gas react to form white solid ammonium chloride. At which position will white ammonium chloride first appear?



14 Symbols representing four particles are shown.

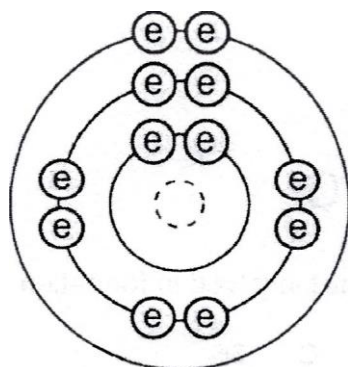


The letters are not the chemical symbols.

Which particles have the same number of electrons?

- A W and  $\text{X}^{3+}$
- B W and Z
- C  $\text{X}^{3+}$  and Z
- D Y and Z

15 The electronic structure of an element is shown below.



key

⊙ electron

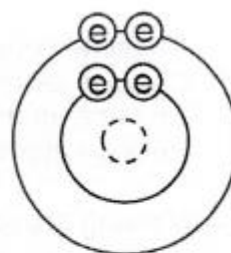
⊖ nucleus

Which diagram shows the electronic structure of another element in the same group in the Periodic Table?

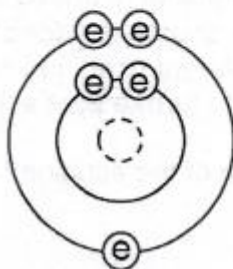
A



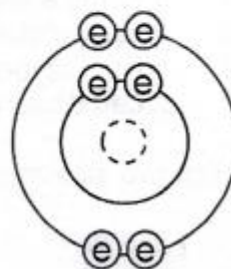
B



C



D



16 The relative atomic mass of chlorine is not a whole number.

Which of the following statements best explains why this is so?

- A Chlorine atoms can have different number of neutrons.
- B Chlorine atoms can have different number of protons.
- C Chlorine atoms are found mixed with atoms of other elements.
- D Relative atomic mass includes the masses of electrons.

17 Which element is made up of atoms with the greatest number of valence electrons?

- A barium
- B fluorine
- C helium
- D rubidium

18 Some properties of elements in the same period of the Periodic Table are listed.

- I charge on the ion
- II number of electrons in the outermost shell
- III number of protons
- IV number of electrons in the inner shells

Moving from left to right across a period, which properties continuously increase?

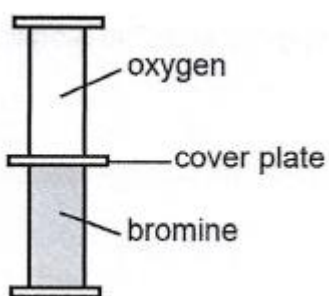
- A I and II
  - B I and III
  - C II and III
  - D II and IV
- 19 Which of the following statements best explains why carbon has a relative atomic mass of 12.01?
- A Different atoms of carbon can have different numbers of neutrons.
  - B Each carbon atom contains 6 protons and 6.01 neutrons.
  - C Impurities are present in the sample of carbon.
  - D The masses of the electrons in each carbon atom have been included.

20 The chemical symbol of an atom of element **Z** may be written as  ${}^3_2\text{Z}$

Which of the following statements is true?

- A Element **Z** exists as discrete atoms in the gaseous state.
- B Element **Z** forms a chloride with the formula  $\text{ZCl}_2$
- C Element **Z** forms an oxide with the formula  $\text{Z}_2\text{O}_3$ .
- D The nucleus of element **Z** contains 3 protons.

- 21 The cover plate is removed from the gas jars shown in the diagram. After several days, the colour of the gas is the same in both jars.



Which statement best explains this change?

- A Bromine gas has a greater relative molecular mass and density than oxygen gas.
- B Equal volumes of oxygen and bromine contain equal numbers of molecules.
- C Oxygen and bromine molecules are in constant, random motion.
- D Oxygen gas diffuses down the jar more quickly than bromine gas diffuses upwards.

**ATOMIC STRUCTURE STRUCTURED QUESTIONS**

**Paper 2**

1 The electronic configurations of five atoms are shown below in Fig. 1.

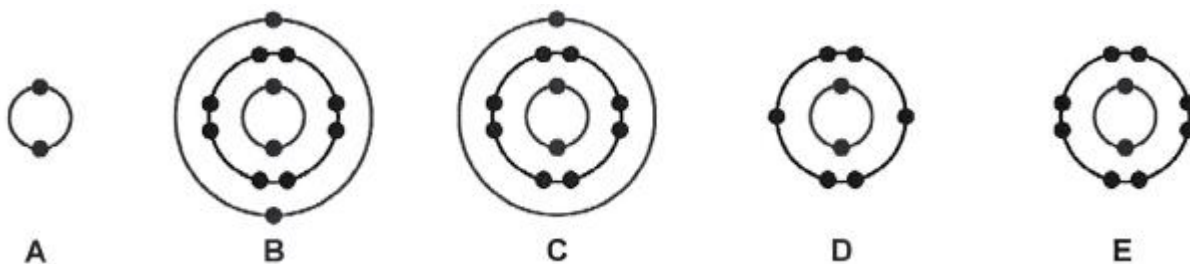


Fig.1

Each electronic configuration may be used once, more than once or not at all.

Which electronic configuration represents

- (a) a sodium atom;  
..... [1]
- (b) an atom of a reactive non-metallic element;  
.....[1]
- (c) an atom with a proton (atomic) number of 12;  
.....[1]
- (d) an atom which forms a noble gas electronic configuration when it gains two electrons?  
..... [1]
- (b) Bromine exists as a mixture of isotopes.

One such isotope, bromine-81 , is represented by the symbol below.



(i) Complete the table below for bromine-81.

Subatomic particles	Number of sub-atomic particles in bromine-81
Protons	
Neutrons	
Electrons	

[1]



**(ii)** Deduce the difference between an atom of bromine-81 and bromine-95, another isotope of bromine.

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

**(iii)** Bromine exists as a diatomic molecule.

Calculate the Mr of such a molecule made from bromine-81.

Mr = .....[1]

[Total: 7 marks]

**2** Bromine is an element which can be found above iodine in the Periodic Table. Showing only the valence electrons, draw a 'dot and cross' diagram of an atom of bromine. [1]

**(b)** Bromine exists as two isotopes, bromine-81 and bromine-79. Explain what is meant by the term isotope. [1]

.....  
.....

**(c)** By making use of the Periodic Table, calculate the relative abundance of each bromine isotope. [1]

3 Use the following information to answer the questions below about the elements **A**, **B**, **C**, **D** and **E**.

substances	atomic number	mass number	electronic structures
<b>A</b>	3	7	2.1
<b>B</b>	18	40	2.8.8
<b>C</b>	8	16	2.6
<b>D</b>	12	24	2.8.2
<b>E</b>	19	39	2.8.8.1

(a) Which element has 22 neutrons in each atom? ..... [1]

(b) Is the bonding between C and E ionic or covalent? ..... [1]

(c) Which element is a noble gas? ..... [1]

(d) Which two elements form ions with the same electronic structure as neon (2.8)? ..... [2]

(e) Which two elements are in the same Group in the Periodic Table of the elements? ..... [2]

4 (a) Draw a 'dot-and-cross' diagram (*showing only valence electrons*) to show the bonding in

(i) sodium fluoride [2]

(ii) fluorine [1]

**(b)** Explain why sodium fluoride has a higher melting point than fluorine. [2]

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## ANSWERS FOR ATOMIC STRUCTURE MCQ

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- 2 Deuterium (chemical symbol D) is an isotope of hydrogen. An atom of deuterium contains one neutron.

Which of the following statements is **not** true?

**A** An atom of deuterium is heavier than an atom of hydrogen.  
**B** An atom of deuterium has a relative atomic mass of 1.  
**C** An atom of deuterium has one valence electron.  
**D** The formula of the compound formed between deuterium and oxygen is  $D_2O$ .

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If element Y is a noble gas, what will be the symbol for the ions formed by elements X and Z in their compounds?

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Which particle is an isotope of P?

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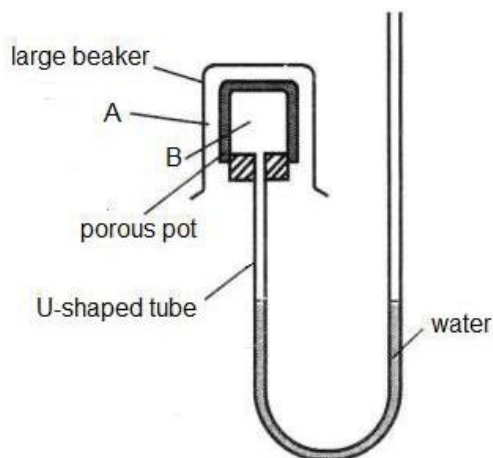
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- 11 A table listing the atomic numbers of 4 elements P, Q, R and S is given below.

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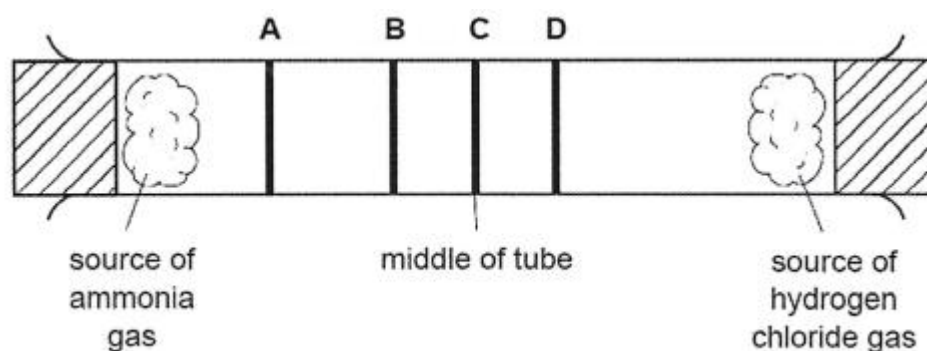
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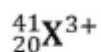
Which of the following statements about these ions is correct?

- A All have stable noble gas configuration
- B All have the same number of electron shells.
- C All have the same number of neutrons in their nuclei.
- D All have more electrons than protons.

13 Ammonia gas and hydrogen chloride gas react to form white solid ammonium chloride.  
At which position will white ammonium chloride first appear? **Answer: D**



14 Symbols representing four particles are shown.

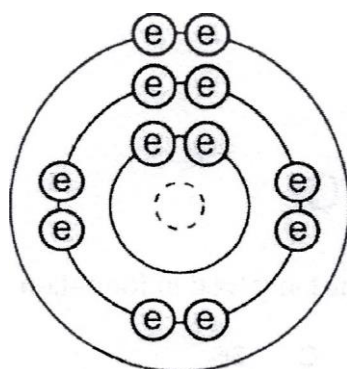


The letters are not the chemical symbols.

Which particles have the same number of electrons?

- A W and  $\text{X}^{3+}$
- B W and Z
- C  $\text{X}^{3+}$  and Z
- D Y and Z

15 The electronic structure of an element is shown below. **Answer: B**



key

⊙ electron

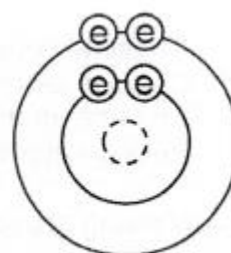
⊖ nucleus

Which diagram shows the electronic structure of another element in the same group in the Periodic Table?

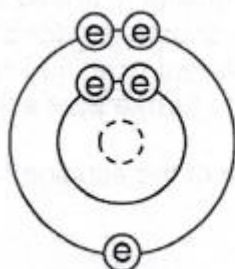
A



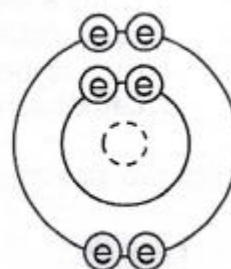
B



C



D



16 The relative atomic mass of chlorine is not a whole number.

Which of the following statements best explains why this is so?

- A** Chlorine atoms can have different number of neutrons.
- B Chlorine atoms can have different number of protons.
- C Chlorine atoms are found mixed with atoms of other elements.
- D Relative atomic mass includes the masses of electrons.

17 Which element is made up of atoms with the greatest number of valence electrons?

- A barium
- B** fluorine
- C helium
- D rubidium



18 Some properties of elements in the same period of the Periodic Table are listed.

- I charge on the ion
- II number of electrons in the outermost shell
- III number of protons
- IV number of electrons in the inner shells

Moving from left to right across a period, which properties continuously increase?

- A I and II
- B I and III
- C II and III
- D II and IV

19 Which of the following statements best explains why carbon has a relative atomic mass of 12.01?

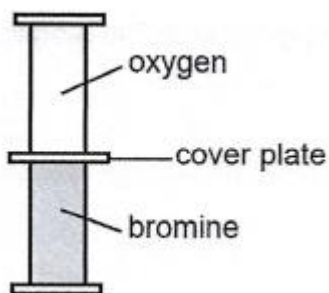
- A Different atoms of carbon can have different numbers of neutrons.
- B Each carbon atom contains 6 protons and 6.01 neutrons.
- C Impurities are present in the sample of carbon.
- D The masses of the electrons in each carbon atom have been included.

20 The chemical symbol of an atom of element **Z** may be written as  ${}^3_2\text{Z}$

Which of the following statements is true?

- A Element **Z** exists as discrete atoms in the gaseous state.
- B Element **Z** forms a chloride with the formula  $\text{ZCl}_2$
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- D The nucleus of element **Z** contains 3 protons.

- 21 The cover plate is removed from the gas jars shown in the diagram. After several days, the colour of the gas is the same in both jars.



Which statement best explains this change?

- A Bromine gas has a greater relative molecular mass and density than oxygen gas.
- B Equal volumes of oxygen and bromine contain equal numbers of molecules.
- C Oxygen and bromine molecules are in constant, random motion.**
- D Oxygen gas diffuses down the jar more quickly than bromine gas diffuses upwards.

## ANSWERS FOR ATOMIC STRUCTURE STRUCTURED QUESTIONS

### Paper 2

- 1 The electronic configurations of five atoms are shown below in Fig. 1.

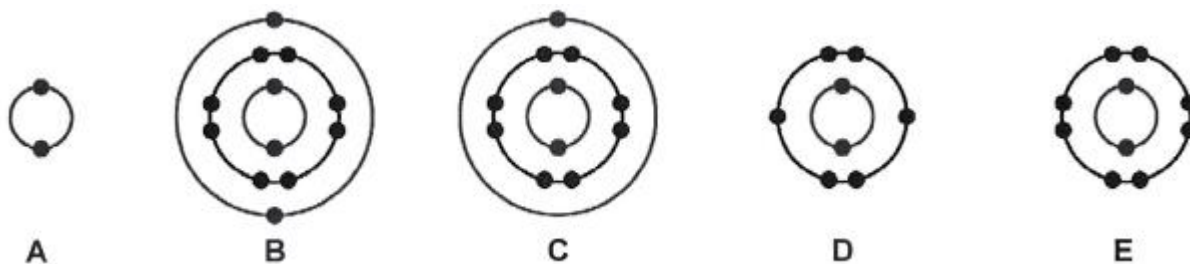


Fig.1

Each electronic configuration may be used once, more than once or not at all.

Which electronic configuration represents

- (a) a sodium atom;

**C** [1]

- (b) an atom of a reactive non-metallic element

**D** [1]

- (c) an atom with a proton (atomic) number of 12;

**B** [1]

- (d) an atom which forms a noble gas electronic configuration when it gains two electrons?

**D** [1]

- (b) Bromine exists as a mixture of isotopes.

One such isotope, bromine-81, is represented by the symbol below.



- (i) Complete the table below for bromine-81.

Subatomic particles	Number of sub-atomic particles in bromine-81
Protons	35
Neutrons	46
Electrons	35

**NOT E: Award [B1· if all three are correct**

[1]

- (ii) Deduce the difference between an atom of bromine-81 and bromine-95, another isotope of bromine.

Bromine-81 has 46 neutrons while bromine-95 has 60 neutrons

OR: Bromine-95 has 14 more n, et .. ns th a. bromine-81

MR: Most candidates were able to give the complete answer, making reference of the correct and specific difference in number of neutrons [1]

- (iii) Bromine exists as a diatomicmolecule.

Calculate the Mr of such a molecule made from bromine-81.

$$\text{Mr} = 2 \times 81 = 162$$

NOTE: Do NOT award [A1] if answer is given with units

MR: One-third of the candidates had erroneous answers as they did not recall that bromine is diatomic [1]

[Total: 7 marks]

- 2 Bromine is an element which can be found above iodine in the Periodic Table. Showing only the valence electrons, draw a 'dot and cross' diagram of an atom of bromine. [1]

Bromine is an element which can be found above iodine in the Periodic Table. Showing only the valence electrons, draw a 'dot and cross' diagram of an atom of bromine



- (b) Bromine exists as two isotopes, bromine-81 and bromine-79. Explain what is meant by the term isotope. [1]

Isotopes are atoms of the same element (bromine) with the same number of proton/ same proton number but different number of neutrons/ nucleon number

- (c) By making use of the Periodic Table, calculate the relative abundance of each bromine isotope. [1]

$$\begin{aligned} \text{Let } x \text{ be the \% abundance of bromine-81} \\ 81x + 79(100 - x) &= 8000 \\ 81x + 7900 - 79x &= 8000 \\ 2x &= 100 \\ x &= 50 \end{aligned}$$

3 Use the following information to answer the questions below about the elements **A**, **B**, **C**, **D** and **E**.

substances	atomic number	mass number	electronic structures
<b>A</b>	3	7	2.1
<b>B</b>	18	40	2.8.8
<b>C</b>	8	16	2.6
<b>D</b>	12	24	2.8.2
<b>E</b>	19	39	2.8.8.1

(a) Which element has 22 neutrons in each atom? ..... **B** ..... [1]

(b) Is the bonding between C and E ionic or covalent? ..... **ionic** ..... [1]

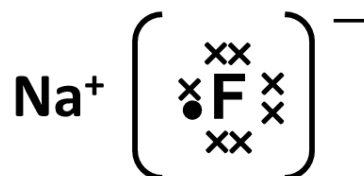
(c) Which element is a noble gas? ..... **B** ..... [1]

(d) Which two elements form ions with the same electronic structure as neon (2.8)? ..... **C and D** ..... [2]

(e) Which two elements are in the same Group in the Periodic Table of the elements? ..... **A and E** ..... [2]

4 (a) Draw a 'dot-and-cross' diagram (*showing only valence electrons*) to show the bonding in

(i) sodium fluoride [2]



Deduct 1 mark for the any of the errors listed (max 2 marks).

1. wrong chemical symbols.
2. wrong number of electrons
3. uses symbols other than dot and cross.
4. lack of brackets for anion

(ii) fluorine [1]



**(b)** Explain why sodium fluoride has a higher melting point than fluorine.

[2]

Sodium fluoride is an ionic compound with strong electrostatic forces of attraction between oppositely charged ions while fluorine is a simple molecule with weak intermolecular forces of attraction between the molecules.

[1]

Greater amount of energy is required to break the strong electrostatic forces of attraction between the ions in sodium fluoride compared with the weak [1] intermolecular forces of attraction between the fluorine molecules..