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# CHEMISTRY

## Edexcel AS & A LEVEL

## Topic Questions

## Paper 1: Advanced Inorganic and Physical Chemistry

**1** Which of the following ions has the biggest radius?

- ☒ **A** $S^{2-}$
- ☒ **B** $Cl^{-}$
- ☒ **C** $K^{+}$
- ☒ **D** $Ca^{2+}$

**(Total for Question = 1 mark)**

**2** The first five successive ionization energies for an element J, in kJ $mol^{-1}$, are

| 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|
| 738 | 1450 | 7733 | 10543 | 13630 |

The formula of the compound of chlorine with element J is

☒ **A** JCl

☒ **B** $JCl_2$

☒ **C** $JCl_3$

☒ **D** $J_2Cl_3$

**(Total for Question = 1 mark)**

**3** Which of the following is the correct order of increasing melting temperature of elements of Period 3?

☒ **A** Na, Mg, Al, Si

☒ **B** Na, Mg, Si, Al

☒ **C** Si, Na, Mg, Al

☒ **D** Si, Al, Mg, Na

**(Total for Question = 1 mark)**

**4** Which one of the following elements undergoes the change in electronic configuration shown when it forms the stated ion?

Atom $1s^2 2s^2 2p^6 3s^2 3p^3$ Ion $1s^2 2s^2 2p^6 3s^2 3p^6$

☒ **A** B to $B^{3+}$

☒ **B** Al to $Al^{3+}$

☒ **C** N to $N^{3-}$

☒ **D** P to $P^{3-}$

**(Total for Question = 1 mark)**

**5** The chemical properties of an element are determined by its

- ☒ **A** electronic structure.
- ☒ **B** number of neutrons.
- ☒ **C** relative atomic mass.
- ☒ **D** number of protons plus neutrons.

**(Total for Question = 1 mark)**

**6** A particle with a **single** positive charge and with the electronic configuration $1s^2\ 2s^2\ 2p^6$ is

- ☒ **A** a sodium ion.
- ☒ **B** a fluoride ion.
- ☒ **C** an oxide ion.
- ☒ **D** a potassium ion.

**(Total for Question = 1 mark)**

**7** In which of the following electronic configurations are only two of the electrons unpaired?

- ☒ **A** $1s^2\ 2s^2$
- ☒ **B** $1s^2\ 2s^2\ 2p^3$
- ☒ **C** $1s^2\ 2s^2\ 2p^4$
- ☒ **D** $1s^2\ 2s^2\ 2p^5$

**(Total for Question = 1 mark)**

**8** Which of the following ions has the **largest** ionic radius?

- ☒ **A** $F^-$
- ☒ **B** $Mg^{2+}$
- ☒ **C** $Na^+$
- ☒ **D** $O^{2-}$

**(Total for Question = 1 mark)**

**9** Which of the following diagrams represents the electrons in the ground state of a boron atom?

| | 1s | 2s | $2p_x$ | $2p_y$ | $2p_z$ |
|---|---|---|---|---|---|
| ☒ **A** | ↑↓ | ↑↓ | ↑ | | |
| ☒ **B** | ↑ | ↑↓ | ↑ | ↑ | |
| ☒ **C** | ↑↓ | ↑ | ↑ | | |
| ☒ **D** | ↑ | ↑ | | | |

**(Total for Question = 1 mark)**

**10** Which of the following species contains the same number of electrons as neutrons?

☒ **A** $^{11}_{5}B$

☒ **B** $^{23}_{11}Na^{+}$

☒ **C** $^{24}_{12}Mg^{2+}$

☒ **D** $^{19}_{9}F^{-}$

**(Total for Question = 1 mark)**

**11** For which of the following pairs of elements does the second have a **higher** 1st ionization energy than the first?

| | First element | Second element |
|---|---|---|
| ☒ **A** | Mg | Al |
| ☒ **B** | N | O |
| ☒ **C** | Ne | Na |
| ☒ **D** | K | Na |

**(Total for Question = 1 mark)**

**12** In which of the following series of elements is there an **increase** in the melting temperatures from left to right?

☒ **A** Na Mg Al

☒ **B** Li Na K

☒ **C** B C N

☒ **D** Si P S

**(Total for Question = 1 mark)**

**13** For barium, the third ionization energy is higher than the second ionization energy because

- ☒ **A** there is an increase in the number of protons.
- ☒ **B** there is an increase in the shielding.
- ☒ **C** the ionic radius is greater.
- ☒ **D** the electron being removed is closer to the nucleus.

**(Total for Question = 1 mark)**

**14** Which pair of ions is isoelectronic?

- ☒ **A** $Ca^{2+}$ and $O^{2-}$
- ☒ **B** $Na^{+}$ and $O^{2-}$
- ☒ **C** $Li^{+}$ and $Cl^{-}$
- ☒ **D** $Mg^{2+}$ and $Cl^{-}$

**(Total for Question = 1 mark)**

**15** The first five ionization energies of an element, **X**, are shown in the table.

| Ionization energy | 1st | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| Value / kJ $mol^{-1}$ | 631 | 1235 | 2389 | 7089 | 8844 |

What is the mostly likely formula of the oxide that forms when **X** burns in oxygen?

- ☒ **A** $X_2O$
- ☒ **B** XO
- ☒ **C** $X_2O_3$
- ☒ **D** $XO_2$

**(Total for Question = 1 mark)**

**16** Which of the following has the largest ionic radius?

- ☒ **A** $S^{2-}$
- ☒ **B** $Cl^{-}$
- ☒ **C** $K^{+}$
- ☒ **D** $Ca^{2+}$

**(Total for Question = 1 mark)**

**17** Which of the following represents a pair of isotopes?

☒ **A** $^{14}_{6}C$ and $^{14}_{7}N$

☒ **B** $^{32}_{16}S$ and $^{32}_{16}S^{2-}$

☒ **C** $O_2$ and $O_3$

☒ **D** $^{206}_{82}Pb$ and $^{208}_{82}Pb$

**(Total for Question = 1 mark)**

**18** Which of the following equations represents the **second** ionization energy of chlorine?

☒ **A** $Cl^+(g) \rightarrow Cl^{2+}(g) + e^-$

☒ **B** $Cl(g) \rightarrow Cl^{2+}(g) + 2e^-$

☒ **C** $Cl(g) \rightarrow Cl^{2-}(g) - 2e^-$

☒ **D** $Cl^-(g) \rightarrow Cl^{2-}(g) - e^-$

**(Total for Question = 1 mark)**

**19** For Period 3 of the Periodic Table, from sodium to argon, what is the trend in the melting temperatures of the elements?

☒ **A** A steady decrease

☒ **B** A steady increase

☒ **C** A decrease to silicon then an increase

☒ **D** An increase to silicon then a decrease

**(Total for Question = 1 mark)**

**20** In which of the following cases would a cation be most polarizing?

| | | Radius | Charge |
|---|---|---|---|
| ☒ | **A** | small | small |
| ☒ | **B** | small | large |
| ☒ | **C** | large | small |
| ☒ | **D** | large | large |

**(Total for Question 1 mark)**

**21** In which of the following series does the melting temperature of the element **increase** from left to right?

☒ **A** Li, Na, K

☒ **B** Al, Si, P

☒ **C** Si, P, S

☒ **D** Na, Mg, Al

**(Total for Question 1 mark)**

**22** If **X** represents the element of atomic number 9 and **Y** the element of atomic number 20, the compound formed between these two elements is

☒ **A** covalent, $\mathbf{YX_2}$.

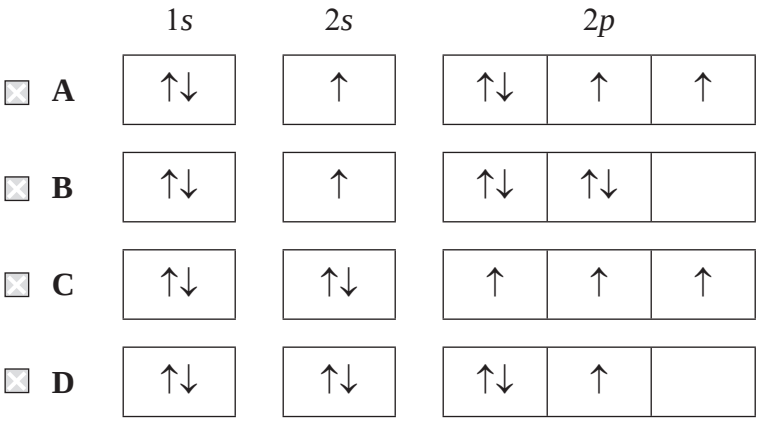
☒ **B** ionic, $\mathbf{YX_2}$.

☒ **C** covalent, **YX**.

☒ **D** ionic, **YX**.

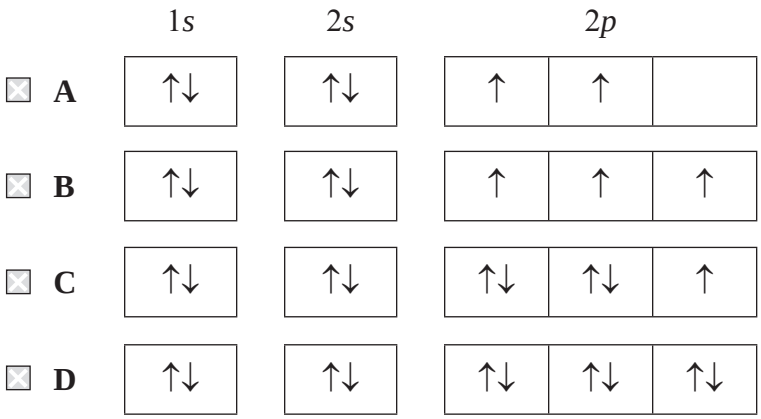
**(Total for Question 1 mark)**

**23** Which of the following represents the electronic structure of a nitrogen atom?



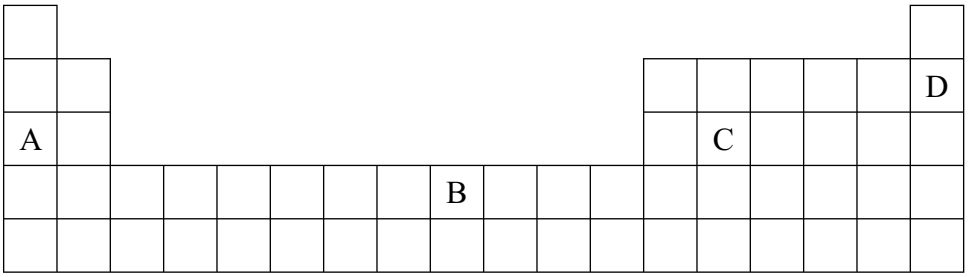

**(Total for Question 1 mark)**

**24** The electronic structures of four elements are given below. Which of these elements has the highest first ionization energy?




**(Total for Question 1 mark)**

**25** In the following outline of the Periodic Table, the letters A to D are **not** the symbols of the elements.




Select from **A to D** the element which

(a) is a non-metal with a high melting temperature and boiling temperature.

**(1)**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) is in the d block of the Periodic Table.

**(1)**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(c) has a very stable electronic structure.

**(1)**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(d) is a metal with a high melting temperature and boiling temperature.

**(1)**

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

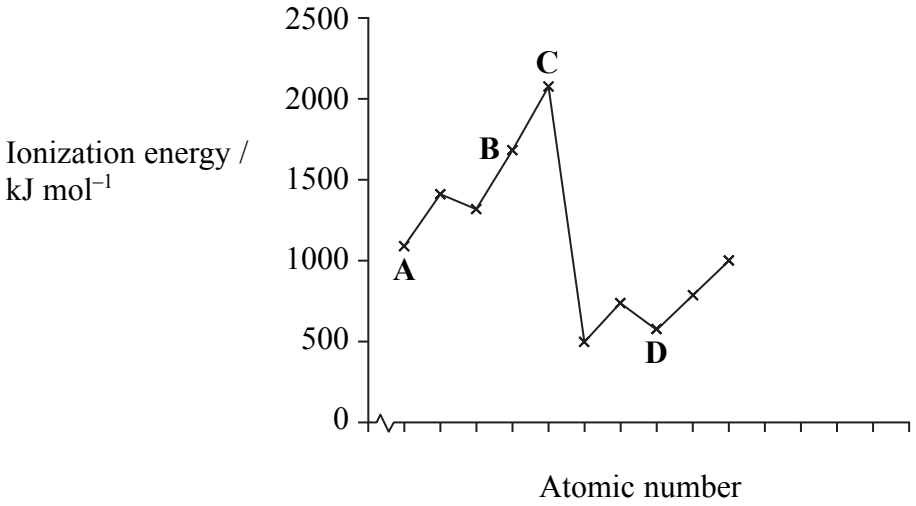
**(Total for Question 4 marks)**

**26** Which of these equations represents the second ionization of magnesium?

- ☒ **A** $Mg^{+}(g) \rightarrow Mg^{2+}(g) + e^{-}$
- ☒ **B** $Mg(g) \rightarrow Mg^{2+}(g) + 2e^{-}$
- ☒ **C** $Mg^{+}(g) + e^{-} \rightarrow Mg^{2+}(g)$
- ☒ **D** $Mg(g) + 2e^{-} \rightarrow Mg^{2+}(g)$

**(Total for Question = 1 mark)**

**27** The sketch graph below shows the trend in first ionization energies for some elements in Periods two and three.




Select, from the elements **A to D**, the one that

(a) has atoms with five p electrons.

**(1)**

- ☐ **A**
- ☐ **B**
- ☐ **C**
- ☐ **D**

(b) is a member of Group 3.

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(c) is likely to be very unreactive.

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(d) normally forms four covalent bonds per atom.

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

**(Total for Question = 4 marks)**