Test Topic 2 Atomic structure Tues 10/24/17

[18 marks]

1. What is the electron configuration of the copper(I) ion, Cu^+? *[1 mark]*

   A. $1s^22s^22p^63s^23p^64s^13d^9$

   B. $1s^22s^22p^63s^23p^64s^23d^8$

   C. $1s^22s^22p^63s^23p^64s^13d^{10}$

   D. $1s^22s^22p^63s^23p^63d^{10}$

Markscheme

D

Examiners report

[N/A]

2. Successive ionization energies for an element, **Z**, are shown in the table below. *[1 mark]*

Electrons removed	1st	2nd	3rd	4th	5th
Ionization energy / kJ mol^{-1}	736	1450	7740	10 500	13 600

   What is the most likely formula for the ion of **Z**?

   A. Z^+

   B. Z^{2+}

   C. Z^{3+}

   D. Z^{4+}

Markscheme

B

Examiners report

[N/A]

3. Which equation represents the second ionization energy of potassium? *[1 mark]*

   A. $K(g) \rightarrow K^{2+}(g) + 2e^-$

   B. $K^+(g) \rightarrow K^{2+}(g) + e^-$

   C. $K(s) \rightarrow K^{2+}(g) + 2e^-$

   D. $K^+(s) \rightarrow K^{2+}(g) + e^-$

Markscheme

B

Examiners report

[N/A]

Iron has three main naturally occurring isotopes which can be investigated using a mass spectrometer.

4. State the full electronic configurations of a Cu atom and a Cu^+ ion. *[2 marks]*

Cu:

Cu^+:

. . . . . .

. . . . . .

. . . . . .

Markscheme

Cu:

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$;

Cu^+:

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$;

Ignore relative order of 3d and 4s.

Penalize only once if noble gas core is given.

Examiners report

Many candidates identified the electronic configuration of Cu as an exception but the 3d electron was often removed in forming the ion instead of the 4s.

5. Between which ionization energies of boron will there be the greatest difference? *[1 mark]*

A. Between 1st and 2nd ionization energies

B. Between 2nd and 3rd ionization energies

C. Between 3rd and 4th ionization energies

D. Between 4th and 5th ionization energies

Markscheme

C

Examiners report

[N/A]

6. What is the correct number of each particle in an oxygen ion, $^{18}O^{2-}$? *[1 mark]*

	Protons	Neutrons	Electrons
A.	8	8	10
B.	8	10	8
C.	8	8	6
D.	8	10	10

Markscheme

D

Examiners report

Two respondents commented on “oxygen ion” rather than “oxide ion”. The former was chosen when the paper was set to draw attention to the particular nature of the isotope in question.

7. Which subatomic particles are located in the nucleus of an atom? *[1 mark]*

A. Protons and electrons

B. Neutrons and electrons

C. Protons and neutrons

D. Protons, neutrons and electrons

Markscheme

C

Examiners report

[N/A]

^{131}I is a radioactive isotope of iodine.

8a. Define the term *isotope*. *[1 mark]*

. . . . . .

. . . . . .

. . . . . .

Markscheme

atoms which have same atomic number but different mass number / atoms of the same element which have different numbers of neutrons / atoms with the same number of protons but different numbers of neutrons / atom of an element with a fixed number of protons but a number of neutrons which can be variable;

Examiners report

In (a)(i), the word *atoms* was frequently omitted from the definition; it is accepted that it would have been preferable to ask for the definition of *isotopes of an element* as specified in the syllabus.

8b. Determine the number of neutrons in one atom of iodine-131. *[1 mark]*

. . . . . .

. . . . . .

. . . . . .

Markscheme

78;

Examiners report

The answer in (ii) was generally correct.

9. Consider the relative abundance of the isotopes of element X. *[1 mark]*

Isotope	Relative abundance (%)
^{24}X	80
^{25}X	10
^{26}X	10

What is the relative atomic mass of X?

A. 24

B. 25

C. Between 24 and 25

D. Between 25 and 26

Markscheme

C

Examiners report

[N/A]

10. The full electron configuration of an element is: *[1 mark]*

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

To which group and period does the element belong?

	Group	Period
A.	2	3
B.	3	2
C.	3	4
D.	14	3

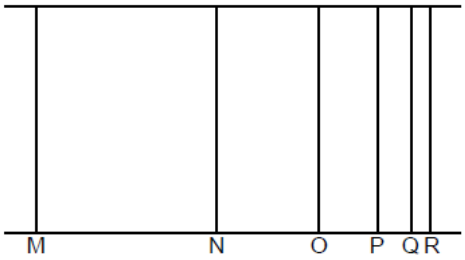
Markscheme

D

Examiners report

[N/A]

11. Which is correct for the line emission spectrum for hydrogen? *[1 mark]*



A. Line M has a higher energy than line N.
B. Line N has a lower frequency than line M.
C. Line M has a longer wavelength than line N.
D. Lines converge at lower energy.

Markscheme

C

Examiners report

[N/A]

12. Which electron configuration is correct for the selenide ion, Se^{2-}? *[1 mark]*

A. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4d^{10}\ 4p^4$

B. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 4d^{10}\ 4p^6$

C. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$

D. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$

Markscheme

D

Examiners report

[N/A]

13. Which species have the same electron arrangements? *[1 mark]*

I. O^{2-}, F^{-}, Ne

II. Li^{+}, Na^{+}, K^{+}

III. S^{2-}, Ar, K^{+}

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

B

Examiners report

[N/A]

14. How many protons, neutrons and electrons are present in each atom of ^{31}P? *[1 mark]*

	Protons	Neutrons	Electrons
A.	16	15	16
B.	15	16	15
C.	15	31	15
D.	16	31	16

Markscheme

B

Examiners report

[N/A]

15. What is the atomic number of a neutral atom which has 51 neutrons and 40 electrons? *[1 mark]*

A. 40

B. 51

C. 91

D. 131

Markscheme

A

Examiners report

Though this did not affect the correct answer, this question wrongly gave the number of neutrons, rather than the mass number, as 91. The lack of blank responses, the high difficulty index of 75% (remember the higher the number the more accessible the question) and the discrimination index of 0.40 all indicate that this error did not affect the validity of the question.

16. The table below shows the number of protons, neutrons and electrons present in five species. *[1 mark]*

Species	Number of protons	Number of neutrons	Number of electrons
X	6	8	6
Y	7	7	7
Z	7	7	8
W	8	8	8
Q	8	10	8

Which **two** species are isotopes of the same element?

A. X and W

B. Y and Z

C. Z and W

D. W and Q

Markscheme

D

Examiners report

[N/A]