Cambridge Assessment International Education

Interactive

Interactive Example Candidate Responses
Paper 22 (May/June 2016), Question 1

Cambridge International AS & A Level Chemistry 9701

Version 1.0

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Select page

HIGH | MIDDLE | LOW

1 (a) Complete the table to show the composition and identity of some atoms and ions.

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge
boron	10	4	4	6	4	0
nitrogen	15	7	7	8	10	-3
lead	208	82	82	126	80	+2
Lithium	6	3	3	3	2	+1

[4]

(b) The fifth to eighth ionisation energies of three elements in the third period of the Periodic Table are given. The symbols used for reference are **not** the actual symbols of the elements.

	ionisation energies, kJ mol^{-1}			
	fifth	sixth	seventh	eighth
X	7012	8496	27107	31671
Y	6542	9362	11018	33608
Z	7238	8781	11996	13842

(i) State and explain the group number of element Y.

group number 7

explanation There is a large difference between the seventh and eighth ionization energy as compared to others. [1]

(ii) State and explain the general trend in **first** ionisation energies across the third period.

Ionization energy increases along the period because the nuclear charge increases whereas the shielding effect remains same. So, attraction between nucleus and outer electrons increases. [2]

(iii) Complete the electronic configuration of element X.

$1s^2$ $2s^2$, $2p^6$, $3s^2$, $3p^6$ [1]

16

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(c)(i) ☐

1(c)(ii) ☐

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7
AND
big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]
due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]
[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 – 99.76 – 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]
[2]

[Total: 11]

EXAMINER COMMENTS | MARK SCHEME

Select page

HIGH | MIDDLE | LOW

(c) A sample of oxygen exists as a mixture of three isotopes. Information about two of these isotopes is given in the table.

mass number	16	17
abundance	99.76%	0.04%

0.2.

(i) Calculate the abundance of the third isotope.

100 − (99.76 + 0.04)

= 0.2 %

abundance = ..0.2.. % [1]

(ii) The relative atomic mass of this sample of oxygen is 16.0044.

Calculate the mass number of the third isotope. You **must** show your working.

$\frac{(16 \times 99.76) + (17 \times 0.04) + (0.2x)}{100} = 16.0044$

1596.84 + 0.2x = 1600.44

0.2x = 3.6

$x = \frac{3.6}{0.2} = 18$

mass number = ..18.. [2]

[Total: 11]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(c)(i) ☐

1(c)(ii) ☐

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7

AND

big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]

due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]

[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 − 99.76 − 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]

[2]

[Total: 11]

EXAMINER COMMENTS | MARK SCHEME

Select page

HIGH | MIDDLE | LOW

1 **(a)** Complete the table to show the composition and identity of some atoms and ions.

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge
boron	10	4	54	56	4	0
nitrogen	14	7	7	8	10	-3
lead	208	82	82	126	80	+2
lithium	6	3	3	3	2	+1

[4]

(b) The fifth to eighth ionisation energies of three elements in the third period of the Periodic Table are given. The symbols used for reference are **not** the actual symbols of the elements.

	ionisation energies, kJ mol^{-1}			
	fifth	sixth	seventh	eighth
X	7012	8496	27 107	31 671
Y	6542	9362	11 018	33 606
Z	7238	8781	11 996	13 842

(i) State and explain the group number of element **Y**.

group number 53 VII

explanation The fifth, sixth, seventh ionisation energies increase steady but the eigth has big energy gap. [1]

(ii) State and explain the general trend in **first** ionisation energies across the third period.

There is a general increase in ionisation energies. This is because nuclear charge increases, number of protons increase so force of attraction increases making it hard to remove electron. [2]

(iii) Complete the electronic configuration of element **X**.

$1s^2$ $2s^2$ $2p^4$ [1]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(c)(i) ☐

1(c)(ii) ☐

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7
AND
big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]
due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]
[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 – 99.76 – 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]
[2]

[Total: 11]

EXAMINER COMMENTS | MARK SCHEME

Select page

HIGH | MIDDLE | LOW

(c) A sample of oxygen exists as a mixture of three isotopes. Information about two of these isotopes is given in the table.

mass number	16	17
abundance	99.76%	0.04%

(i) Calculate the abundance of the third isotope.

100 − (99.76 + 0.04)

abundance = 0.2 8 % [1]

(ii) The relative atomic mass of this sample of oxygen is 16.0044.

Calculate the mass number of the third isotope. You **must** show your working.

$\frac{(16 \times 99.76) + (17 \times 0.04) + (0.28x)}{100} = 16.0044$

$\frac{(16 \times 99.76) + (17 \times 0.04) + (0.28x)}{100} = 16.0044$

$1596.84 + 0.28x = 1600.44$

$0.28x = 3.6$

$x = 12.86$

mass number = 12.86 [2]

[Total: 11]

Your Mark

1(a)

1(b)(i)

1(b)(ii)

1(b)(iii)

1(c)(i)

1(c)(ii)

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7

AND

big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]

due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]

[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 − 99.76 − 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]

[2]

[Total: 11]

EXAMINER COMMENTS

MARK SCHEME

Select page

HIGH | MIDDLE | LOW

Answer **all** the questions in the spaces provided.

1 **(a)** Complete the table to show the composition and identity of some atoms and ions.

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge
boron	10	4	4	6	4	0
nitrogen	14	7	7	8	10	-3
lead	208	82	82	126	80	+2
lithium	7	3	3	3	2	+1

[4]

(b) The fifth to eighth ionisation energies of three elements in the third period of the Periodic Table are given. The symbols used for reference are **not** the actual symbols of the elements.

	ionisation energies, kJ mol^{-1}			
	fifth	sixth	seventh	eighth
X	7012	8496	27 107	31 671
Y	6542	9362	11 018	33 606
Z	7238	8781	11 996	13 842

(i) State and explain the group number of element **Y**.

group number 6th or sixth

explanation There is huge change in ionisation energy which tell us that there are six valence electron. [1]

(ii) State and explain the general trend in **first** ionisation energies across the third period.

Across the third period the ionisation energy increases because of same atomic radius and the nuclear charges increase due to more number of proton [2]

(iii) Complete the electronic configuration of element **X**.

1s^2 2s^2 2p^6 3s^1 3p^6 4d^5 4s^1 [1]

Your Mark

1(a) ☐

1(b)(i) ☐

1(b)(ii) ☐

1(b)(iii) ☐

1(c)(i) ☐

1(c)(ii) ☐

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7
AND
big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]
due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]
[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 – 99.76 – 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]
[2]

[Total: 11]

EXAMINER COMMENTS

MARK SCHEME

Select page

HIGH | MIDDLE | LOW

(c) A sample of oxygen exists as a mixture of three isotopes. Information about two of these isotopes is given in the table.

mass number	16	17
abundance	99.76%	0.04%

(i) Calculate the abundance of the third isotope.

Total = 100 %

So, = 100 − 99.76 − 0.04

= 0.20

abundance = ..0.20.. % [1]

(ii) The relative atomic mass of this sample of oxygen is 16.0044.

Calculate the mass number of the third isotope. You **must** show your working.

$16.0044 = \frac{16 \times 99.76 + 0.04 \times 17 + 0.2 \times n}{100}$

$1600.44 = 1596.84 + 0.2n$

$3.6 = 0.2n$

$\frac{3.6}{0.2} = n$

mass number = ..18.0.. [2]

[Total: 11]

Your Mark

1(a)

1(b)(i)

1(b)(ii)

1(b)(iii)

1(c)(i)

1(c)(ii)

Q1 Mark scheme

(a)(i)

name of element	nucleon number	atomic number	number of protons	number of neutrons	number of electrons	overall charge	
boron	10	5	5	5	5	0	[1]
nitrogen	15	7	7	8	10	-3	[1]
lead	208	82	82	126	80	+2	[1]
lithium	6	3	3	3	2	+1	[1]

[4]

(a)(ii) Group 17 / VII / 7

AND

big (owtte) increase / big difference / big gap / big jump / jump in increase / jump in difference after 7th IE **[1]**

(b) increases across period due to increasing attraction (of nucleus for electrons) [1]

due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1]

[2]

(c) $1s^2 2s^2 2p^6 3s^2 3p^4$ **[1]**

(100 − 99.76 − 0.04=) 0.2 **[1]**

$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$ [1]

x = 18 [1]

[2]

[Total: 11]

EXAMINER COMMENTS

MARK SCHEME

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