



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

Cambridge International AS & A Level Chemistry 9701



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(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	<u>+2</u>
Lithium			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	33606					
z	7238	8781	11996	13842					

 State and explain the group number of element Y. 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. (iii) State and explain the general trend in institution energies across the till period Jonization energy increases along The period because the nuclear charge increases whereas The shielding effect remains same. So, attraction between nucleus and outre electrons (iii) complete the electronic configuration of element x.

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

Your Mark	Q1	Mark s	cheme						
1(a)	(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]
1(b)(i)		lithium	6	3	3	3	2	+1	[1]
									[4]
	(a)(ii)	Group 17 AND	/ VII / 7						
1(b)(ii) big (owtte) increase / big difference / big gap / big jump / jum increase / jump in difference after 7th IE							ump in	[1]	
	(b)	increases electrons		eriod due	e to increa	ising attrac	ction (of nu	cleus fo	r [1]
							on number / energy le		[1]
									[2]
1(b)(iii)	(C)	1s ² 2s ² 2p ⁶	³ 3s ² 3p ⁴						[1]
		(100 – 99	9.76 – 0.0	4=) 0.2					[1]
		0.2x + (9)	9.76 × 16 100		× 17) = 16	5.0044			[1]
		x = 18	100)					[1]
1(c)(i)									[2]
								[Total	: 11]

1(c)(ii)

16

(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.

(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.

 $\frac{(16 \times 99.76) + (17 \times 0.04) + (0.2x)}{100} = 16.0044$ 159684+0-2x=1600.44 é

0.2x=3.6 x=3.6=18

[Total: 11]

Your **Q1** Mark scheme Mark (a)(i) name of nucleon number atomic number number overall 1(a) element number number of of of charge protons neutrons electrons [1] boron 10 5 5 5 nitroger 15 7 7 10 -3 [1] 8 208 82 126 80 +2 lead 82 [1] lithium 6 3 3 2 +1[1] 1(b)(i) [4] Group 17 / VII / 7 (a)(ii) AND big (owtte) increase / big difference / big gap / big jump / jump in 1(b)(ii) increase / jump in difference after 7th IE [1] increases across period due to increasing attraction (of nucleus for (b) electrons) [1] due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level [1] [2] 1(b)(iii) [1] (c) 1s²2s²2p⁶3s²3p⁴ (100 - 99.76 - 0.04 =) 0.2[1] $0.2x + (99.76 \times 16) + (0.04 \times 17) = 16.0044$ [1] 100 [1] x = 18 1(c)(i) [2] [Total: 11] 1(c)(ii)

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[4]



	name of element	nucleon number	atomic number	number of protons	number.of neutrons	number of electrons	overall charge
7	boron	10	4	\$4	5.6	· _ 4	. 0
	nitrogen	14	7		8	10	-3
	lead	208	82	82	12.6	80	+2
ſ	lithium	6	3	3	3	2	+1

(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.

]			
		fifth	sixth	seventh	eighth	
Ö.	х	7012	8496	27 107	31671) ()
	Y	6542	9362	11018	33606	-
	z	7238	8781	11 996	13842	

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

group number 3 VII

explanation The fifth sinth, seventh ionisation energies increase steady but the eight has big energy gap.

- (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 change increases, number of pertons increase so force of attraction increases making it hand to remove electron. [2]
- (iii) Complete the electronic configuration of element X.
 - 1s² .2,5² 2,ρ⁴ [1]

-	our ark	Q1	Mark s	cheme							
1(a)		(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]	
(b)(i)			lead	208	82	82	126	80	+2	[1]	
			lithium	6	3	3	3	2	+1	[1]	
(b)(ii)										[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								
b)(iii)		(b)	increases across period due to increasing attraction (of nucleus for electrons) due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level								
		(c)	1s ² 2s ² 2p ⁶	⁶ 3s ² 3p ⁴						[2] [1]	
1(c)(i)			(100 – 99	9.76 – 0.0	4=) 0.2					[1]	
			0.2x + (9			× 17) = 16	6.0044			[1]	
			x = 18	100)					[1]	
									[Total	[2] : 11]	
(c)(ii)			1						-	_	

OM

(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)

. .

(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.

$$\frac{(16 \times 99.76)_{+} (17 \times 0.04)_{+} (0.282)_{+}}{100} = 16.0044$$

$$\frac{(16 \times 99.76)_{+} (17 \times 0.04)_{+} (0.282)_{-}}{100} = 16.0044$$

$$\frac{100}{100}$$

$$1596.84_{+} = 0.282_{-} = 1600.44$$

$$0.282_{-} = 3.6$$

$$24 = 12.86$$
(Totai: 11]

[2]

.

.

.

Your Mark	Q1	Mark s	cheme						
1(a)	(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]
1(b)(i)		lead	208	82	82	126	80	+2	[1]
		lithium	6	3	3	3	2	+1	[1]
1(b)(ii)									[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							
	(b)	increases across period due to increasing attraction (of nucleus for electrons)							r [1]
1(b)(iii)		due to increasing nuclear charge / atomic / proton number AND constant / similar shielding / same (outer) shell / energy level							
	(c)	1s ² 2s ² 2p ⁶	³ 3s ² 3p ⁴						[1]
1(c)(i)		(100 – 99	9.76 – 0.0	4=) 0.2					[1]
		<u>0.2x + (9</u>	9.76 × 16 100		× 17) = 16	6.0044			[1]
		x = 18	100)					[1]
									[2]
								[Total	: 11]

1(c)(ii)

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Answer all the questions in the spaces provided.

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

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

(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	11018	33 606				
z	7238	8781	11 996	13842				

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

group number 6th or sixth explanation There is huge change in ionisation energy which lell us that there are six valence dectron

(ii) State and explain the general trend in first ionisation energies across the third period.
 Across the third period the ionisation energy increases
 because g came about radius and the nuclear charges increase due to more number g pathn [2]
 (iii) Complete the electronic configuration of element X.

182 252 206 351 306 4d5 4d1 [1]

Your									
Mark	Q1	Mark s	cheme						
1(a)	(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]
1(b)(i)	(a)(ii)	Group 17 AND	/ VII / 7						
				e / big dif difference			ig jump / ji	ump in	[1]
1(b)(ii)	(b)	increases electrons		eriod due	to increa	ising attrac	tion (of nu	cleus fo	r [1]
							on number		[4]
		constant	/ Similar s	snielaing /	same (or	uter) shell,	/ energy le	vei	[1] [2]
	()	1 20 20 6	30 20 4						_
	(c)	1s ² 2s ² 2p ⁶	'3s²3p⁺						[1]
		(100 – 99	9.76 – 0.0	4=) 0.2					[1]
		0.2x + (9) + (0.04 :	× 17) = 16	6.0044			[1]
1(b)(iii)		x = 18	100)					[1]
									[2]
								[Total	
1(c)(i)								[
1(c)(ii)									

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[4]

(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.

$$T_{0} hol = 160 \%$$
So, = 360 - 99.76 - 0.04
= 0.20 abundance =0..29......% [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.

$$I_{0}^{0} - 0.044 = \frac{16 \times 99.76 + 0.04 \times 17 + 0.20 \times 21}{100}$$

$$I_{0}^{0} - 1596.84 + 0.20 \times 100$$

$$I_{0}^{0} - 150 \times 100$$

[Total: 11]

$$\frac{3.6}{0.2} = \mathcal{N}$$

Mark	Q1	Mark s	cheme						
1(a)	(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]
1(b)(i)	(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							
1(b)(ii)	(b)	increases across period due to increasing attraction (of nucleus for electrons)							
		due to increasing nuclear charge / atomic / proton number ANI constant / similar shielding / same (outer) shell / energy level							[1
		Constant / Similar Simerany / Same (outer) Sheir / energy level							
	(c)	1s ² 2s ² 2p ⁶	⁸ 3s²3p ⁴						[2 [1
		(100 - 99.76 - 0.04=) 0.2							[1
		$\frac{0.2x + (99.76 \times 16) + (0.04 \times 17)}{100} = 16.0044$							[1
1(b)(iii)		x = 18	100)					[1
									[2
								[Total	: 11
1(c)(i)									

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