ATOMS, ELECTRON STRUCTURE AND PERIODICITY TEST MS

1.

isotope	protons	neutrons	electrons	
^{12}C	6	6	6	
^{13}C	6	7	6	

[2]

2. (i) (atoms of the) same element **OR** same atomic no.
OR no. of protons

AND

with different numbers of neutrons **OR** different masses

IGNORE *'same number of electrons'*

DO NOT ALLOW *'different numbers of electrons'*

DO NOT ALLOW *'different relative atomic masses'*

DO NOT ALLOW *'elements with different numbers of neutrons'* ***without*** *mention of same protons* ***OR*** *same atomic number*

1

(ii) **same** (number of) **electrons** (in the outer shell)

OR

same **electron** configuration **OR** structure

DO NOT ALLOW *different number of protons*

IGNORE *'same number of protons'*

IGNORE *'they are both carbon'* ***OR*** *'they are both the same element'*

1

(iii) **mass** of the isotope compared to 1/12th
OR
mass of the atom compared to 1/12th

(the mass of a) carbon-12 **OR** ^{12}C (atom)

IGNORE *reference to average* ***OR*** *weighted mean*
(i.e. correct definition of relative atomic mass will score both marks)

ALLOW *mass of a* ***mole*** *of the isotope/atom with 1/12th the mass of a* ***mole OR*** *12 g of carbon –12*

ALLOW 2 marks for:
*'****mass*** *of the isotope* ***OR mass*** *of the atom compared to* ^{12}C *atom given a mass of 12.0'*
i.e. 'given a mass of 12' communicates the same idea as 1/12th.'

ALLOW *12C* ***OR*** *C12*

ALLOW FOR 2 MARKS:

i.e. fraction is equivalent to 'compared to'

ALLOW 1 MARK FOR *a mix of mass of atom and mass*

of mole of atoms, ***i.e.:***
'mass of the isotope/mass of an atom compared with 1/12th the mass of a ***mole OR*** *12 g of carbon –12.'*

2

[4]

3. (i) mass of an isotope compared with carbon-12
1/12th of mass of carbon-12/on a scale where carbon-12 is 12 2

mass of 1 mole of the isotope/mass of 1 mole of carbon-12 is equivalent to the first mark
"mass of the isotope that contains the same number of atoms as are in 1 mole of carbon-12" $\rightarrow$ *1 mark (mark lost because of mass units)*

(iii) $12 \times 95/100 + 13 \times 5/100$ OR 12.05
= 12.1 (mark for significant figures)
(12.1 scores both marks) 2

[4]

4. (i)

		protons	neutrons	electrons
^{25}Mg	12	13	12	
^{26}Mg	12	14	12	2

(ii) $1s^2 2s^2 2p^6 3s^2$

$24 \times 78.60/100 + 25 \times 10.11/100 + 26 \times 11.29/100$ 1

(iii) = 24.33 (calc value: 24.3269. This scores one mark)
24.32 with no working, award 1 mark only.
24.3 with no working, no marks (Periodic Table value) 2

[5]

5. (i) $1s^2 2s^2 2p^6 3s^2 3p^6 .....3d^{10} 4s^2 4p^5$ 2

Award 1 mark for p^5.

(ii) Highest energy sub-shell/sub-shell/being filled is the p sub-shell/outer electrons are in a p (sub-shell/orbital/shell) 1

[3]

6. (i) number of protons (in the nucleus)

ALLOW *proton number*
ALLOW *number of protons in an atom*
IGNORE *reference to electrons*

1

(ii) $(1s^2)2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$

ALLOW *$1s^2$ written twice*
ALLOW *subscripts*
ALLOW *$4s^2$ before $3d^{2+}$*

1

(iii) Mn / manganese **and** d

ALLOW *D*

1

[3]

7. (i) $Ca^+(g) \rightarrow Ca^{2+}(g) + e^-$
Equation with correct charges and 1 electron lost
state symbols
'−' not required on 'e' 2

(ii) same number of protons or same nuclear charge attracting
less electrons/
electron removed from an ion/
less electron-electron repulsion (**not** less shielding)/
ion is smaller 1

(iii) atomic radii of Sr > atomic radii of Ca/
Sr has electrons in shell further from nucleus than Ca/
Sr has electrons in a higher energy level/
Sr has more shells
Therefore less attraction
Sr has **more** shielding than Ca
(***'more'*** *is essential*) 3

increased nuclear charge is outweighed / despite increased nuclear charge …..by at least one of the factors above

[6]

8. (i) atomic radii decrease /similar shielding /electrons added to same shell **(1)**
number of protons in the nucleus increases **(1)**
nuclear attraction increases **(1)** 3

(ii) $Na^{2+}(g) \rightarrow Na^{3+}(g) + e^-$: equation and state symbols **(1)** 1

(iii) large jump (in energy) between the 4th and 5th ionisation energies **(1)**
four electrons in outer shell so element is Si **(1)** 2

[6]

9. (i) Energy change when each atom in 1 mole of gaseous atoms
loses an electron (to form 1 mole of gaseous 1+ ions). 3

(ii) increasing nuclear charge/number of protons
electrons experience greater attraction or *pull* / atomic radius decreases / electrons added to same shell /same or similar shielding 2

(iii) In B, electron being removed is at a higher energy /
In Be, electron being removed is at a lower energy

An s electron is lost in Be AND a p electron is lost in B 2

[7]

10. (i) They have different numbers of protons/
Ba has one more proton/Ba has 56 p^+; Cs has 55 p^+ 1
(ignore electrons: any mention of 'neutrons' is wrong)

(ii) s 1

(iii) Cs to Ba: nuclear charge increases/more protons
electrons are in: the same shell/sub-shell/orbital
/similar shielding/same shielding 3
attraction increases/pull increases …….ORA

(iv) smaller 2
shell has been lost/less shielding/less electron repulsion/proton : electron ratio larger
mark separately

[7]