Answers to practice exam questions for Chapter 5 Atoms

Question 1

a [Ar] $3d^3\ 4s^2$ **or** $1s^2\ 2s^2\ 3s^2\ 3p^6\ 3d^3\ 4s^2$ A

b +5 A
Vanadium can lose or share all 5 valence (outer shell) electrons. M

c Vanadium sometimes only loses the two 4s electrons.
A = loses 2 electrons, M = mentions which 2

d **i** Forms (various) coloured species. (**NOT: Has different colours.)**
ii Has different oxidation states (commonly forms +2 ions).
A = one correct, M = both correct

Question 2

a **i** S^{2-} has the larger radius. A
The addition of 2 electrons to the valence shell results in increased repulsion between the electrons and decreased attraction between nucleus and valence electrons. M

ii S^{2-} has the larger radius. A
The additional shell of electrons is further from the nucleus. M

b Cl has the larger ionisation energy. A
Chlorine has an extra electron which goes into the same shell, but it also has an extra proton giving it a greater effective nuclear charge, and hence a stronger electrostatic attraction has to be overcome. M

Question 3

a **i** P/S/Cl/Si
ii Br
iii Mn/Cl/Br
iv Cr/Cu
v F
vi P/As/Mn/V
A = 3 correct, M = 5 correct

b **i** $1s^2 2s^2 2p^6 3s^2 3p^3$ **or** $[Ne]3s^2 3p^3$
ii $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ **or** $[Ar]3d^{10}$
A = 1 correct, M =2 correct

c **i** $Mg(g) \rightarrow Mg(g) + e^-$
A = correct, but no state symbols, M = correct

ii endothermic A

d **i** C A
ii B A

iii The outer electrons go into the same shell, but the nuclear charge increases as the number of protons increases. Hence, the attraction for the electrons increases and they are pulled in closer, making the radius smaller.
A = one correct point, M = both points mentioned

e **i** The unpaired d electrons absorb light (energy in the visible region of the electromagnetic spectrum) as they move between orbitals. This makes the compound coloured.
A = absorbs light, M = linked to unpaired d electrons

ii Various numbers of the s and d electrons can be lost. A