Marks

- Reaction of nitrogen-14 with a neutron forms two products, one of which is carbon-14. Radiocarbon dating involves the carbon-14 isotope which undergoes β-decay (emission of an electron from the nucleus). Write the two nuclear equations that illustrate the formation and decay of carbon-14. **2**

^{14}C formation:

^{14}C decay:

- Complete the following table. **3**

Orbital	Principal quantum number, *n*	Angular momentum quantum number, *l*	Number of spherical nodes	Number of planar nodes
4*s*				0
			1	1
	3			2

- It requires 151 kJ mol^{-1} to break the bond in I_2. What is the minimum wavelength of light needed to break this bond? Give your answer in nm. **2**

Answer:

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

- Calculate the wavelength of light (in nm) emitted when an electron moves from the $n = 4$ to $n = 2$ energy levels in a hydrogen atom. **3**

Answer:

What is the energy of this radiation (in kJ mol^{-1})?

Answer:

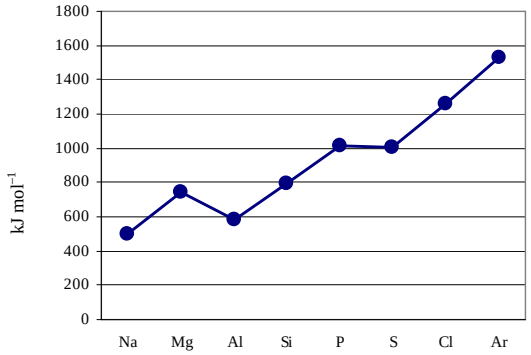
- Like most medicines, the platinum complex, cisplatin, *cis*-$[PtCl_2(NH_3)_2]$, is both effective and toxic. What is cisplatin used to treat? **4**

What does the cisplatin react with in the body to cause most of the toxicity?

Draw a graph showing the relationship between overall health and the level of platinum in the body of a healthy person.

Marks 3

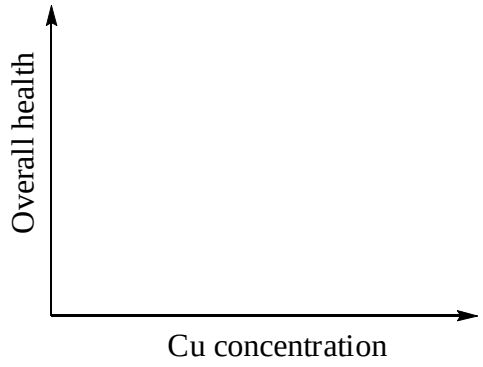
- The diagram below shows the general trend for the first ionisation energy for some *s* and *p* block elements.



How will the general trend differ for the second ionisation energy of these elements (*i.e.* $X^{+}(g) \rightarrow X^{2+}(g) + e^{-}$)? Explain.

- Copper is an essential element in human biology, deficiencies leading to blood disorders. Excess copper can occur in cases of poisoning or in Wilson's disease. Draw a graph showing the relationship between overall health and the level of copper in the body and identify the 'healthy' range.

4



Describe one biological function of copper.

Suggest one approach for treating an excess level of copper.

- Indicate a biological function for each of the following elements.

Marks 5

Element	Biological Function
cobalt	
sodium	
iodine	
magnesium	
zinc	

	Marks
• Gamma emission involves the radiation of high energy γ photons and accompanies most types of radioactive decay processes. γ photons typically have wavelengths less than 0.1 Å. Calculate the energy of a photon with wavelength λ = 0.1 Å. Give your answer in J per photon and kJ mol^{-1}.	**3**

E = J per photon	E = kJ mol^{-1}

Why is high energy or gamma radiation called ionising radiation?

• What are two of the key results arising from a wavelike description of matter?	**2**

• Each of the following electron configurations represents an atom in an excited state. Identify the element and write its ground state electron configuration.	**2**

Electron configuration of excited state	Element	Electron configuration of ground state
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4\ 4s^1$		
$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3\ 4p^1$		

- The atomic radius decreases across a period and increases down a group within the periodic table. Explain these observations.

2