

• In the spaces provided, briefly explain the meaning of the following terms.	<b>Marks</b> <b>3</b>
Effective nuclear charge	
Atomic emission spectrum	
Core electrons	

**THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.**

- The yellow light emitted from an excited sodium atom has a wavelength of 590 nm. What is the energy of one photon of this light and one mole of photons? Specify appropriate units with your answers.

**Marks**  
**5**

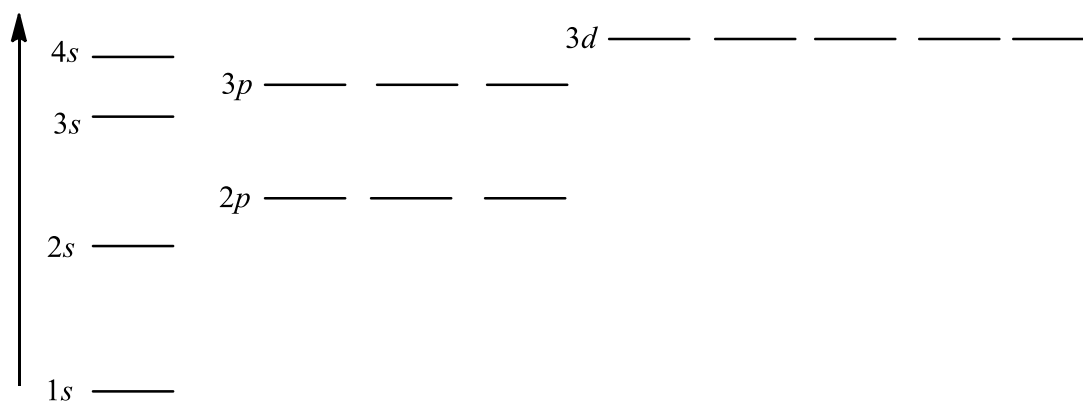
Energy

of one photon:

of 1 mol of photons:

The yellow light is associated with the longest wavelength transition as the atom returns to the ground state electron configuration. Fill in the following energy level diagram for sodium and indicate the transition associated with the emission of yellow light.

Energy



A quantum mechanical model of an atom can explain the emission spectrum of sodium, but the Bohr model of the atom cannot. Why?

**Marks**  
**2**

- $^{11}\text{C}$  is used in positron emission tomography – PET. It is synthesised by bombarding a  $^{14}\text{N}$  target with protons. Write a nuclear equation for the formation of  $^{11}\text{C}$  and thus identify the by-product of this synthesis.

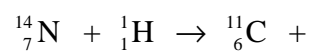
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$^{11}\text{C}$  undergoes positron decay with a half life of 20.3 minutes. Write a nuclear equation to identify the product of this decay reaction.

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**Marks**  
**2**

- Glucose labelled with  $^{11}\text{C}$  is used to monitor brain function in positron emission tomography (PET) scans. Identify the missing particles in the following nuclear reactions showing the synthesis and decay of  $^{11}\text{C}$ .



- Complete the following table, providing the ground state electron configuration for each of the following species.

**3**

Species	Ground state electron configuration
chlorine atom	
magnesium ion	
arsenic(V) ion	

- Complete the following table, providing the ground state electron configuration for each of the following species.

**3**

Species	Ground state electron configuration
nitrogen atom	
chloride ion	
manganese(II) ion	

**Marks**  
**2**

- Give the full electron configuration for the ground state K atom.

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What are the three quantum numbers that describe the orbital that contains the electron furthest from the nucleus in the K atom?

$n =$	$l =$	$m_l =$
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