

Question			Expected response	Max mark	Additional guidance
8.	(a)	(i)	$(A = \pi r^2)$ $A = \pi \times (15 \times 10^{-3})^2$ (1) $I = \frac{P}{A}$ (1) $17 = \frac{P}{\pi \times (15 \times 10^{-3})^2}$ (1) $P = 0.012 \text{ W}$ (1)	4	Accept: 0.01, 0.0120, 0.01202 The use of 3.14 is acceptable for π . For use of 3.14, accept: $P = 0.01201$ $I = \frac{P}{A}$ anywhere (1) If no attempt to calculate area, maximum (1) mark for irradiance relationship.
		(ii)	(Experimental setup is) not a point source OR Parallel beam so the irradiance does not change with distance.	1	Accept: The beam of light does not diverge Sodium lamp is not a point source, on its own - award (0) marks.
	(b)	(i)	Lower (energy level)	1	
		(ii)	$v = f\lambda$ (1) $3.00 \times 10^8 = f \times 589.0 \times 10^{-9}$ (1) $E = hf$ (1) $E = 6.63 \times 10^{-34} \times \left(\frac{3.00 \times 10^8}{589.0 \times 10^{-9}} \right)$ (1) $E = 3.38 \times 10^{-19} \text{ J}$ (1)	5	Accept: 3.4, 3.377, 3.3769 Accept: $\Delta E = hf$ OR $E_2 - E_1 = hf$ $v = f\lambda$ anywhere (1) $E = hf$ anywhere (1) Alternative method: $(\Delta)E = \frac{hc}{\lambda}$ OR $E_2 - E_1 = \frac{hc}{\lambda}$ Combined relationship (2) Substitution for c and λ (1) Substitution for h (1) Final answer (1)

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8.	(b)	(iii)	There are more electrons (per second) making the transition for the 589.0 nm line. (1) Meaning more photons (per second) are emitted. (1) OR There are fewer electrons (per second) making the transition for the 589.6 nm line. (1) Meaning fewer photons (per second) are emitted. (1)	2	Do not accept greater brightness due to greater frequency/energy of the photons.