8 (a) All objects emit electromagnetic radiation.

The intensity and wavelength of the emitted radiation vary with the temperature of the object.

Figure 12 shows this variation for a filament lamp at two different temperatures.

The visible region of the electromagnetic spectrum is also shown.

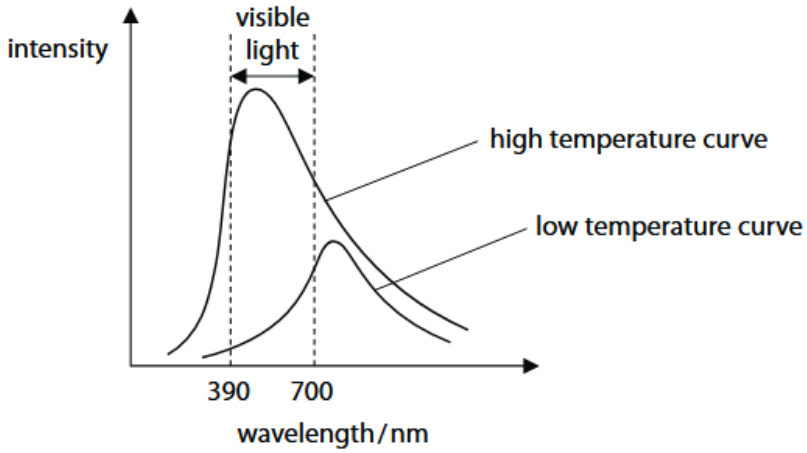

Figure 12

(i) Explain why a filament lamp appears brighter and less red as its temperature increases.

(4)

(ii) The intensity of gamma radiation can be measured using a Geiger-Müller tube and counter.

The count rate recorded by the counter tube depends on how far away the Geiger-Müller tube is from the gamma radiation source.

The equation relating count rate to distance from the source is

$$\text{count rate} = \frac{k}{d^2}$$

where d is the distance from the source and k is a constant.

A Geiger-Müller tube is placed 0.70 m from a source of gamma radiation.
The counter displays a count rate of 85 000 count per minute.

Calculate the count rate recorded when the Geiger-Müller tube is placed 1.3 m away from the same gamma radiation source.

(3)

count rate = ... counts per minute

*(b) Sulfates and black soot are particles formed by industrial processes.

Some of these particles are found in the atmosphere over the Arctic Ocean.

The sulfates stay in the atmosphere and reflect (scatter) sunlight.

The black soot falls onto the Arctic ice.

Discuss how a reduction in these industrial processes is likely to affect the temperature of the atmosphere.

(6)

(Total for Question 8 = 13 marks)

Question number	Answer	Mark
8(a)(i)	An explanation that combines identification via a judgement (2 marks) to reach a conclusion via justification/reasoning (2 marks): • intensity of radiation increases with temperature (1) • the distribution of the emitted wavelengths of radiation is affected by temperature (1) • at low temperatures the intensity of radiation emitted is low and the (range of) emitted wavelengths (of radiation) are high so the lamp appears dull red (1) • at higher temperatures the intensity of the radiation is greater and the (range of) emitted wavelengths (of radiation) are low so the lamp appear to be brighter and less red (1)	**(4)**

Question number	Answer	Additional guidance	Mark
8(a)(ii)	Substitution and rearrangement to find k (1) $k = 85000 \times 0.70^2$ Substitution to find new count rate (1) count rate $= \frac{85000 \times 0.70^2}{1.3^2}$ Answer (1) 25000 (counts per minute)	41650 24645 (counts per minute)	**(3)**

Question number	Indicative content	Mark
*8(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • the soot could make the ice black • black ice will absorb more IR radiation than white ice • black ice might cause an increase in the temperature of the Earth because absorption of IR radiation (can) cause an increase in temperature • reduction in soot might reduce warming because the ice will not be as black/will be more white • shiny sulfates (are good at) reflecting/scattering IR radiation which means less heat absorbed • sulfates scatter the IR and this reduces the amount of IR radiation falling on the Earth • sulfates might cause a decrease in the temperature of the Earth • reduction in sulfates might increase warming	**(6)**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• The discussion attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• The discussion is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• The discussion is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)