8 An object that is at a higher temperature than its surroundings loses thermal energy by emitting electromagnetic radiation.

For loss of thermal energy as electromagnetic radiation, the intensity I_λ of the emitted radiation of wavelength λ varies with wavelength λ as shown in Fig. 8.1.

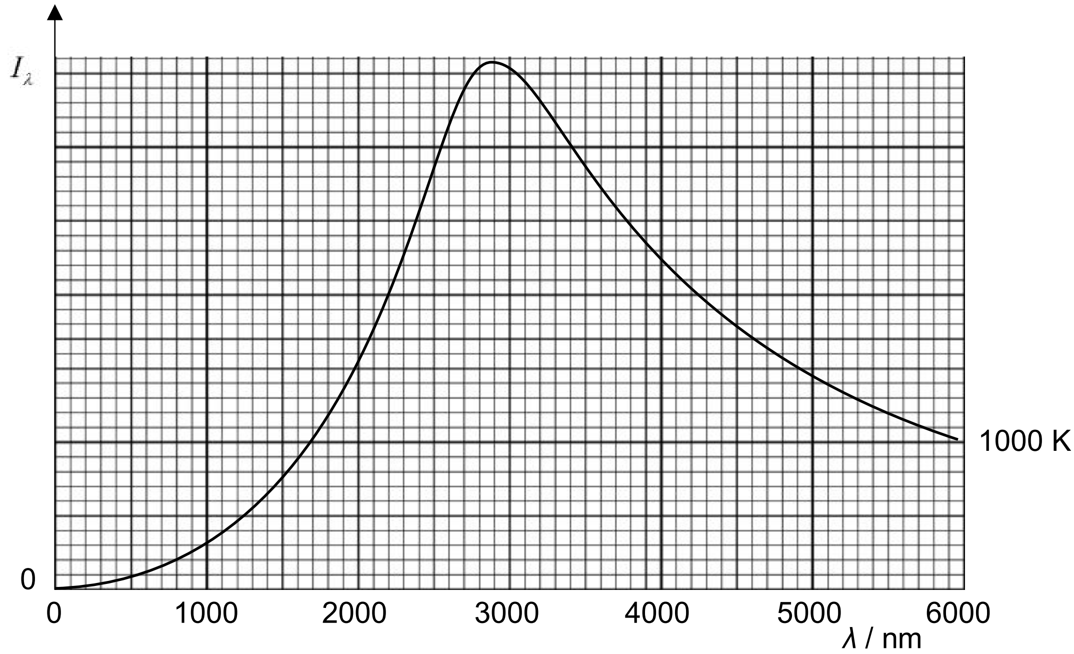

Fig. 8.1

Fig. 8.1 shows the variation of I_λ with λ for the body when it is at 1000 K.

The distribution of intensity is different at different temperatures. This is illustrated in Fig. 8.2.

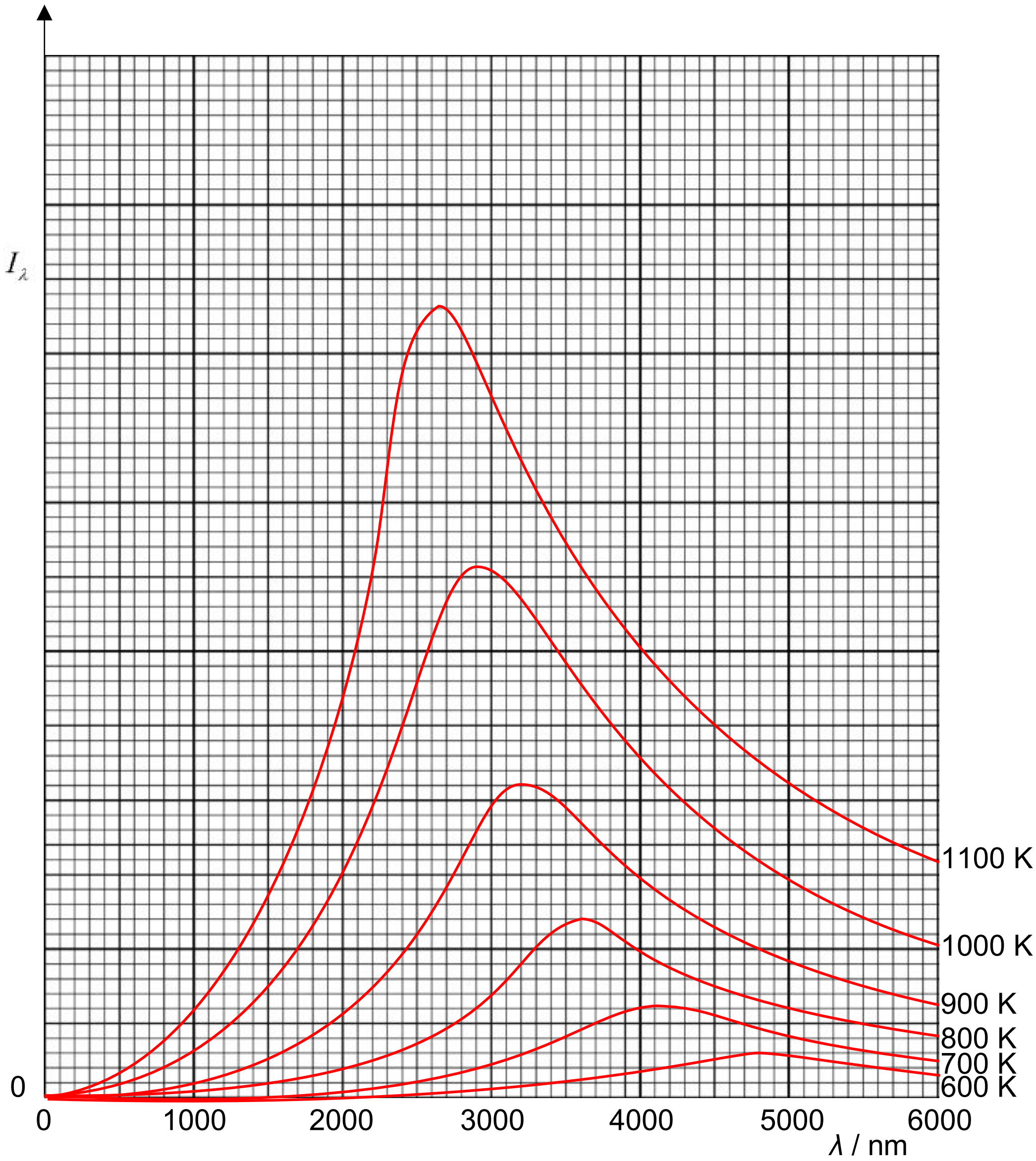

Fig. 8.2

(a) **(i)** On the horizontal axis of Fig. 8.2, indicate with the letter V a wavelength that is in the visible region of the electromagnetic spectrum. [1]

(ii) Hence suggest why, at a temperature of 1100K, the object would glow with a red colour.

....

.... [1]

(b) At any temperature T, the graph of Fig. 8.2 shows a peak corresponding to a wavelength λ_{max} and an intensity I_{max}. Data for T and λ_{max} are shown in Table 8.3.

Table 8.3

T / K	λ_{max} / nm
600	4830
700	4140
800	3610
900	3210
1000	2900
1100	2630

(i) Without drawing a graph, show that

$$T \times \lambda_{max} = \text{constant},$$

and determine the constant.

constant = ………………………….. [3]

(ii) Hence, determine the wavelength for the maximum intensity at a temperature T of 1200 K.

wavelength = ……………………….. m [2]

(c) The total intensity of emitted radiation from a particular body at temperature T is I_{tot}. Fig. 8.4 shows the values of lg(T/K) plotted against the corresponding values of lg(I_{tot}/W m^{-2}).

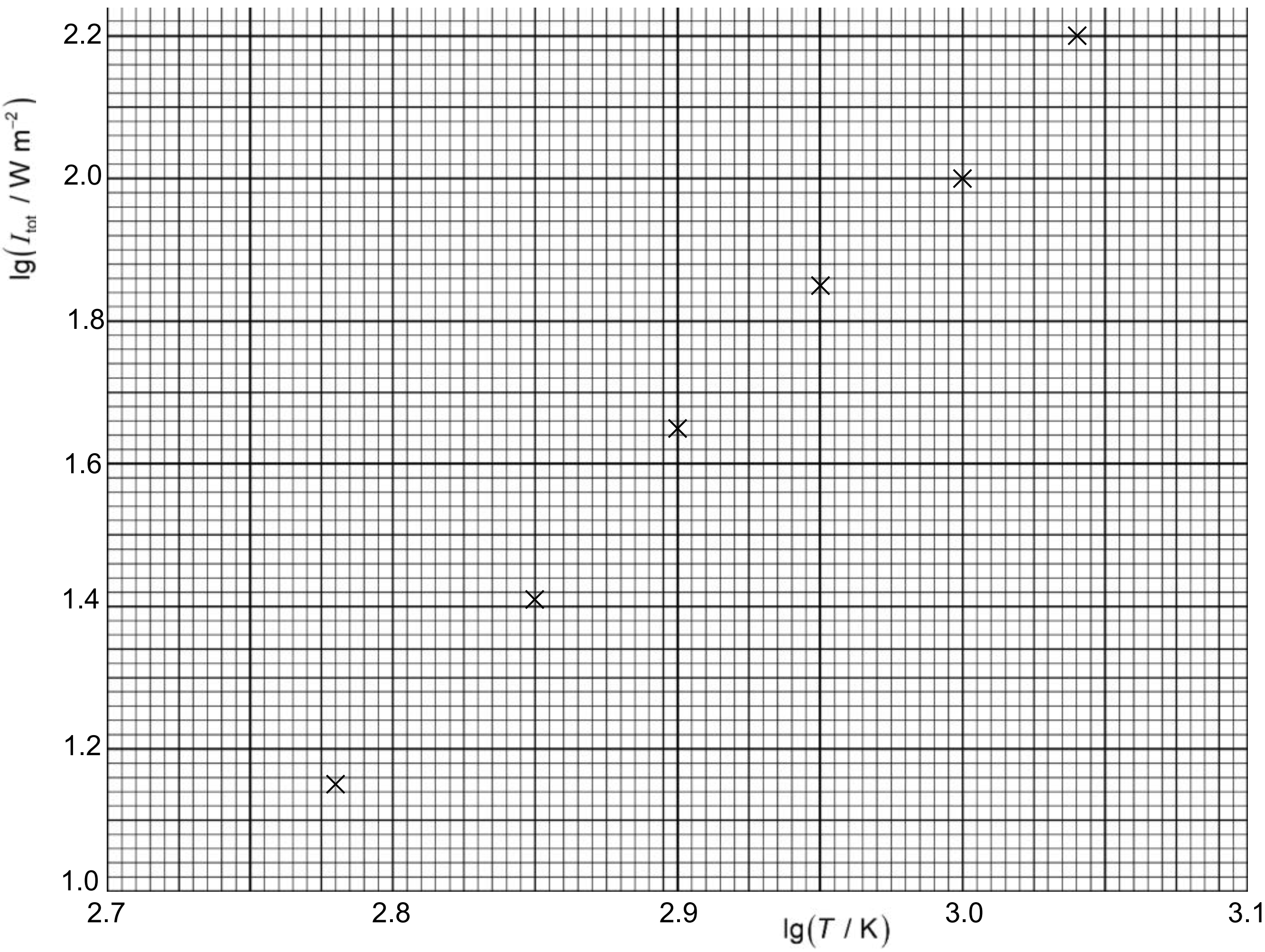

Fig. 8.4

It is known that I_{tot} varies with T according to the relation

$$I_{tot} = cT^n,$$

where c and n are constants.

(i) Use Fig. 8.4 to determine a value for n.

n = ... [3]

(ii) For this body at $T = 900$ K, I_{tot} is found to be 71 W m^{-2}.

Use these data and your answer to (c)(i) to determine I_{tot} for the body at a temperature of 1200 K.

I_{tot} = ... W m^{-2} [3]

(d) Using your answer to **(b)(ii),** sketch on Fig. 8.2, the variation with wavelength λ of intensity I_λ for a temperature of 1200 K. [3]

(e) The radiation emitted by a hot body may be used as a means of determining the temperature of the body.

(i) Suggest and explain a property of the radiation that could be used for this purpose.

....

....

.... [2]

(ii) Suggest one advantage and one disadvantage of this method for measuring temperature.

advantage: ....

....

disadvantage: ....

.... [2]

[Total: 20]