9 **(a)** Explain what is meant by

(i) *diffraction*,

.....

.....

.....

..... [1]

(ii) the *principle of superposition*.

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.....

..... [1]

(b) A single slit of width 0.30 mm is illuminated by a source of light of wavelength λ = 630 nm.

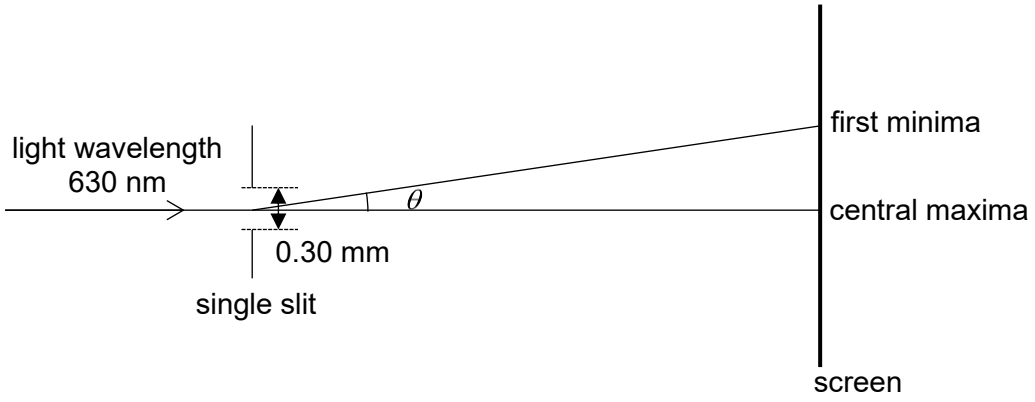

Fig. 9.1

A central maxima is formed on the screen adjacent to the first minima, as shown in Fig. 9.1.

(i) Determine angle θ.

θ = …… rad [2]

(ii) On Fig. 9.2, sketch the variation of intensity with angular position θ from the central maxima.

Label this graph X and indicate significant values of θ. [1]

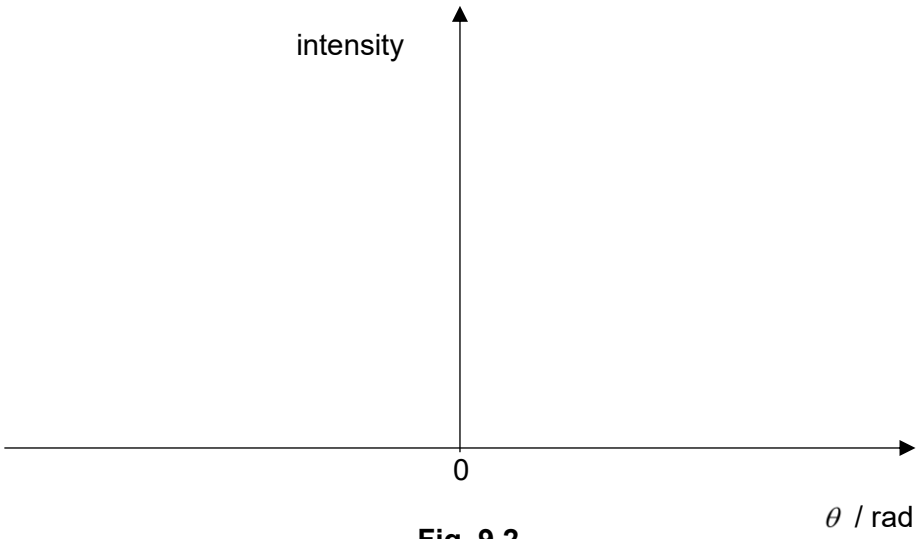

Fig. 9.2

(iii) The single slit is replaced with double slits that are 0.45 mm apart such that the central maxima remains at the same position on the screen.

On Fig. 9.2, sketch the variation of intensity with angular position θ from the central maxima.

Label this graph Y and indicate significant values of θ. [1]

(iv) Without further calculation, describe and explain how the variation of intensity with θ would change when

1. the slit separation between the double slit is reduced,

.....

.....

.....

..... [1]

2. a linear polarizer is placed in front of each slit, with the individual axes of polarization

at right angles to each other.

.....

.....

.....

..... [1]

(c) The double slit is now replaced with a diffraction grating with 300 lines per mm.

Determine the number of bright spots that will be visible on the screen.

number = ……. [2]

(d) State what is meant by

(i) *specific latent heat of fusion*,

.....

.....

.....

..... [1]

(ii) *specific heat capacity*.

.....

.....

.....

..... [1]

(e) An ice cube of mass of 24 g is kept at a temperature of −15 °C in a freezer. It is removed from the freezer and placed in a beaker containing 200 g of water at a temperature of 28 °C. Data for ice and for water are given in Fig. 9.3.

	specific heat capacity / J kg^{-1} K^{-1}	specific latent heat of fusion / J kg^{-1}
ice	2.1×10^3	3.3×10^5
water	4.2×10^3	-

Fig. 9.3

The beaker has negligible mass.

Calculate the final temperature of the water in the beaker.

temperature = …… °C [3]

(f) The mass of the beaker is not negligible in reality.

State and explain whether your value in **(e)** is an overestimate or underestimate.

.....

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.....

.....

.....

.....

[2]

(g) The first law of thermodynamics may be expressed in the form

$$\Delta U = Q + W$$

where ΔU is the internal energy of the system,
Q is the heat supplied to the system,
W is the work done on the system.

Complete Fig. 9.4 for each of the processes shown, using the symbol '+' to indicate an increase, the symbol '-' to indicate a decrease and the numeral '0' to indicate no change. [3]

	ΔU	Q	W
an ideal gas is compressed in an insulated container	…….	…….	…….

a solid is cooled without a change in volume	.....	.....	.....
water is boiling at 100°C	.....	.....	.....

Fig. 9.4

[Total: 20]

“End Of Paper