[2]

(b)

A parallel beam of wavelength 600 nm is incident normally on a diffraction grating.

Fig. 1.3 shows part of the diffraction grating used.

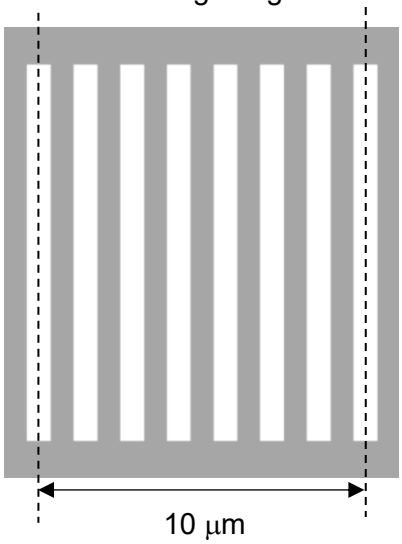

Fig. 1.3

(i)

Determine the distance between adjacent slits on the grating.

distance = …… m [2]

(ii)

Fig 1.4 shows how the parallel beam of light that was incident on the diffraction grating.

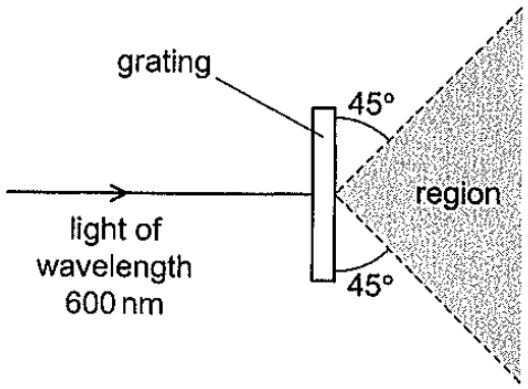

Fig. 1.4

Calculate the total number of images that emerge from the grating within the shaded 90° region shown in Fig. 1.4.

total number of images = …… [2]

(iii)

In a mass production of diffraction gratings with slit separation *d*, a monochromatic laser light with a fixed wavelength λ was used to check for the quality of the diffraction gratings produced. In a certain test, a few defective pieces were found.

In a good product, the first order maximum occurs at an angle of α from the zeroth order maximum. In a defective product, the first order maximum is not a single sharp point but a band of light extending from angle α to β, where β is larger than α. The band of light is brightest at an angle of α and reduces towards the angle of β.

Describe what could be the fault in the manufacturing of the grating to result in this observation.

……..

……..

……..

……..

……..….. [2]

(c)

On an initially calm day out at sea, water waves of constant speed approach a sea wall and a stationary wave is formed.

(i)

State how the stationary wave is formed.

……..

……..

……..

…….. [2]

(ii)

When the waves hit the wall, an increase in amplitude of the wave was observed at the sea wall.

State and explain if the water waves experienced a phase change when hitting the wall to result in the increase in amplitude.

……
…

……
…

……
…

……...
[2]

(iii)

In Fig. 1.5, fine sand is spread along the length of a tube fitted with a piston. A small loudspeaker which emits sound of 720 Hz is placed at the opened end and the length of the air column was varied by adjusting the position of the piston.

When the air column is 0.78 m, the sand in the tube forms the pattern as shown.

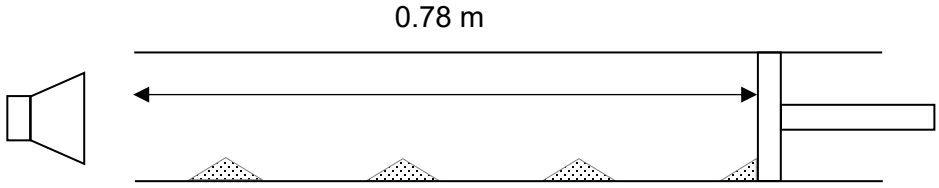

Fig. 1.5

Calculate the speed of sound travelling through the air column.

speed of sound = …… m s^{-1} [2]

[Total: 14]

2

(a)

(i) State the first law of thermodynamics.

……
...

……
...

……..…[2]

(ii) Use first law of thermodynamics to explain how roasting of potatoes causes its temperature to rise.

……
…

……
…

……
…

……
…

……
…

……
…

……[
3]

(b)

An ideal gas undergoes a cycle of changes A → B → C → A as shown in Fig. 2.1.

Process A to B takes place at constant temperature of 310 K. Process B to C takes place at constant volume and during this process, 55 J of heat leaves the system. The temperature at C is 280 K. Process C to A takes place with no heat exchange.

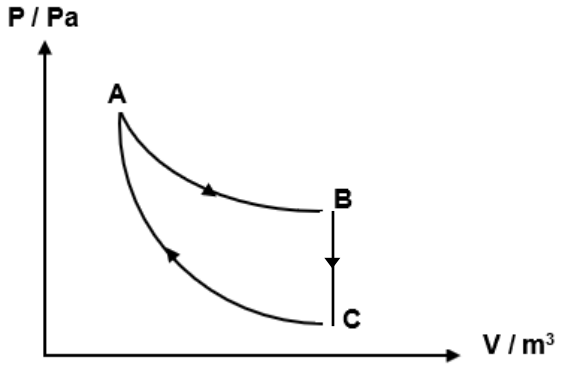

Fig. 2.1

(i)

Calculate the change in internal energy of the gas during the process B to C.

change in internal energy = …… J [2]

(ii)

Determine the work done by the gas during the process C to A.

Explain your working clearly.

work done by the gas = …… J [3]

[Total: 10]