**6** Fig 6.1 shows a miniature E10 filament light bulb with a rating of 6.0 V, 3.0 W.

**Fig. 6.1**

**(a) (i)** Calculate the resistance of the bulb.

resistance = ..... Ω [1]

**(ii)** The filament of the bulb is made of tungsten wire of length 2.0 cm and diameter 78 μm.

Calculate the resistivity of the tungsten filament.

resistivity = ..... Ω m [2]

**(iii)** The resistivity of tungsten from a table of constants is stated to be $5.6 \times 10^{-8}$ Ω m.

Explain, in microscopic terms, the difference between this value and your answer in **(a)(ii)**.

.....

.....

.....

.....

..... [2]

**(b)** Six identical E10 light bulbs are connected to a 6.0 V d.c. supply of negligible internal resistance in the arrangement shown in Fig. 6.2.

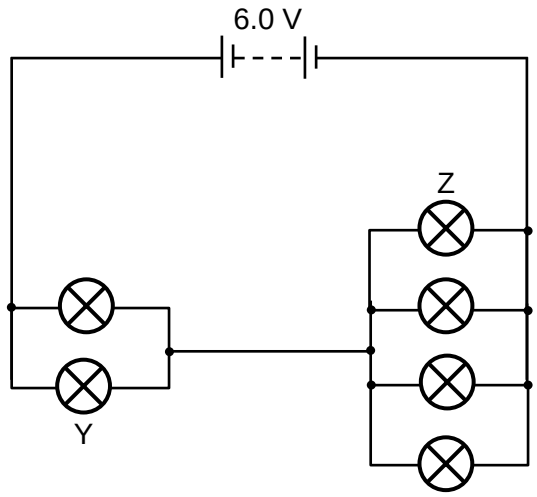


**Fig. 6.2**

Assume that the resistance of each bulb is as calculated in **(a)(i)**.

**(i)** Determine the amount of charge that passes through bulb Y in 2 minutes.

charge = ..... C [2]

**(ii)** Explain how the mean drift velocity of the electrons in the filament of bulb Y compare with that of the electrons in the filament of bulb Z.

.....

.....

.....

.....

..... [2]

**(c)** The six E10 light bulbs are now connected to an alternating power supply with frequency 50 Hz and r.m.s. voltage 6.0 V. An ideal diode is connected in parallel to bulb Z as shown in Fig. 6.3.

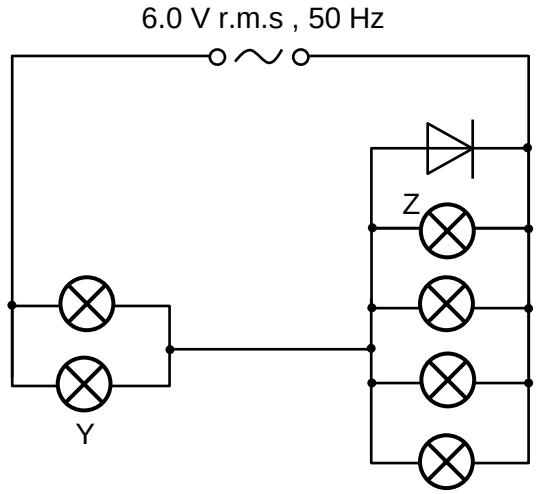


**Fig. 6.3**

On Fig. 6.4, sketch the variation with time *t* of the power *P* dissipated in bulb Y from $t = 0$ s to $t = 0.04$ s.

Include appropriate values for power on the vertical axis.

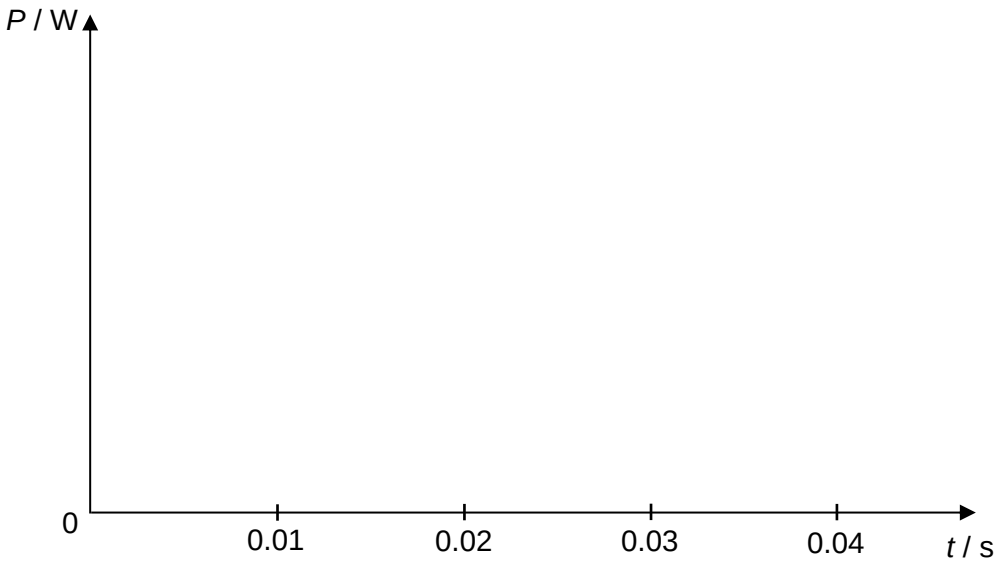


**Fig. 6.4**

[3]