2 (a) A piece of resistance wire PQ of length 120 cm and diameter 1.1 mm has resistivity 1.1×10^{-6} Ω m.

(i) Show that the resistance of the wire PQ is 1.4 Ω. [1]

(ii) Wire PQ is now connected to a circuit as shown in Fig. 2.1 below. A voltmeter is connected to point X and Y, where X is the mid-point between PQ.

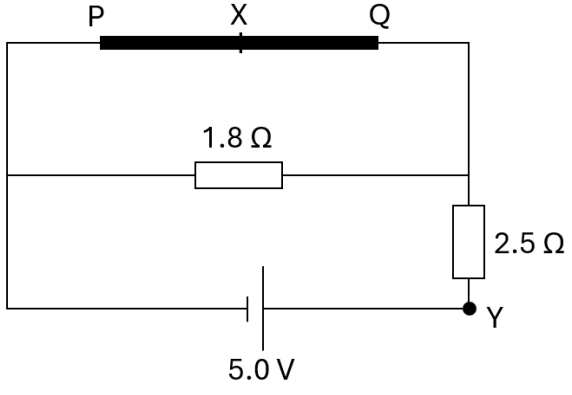

Fig. 2.1

Determine the reading on the voltmeter.

voltmeter reading = …… V [3]

(b) Two long straight parallel wires A and B carrying currents I_A and I_B respectively are positioned 5.0 cm apart as shown in Fig. 2.2. Currents I_A and I_B are directed along the same direction.

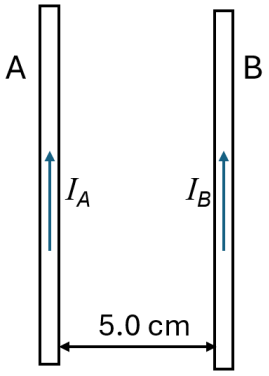

Fig. 2.2

(i) Explain why the two wires are attracted to one another.

.....

.....

..... [2]

(ii) The currents are now replaced with alternating currents.

I_A is represented by the equation:

$$I_A = -3.0 \cos (200\pi t)$$

I_B is represented by the graph shown in Fig. 2.3.

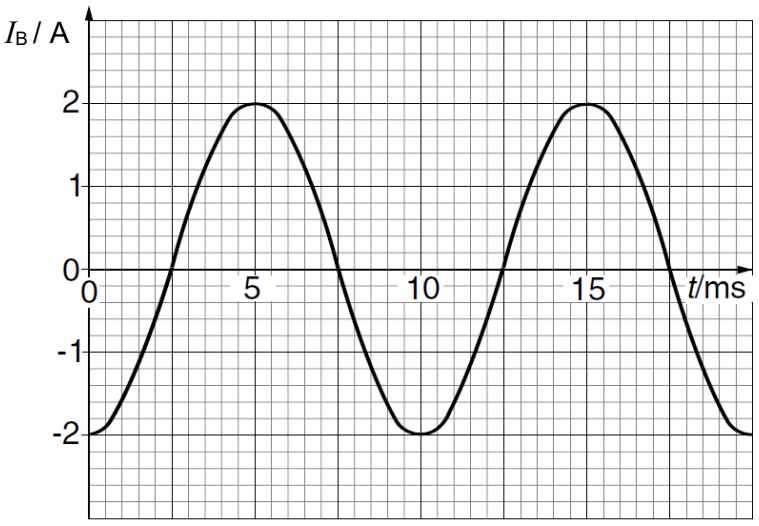

Fig. 2.3

1. Determine the instantaneous force per unit length acting on wire A when t = 6.5 ms.

force per unit length = …….. N m^{-1} [3]

2. A diode is connected in series to wire A such it is reversed biased.

Sketch in in Fig. 3.2 the graph of the attractive force per unit length acting on wire A against time t from t = 0 ms to t = 15 ms. Numerical value of the force per unit length is not required.

force per unit length / N m^{-1} [2]

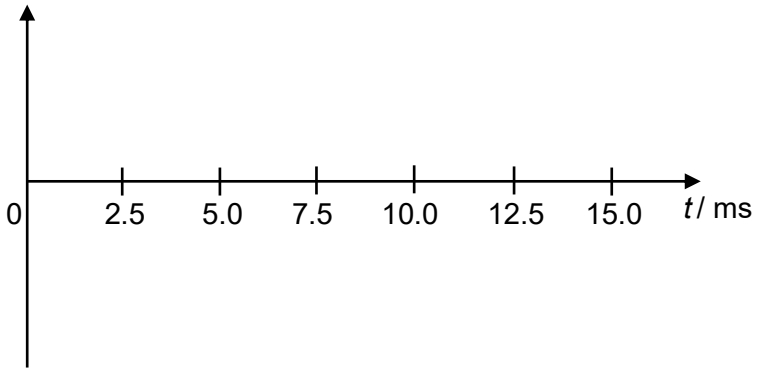

Fig. 3.2

3. The diode in **(b)(ii)2.** remains connected.

Determine the mean power dissipated across wire A given that the resistance of wire A is 15 Ω.

mean power = …….. W [1]

[Total: 12]