A Level Physics A

H556/02 Exploring physics

Question Set 14

1* A metal circular plate is rotated at a constant frequency by an electric motor.
The plate has a small hole close to its rim.
Fig. 17.1 shows an arrangement used by a student to determine the frequency of the rotating plate.

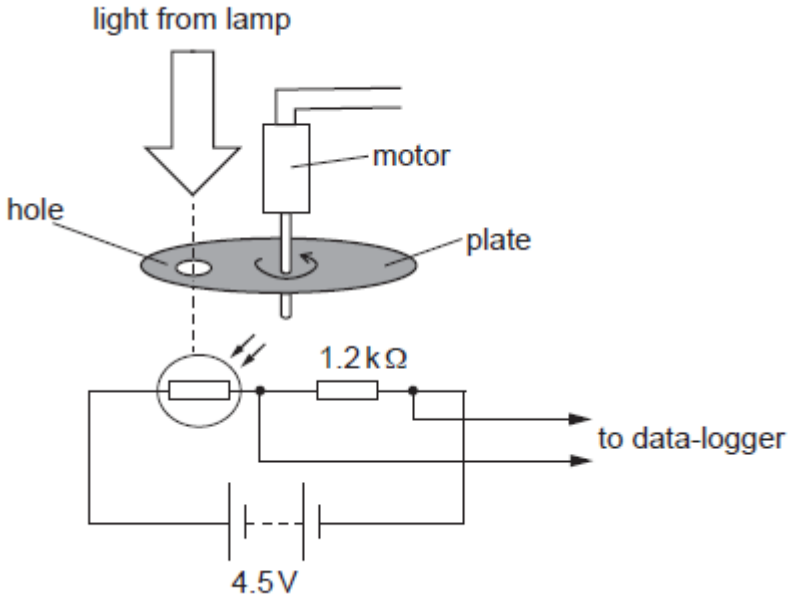

Fig. 17.1

A light-dependent resistor (LDR) and a fixed resistor of resistance 1.2 kΩ are connected in series to a battery. The battery has e.m.f. 4.5 V and has negligible internal resistance. The potential difference *V* across the resistor is monitored using a data-logger.

Fig. 17.2 shows the variation of *V* with time *t*.

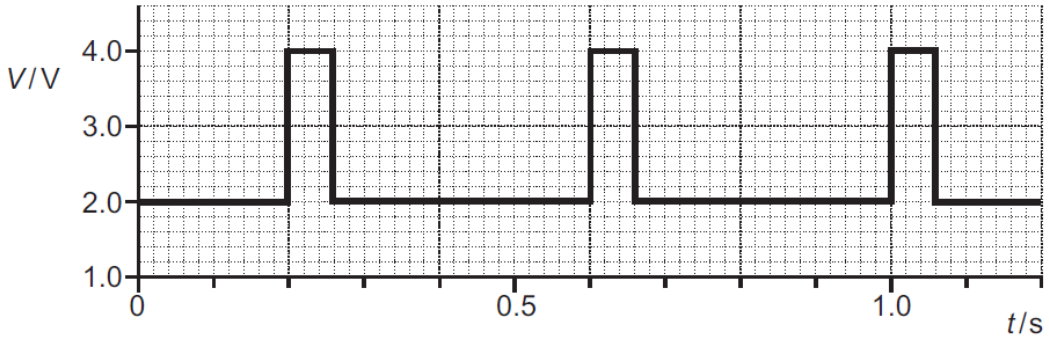

Fig. 17.2

Use your knowledge and understanding of potential divider circuits to explain the shape of the graph shown in Fig. 17.2. Include in your answer the maximum and minimum values of the resistance of the LDR.
Describe how the student can determine the frequency of the rotating plate.

[6]

- The trace pattern is caused by light alternately falling on the LDR, then being shaded
- When light is on the LDR, its resistance is low so p.d. across it is low and hence p.d. across the resistor (V) is high at 4 V
- When light is not on the LDR, its resistance is high so p.d. across it is high and hence V is low at 2 V.
- Time between pulses is constant so f can be determined → $T = 0.4\,s$ $\quad f = \frac{1}{T} = 2.5\,Hz$
- In light: $I = \frac{V}{R} = \frac{4}{1200} = \frac{1}{300}\,A \Rightarrow R_{LDR} = \frac{V}{I} = \frac{4.5-4}{1/300} = 150\,\Omega$
- In darkness: $I = \frac{V}{R} = \frac{2}{1200} = \frac{1}{600}\,A \Rightarrow R_{LDR} = \frac{V}{I} = \frac{4.5-2}{1/600} = 1500\,\Omega$

Total Marks for Question Set 14: 6