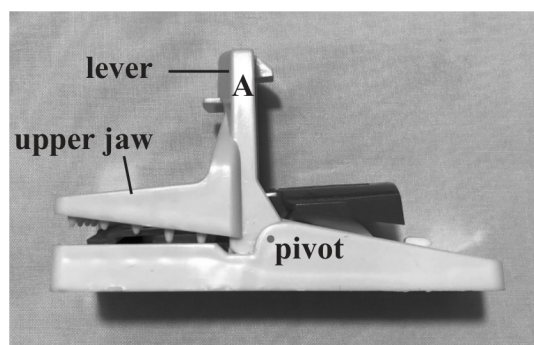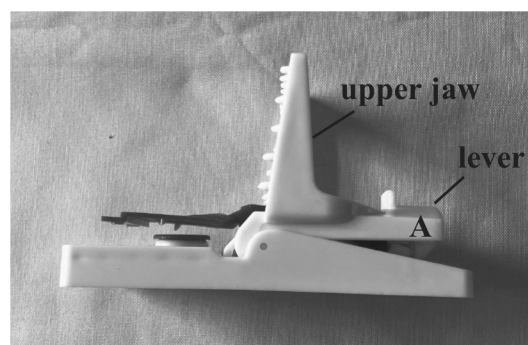**15** A student carried out an investigation to compare the energy stored in a mechanical mouse trap with the energy stored in an electronic mouse trap.

(a) The photographs show the mechanical version trap before and after it is set to trap a mouse.

Before being set   After being set

The trap was set by applying a force on the lever at point A. The lever rotated through an angle of 90°, stretching a spring. The force was applied at right angles to the lever throughout the process.

The initial force applied was 2.6 N and the force increased steadily to a final value of 9.6 N when the trap was set.

Show that the work done setting the trap was about 0.5 J.

length of lever = 4.9 cm

(2)

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(b) The electronic mouse trap works by applying a large potential difference (p.d.) across two metal plates. The diagram shows part of the circuit for the electronic mouse trap.
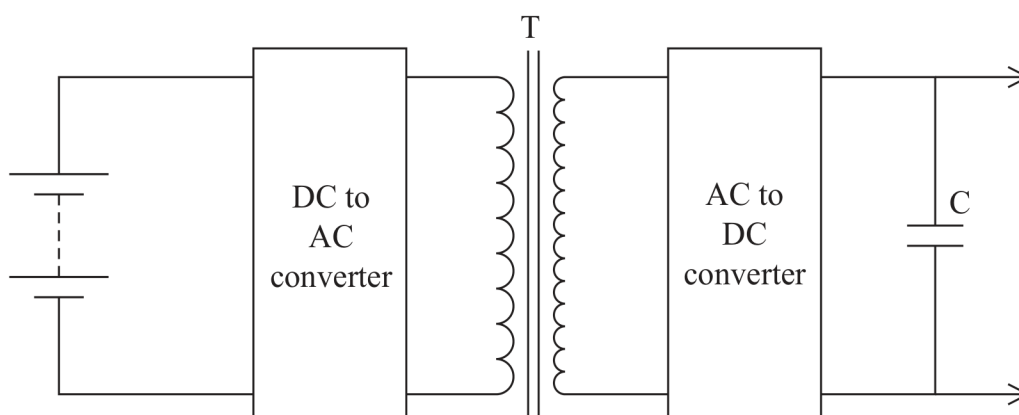
*(i) The transformer T consists of two coils wound around a single iron core. An alternating p.d. is applied to the input coil and the output coil is connected, through a diode, to a capacitor.

Explain how applying a p.d. across the input coil causes the capacitor to charge.

(6)

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(ii) The graph shows how the magnetic flux density B in the iron core varies with time.

$B/10^{-3}$ T

[Graph showing a sinusoidal curve. Vertical axis labelled $B/10^{-3}$ T from -10.0 to 10.0 in steps of 2.0. Horizontal axis labelled $t/10^{-5}$ s from 0.0 to 12.0. The curve peaks at about 8.3 near $t = 1.0$ and $t = 6.0$, and troughs at about -8.3 near $t = 3.5$ and $t = 8.5$.]
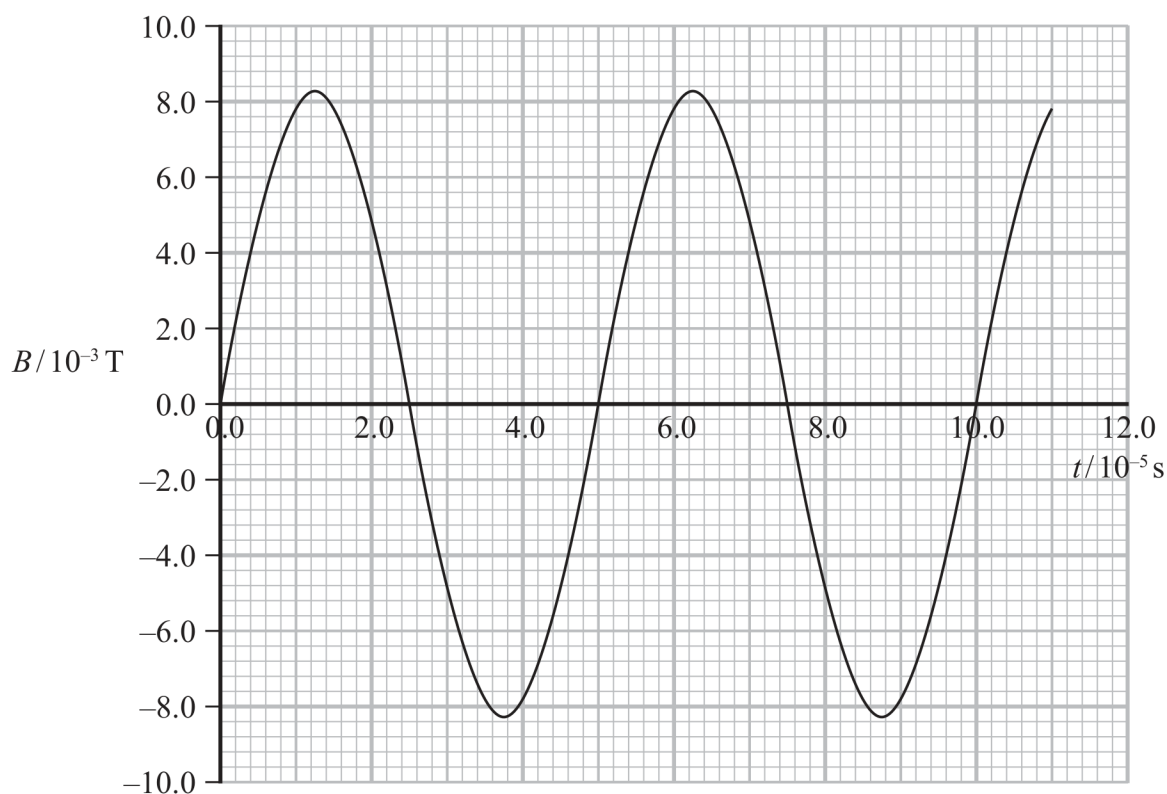
Show that the maximum p.d. across the output coil is about 600 V.

number of turns on coil = 1700

cross-sectional area of coil = 3.5×10^{-4} m²

(3)

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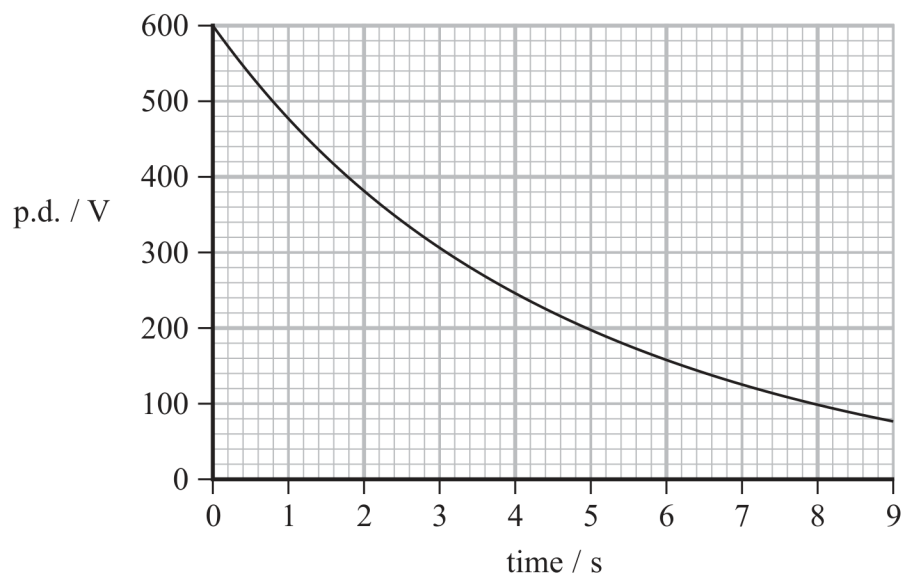
Turn over ▶

(c) The student tested the capacitor by charging it until the p.d. across the capacitor was 600 V and recording the p.d. as it was discharged through a resistor of resistance 3000 Ω.

The following graph was obtained.

Determine whether the mechanical or the electric mouse trap stores the most energy.

(5)

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