

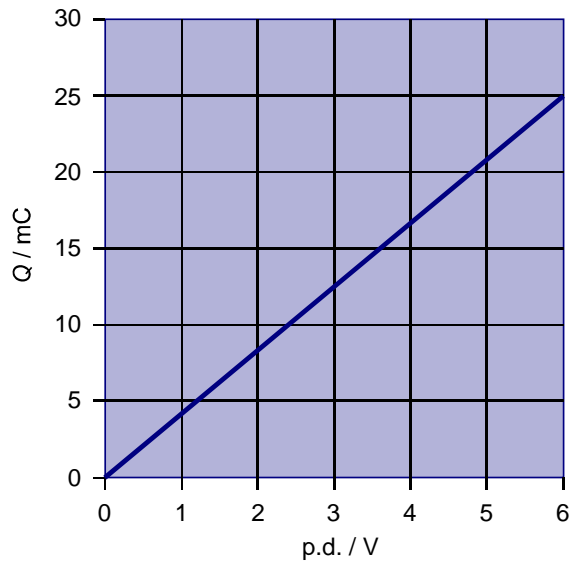
TAP 128- 5: Energy to and from capacitors

What to do

Work your way through the questions, preferably in the order in which they appear. The first few questions will give you some practice in using the equations relating to energy storage.

Questions

The graph shows the relation between the charge on a capacitor and the pd across it.



1. Use the graph to find the capacitance of the capacitor.
2. Use the graph to find the energy stored, first when the pd across the capacitor is 4.0 V and again when the pd is 6.0 V.

A capacitor in a catalogue is marked 33 000 μF , 10 V. It also has a mass of 40 g. It is charged to 10 V.

3. Calculate the energy stored.
4. If all energy stored could be converted to kinetic energy, how fast would the capacitor be moving?

5. If all the stored energy could be converted to gravitational potential energy, how high would it rise?

Practical advice

The range of questions is designed to give students practice in handling the relevant equations.

Answers and worked solutions

1.

$$\text{Capacitance} = \text{gradient} = \frac{25 \times 10^{-3} \text{ C}}{6.0 \text{ V}} = 4.2 \text{ mF.}$$

2.

$$E_4 = \text{area under the graph to } 4.0 \text{ V} = \frac{1}{2} \times 4.0 \text{ V} \times 17 \times 10^{-3} \text{ C} = 0.034 \text{ J}$$

$$E_6 = \text{area under the graph to } 6.0 \text{ V} = \frac{1}{2} \times 6.0 \text{ V} \times 25 \times 10^{-3} \text{ C} = 0.075 \text{ J}$$

3.

$$\begin{aligned} E &= \frac{1}{2} CV^2 \\ &= \frac{1}{2} \times 33000 \times 10^{-6} \text{ F} \times (10 \text{ V})^2 \\ &= 1.65 \text{ J} \end{aligned}$$

4.

$$v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{2 \times 1.65 \text{ J}}{40 \times 10^{-3} \text{ kg}}} = 9.1 \text{ m s}^{-1}$$

5.

$$1.65 \text{ J} = (40 \times 10^{-3} \text{ kg}) \times 10 \text{ Nkg}^{-1} \times h.$$

Therefore h is 4.1 m.

External references

This activity is taken from Advancing Physics Chapter 10, 120S