

Capacitors & Electric and Magnetic Fields – Test B

1. Two identical charged spheres of radius r are in contact. The charge on one sphere is $+Q$ and the charge on the other is $-Q$. The electrostatic force between them is F . What is the electrostatic force between two spheres also in contact, each of radius $2r$, when the charge on one sphere is $+Q$ and the charge on the other is $-Q$?

A $0.25F$ B $0.5F$ C F D $2F$

2. A capacitor is fully charged. Which row in the table gives correct information about the variation of charge with time?

	shape of the graph	quantity given by the gradient
A	linear decrease	current
B	linear decrease	energy
C	exponential decay	current
D	exponential decay	energy

3. Describe one difference between the law for the force between masses and the law for the force between charges.

4. A hydrogen atom consists of one proton and one electron. Assuming that the forces between the proton and the electron are gravitational and electrostatic, calculate:

- (a) the gravitational force between them
(b) the electrostatic force between them
Take the radius of a hydrogen atom to be 53 pm.

5. Calculate the electric field strength at a distance of 10^{-10} m from an electron.

6. A 2000 μF capacitor is charged to 9.0 V with the switch at position 1 using the circuit to the right.

- (a) Calculate the charge on the capacitor when it is charged to 9.0 V.

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- (b) The switch is then moved to position 2.

On graph paper, plot a graph to show the variation of charge with time for the first 8 s after the switch is moved to position 2.

[5]

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7. In capacitors, any insulating material that is used to separate the plates is called a dielectric. Describe how you would determine the relative permittivity, ϵ_r , of a material using the following equipment:

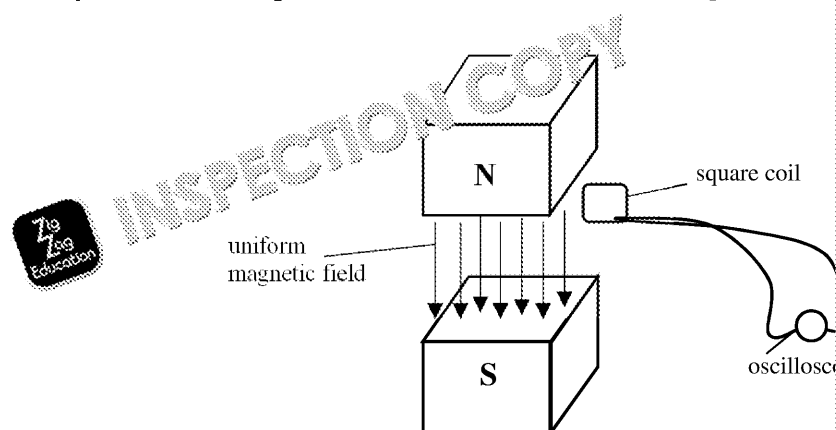
Describe how you would determine the relative permittivity, ϵ_r , of a material using the following equipment:

- aluminium foil
- a ruler
- paper
- scissors
- a d.c. power supply
- a voltmeter
- a selection of resistors
- a selection of capacitors

Include in your answer the variables you will change, measure and control, and how you will measure them.

8. A washing machine uses an electric motor to rotate a drum that contains clothes. The motor is a simple motor with a permanent magnetic field of 11.7 mT. The coil is rectangular and has an area of 0.025 m². Calculate the flux linkage when the plane of the coil is at 45° to the magnetic field.
- (b) When an electric motor is connected to a power supply, it speeds up to a constant speed. Explain why the motor does not continue to get faster and faster. Explain why the motor does not continue to get almost zero friction in the bearings.

9. The diagram shows a square coil of wire in a uniform magnetic field.



A student wishes to use this equipment to investigate how the magnitude of the induced e.m.f. varies with the angle that the plane of the coil makes with the magnetic field.

The coil is initially set to be perpendicular to the magnetic field and the oscilloscope shows a reading of 0 V.

- (a) Explain why the oscilloscope shows no reading when the coil is perpendicular to the magnetic field.
- (b) The coil is moved at a steady speed and the e.m.f. recorded. Calculate the angle to which the coil should be rotated to generate half this e.m.f. under the same conditions.
- (c) Explain why there is zero e.m.f. induced when the plane of the coil is parallel to the magnetic field.

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Preview of Questions Ends Here

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