MODEL ANSWER
A2 PHYSICS
ELECTRIC FIELD & CAPACITORS

JAN 2006 PHY5

1. (a) Given the two identical capacitors, $C_1 = C_2$

Capacitance of each capacitors = $C = C_1 = C_2$

Total electrical energy stored = 1.08×10^{-4} J

$$W = \tfrac{1}{2} C_T V^2$$

$$C_T = 2W / V^2$$

$$= 2 \times 1.08 \times 10^{-4} / 6^2$$

$$= \underline{6\ \mu F}$$

$$1 / C_T = 1 / C_1 + 1 / C_2$$

$$1 / 6 = 2 / C$$

$$C = \underline{12\ \mu F}$$

(b) (i) Total Charge, $Q_T = C_T V$

$$= [3.0 + 3.0] \times 6.0$$

$$= \underline{36.0\ \mu C}$$

Total electrical energy stored = ½ QV

$$= \tfrac{1}{2} \times 36.0 \times 10^{-6} \times 6.0$$

$$= \underline{1.08 \times 10^{-4}\ J}$$

3. (i) Upward arrow labeled electrostatic force due to field OR upward arrow labeled electric force.

Downward arrow labeled weight OR downward arrow labeled gravitational force.

(ii) $E = F / Q$ **---(1)**

$E = V / d$

$= 500 / 2.5 \times 10^{-3}$ **---(2)**

At equilibrium, $F = mg = EQ$

$$1.96 \times 10^{-14} = 500 / 2.5 \times 10^{-3}\ Q$$

$$Q = [1.96 \times 10^{-14}] / [500 / 2.5 \times 10^{-3}]$$

$$= \underline{9.61 \times 10^{-19}\ C}$$

(iii) When the two plates are moved closer together, with the assumption that potential difference remains unchanged, based on

$F_{upward} = QE = QV / d$

The electrostatic force will increase and therefore the oil drop accelerates upwards. The upward force is greater

Upward electrostatic force > weight

$F_{upward} > mg$

OR $mg < QV / d$

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