Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

(a) Explain what is meant by the term electric field strength.

(2)

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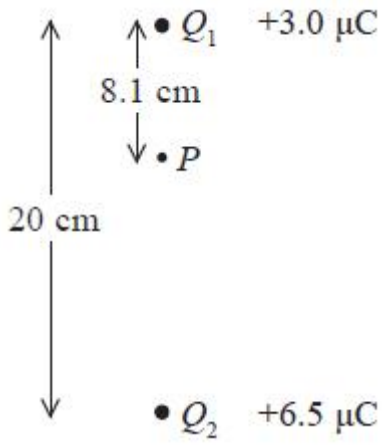
(b) (i) Two point charges Q_1 and Q_2 are placed 20 cm apart. Q_1 has a charge of +3.0 μC and Q_2 has a charge of +6.5 μC.



At point *P*, a distance 8.1 cm from Q_1, the electric field strength is approximately zero.
Demonstrate by calculation that this statement is correct.

(3)

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(ii) A charge of +4.5 μC is placed at point *P*.
State the magnitude of the force acting on this charge.

(1)

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(iii) The + 4.5 μC charge is moved from point *P* to a point half way between Q_1 and Q_2.
Explain qualitatively why energy would be needed for this movement.

(2)

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(Total for question = 8 marks)

Q2.

A simple model of the hydrogen atom consists of an electron moving in a circular path around a proton.

(i) In this simple model it is the electrostatic force, rather than the gravitational force, that is responsible for keeping the electron in a circular path.
By means of calculations justify this statement.
radius *r* of the hydrogen atom = 5.3×10^{-11} m

(4)

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(ii) Ignoring the gravitational force, calculate the velocity of the electron in this simple model of the hydrogen atom.

(3)

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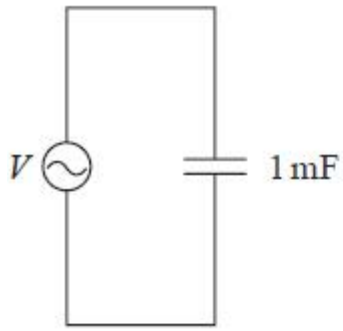
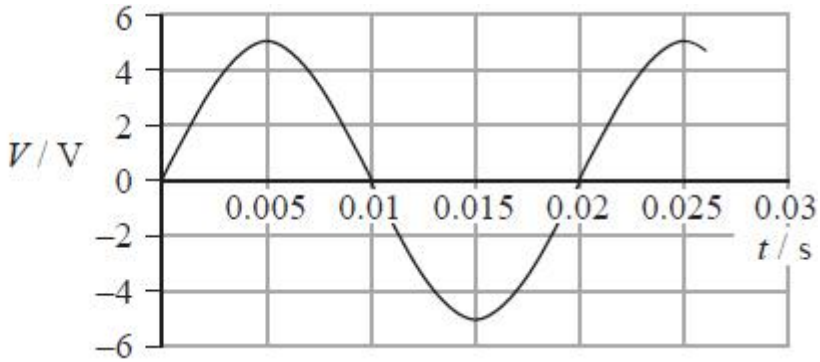
Velocity = ...

(Total for question = 7 marks)

Q3.

The circuit shows a 1 mF capacitor connected to an a.c. supply. The graph shows how the potential difference *V* varies with time *t*.





A spreadsheet is used to model how the current *I* in the 1 mF capacitor varies with *t*. Six rows of the spreadsheet are shown below.

	A	B	C	D	E	F	G
	t / s	Δt / s	V / V	$Q_{initial}$ / C	Q_{final} / C	ΔQ / C	I / A
7	0.0050	0.0010	5.00	0.00476	0.00500	0.00024	0.24
8	0.0060	0.0010	4.76	0.00500	0.00476	–0.00024	–0.24
9	0.0070	0.0010	4.05	0.00476	0.00405	–0.00071	–0.71
10	0.0080	0.0010	2.94	0.00405	0.00294	–0.00111	–1.11
11	0.0090	0.0010	1.55	0.00294	0.00155	–0.00139	–1.39
12	0.0100	0.0010	0	0.00155	0.00000	–0.00155	–1.55

(i) Explain how cell E10 has been calculated.

(2)

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(ii) State the formula used to calculate cell G11.

(1)

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(iii) Calculate the maximum energy stored on the capacitor.

(2)

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Maximum energy stored on the capacitor = ...

(Total for question = 5 marks)