

Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Mark Schemes

Q1.

- (a) (i) 2200×10^{-6} farads ($C V^{-1}$) or $2200 \mu C V^{-1}$
 or idea of capacitance measuring charge (or coulomb) per volt
 or $C = Q / V$ with terms defined
 C1
 the capacitor 'stores' $2200 \mu C$ of charge for a potential difference of 1 volt
 A1
 (2)
- (ii) 15 V is
 the maximum safe voltage between the terminals of the capacitor.
 or the maximum voltage that should be used across the capacitor
 or the voltage at which the capacitor breaks down / insulator conducts
 B1
 (1)
- (b) (i) correct curvature starting at 6 V at time = 0
 points plotted correctly at 3 and 6 minutes with reasonable curve (2.2 V and 0.8 V)
 B1
 or at 3 V at 2.1 minutes and 1.5 V at 4.2 minutes if 'half life' calculated and used
 allow ± 0.5 small square
 B1
 (2)
- (ii) time alarm rings read correctly from the graph at 2 V (about 200 s but use candidate's graph condone any shape graph)
 B1
 (1)
- (iii) time constant = RC or $(R = \frac{180}{2.2 \times 10^{-3}})$ or time to halve = $0.69CR$
 C1
 82 k Ω
 A1
 (2)
- (iv) cooking time $\propto CR \propto R$

or quotes $V = V_0 e^{-t/CR}$ **or** $2 = 6 e^{-300/CR}$

C1

resistance = 120 k Ω (124 k Ω)

A1

(2)

(v) connect it in parallel (with the other capacitor)

or

replace capacitor with one of higher value (not just use a larger capacitor)

B1

(3)

[11]

Q2.

(a) (i) 0.02 C of charge produce a p.d. of 1 V between the two terminals

or 0.02 C of charge per unit p.d.

B1

(2)

(ii) straight line through the origin

M1

correct gradient (possible check point 0.2 C at 10 V)

and graph line up to 20 V

A1

(2)

(iii) area between graph line and charge axis

(allow area under graph)

not area of the graph

not area under graph / 2

M1

from 0 to the required voltage or up to the required voltage

A1

or energy = $\frac{1}{2}QV$ or $\frac{1}{2}CV^2$

M1

read corresponding Q from the graph

A1

(only allow second mark if graph is straight line through the origin)

or C determined from gradient of graph and V given

(2)

(iv) sketch showing two capacitors in parallel connected to a supply

B1

(1)

(b) (i) energy stored = $0.5 CV^2$

C1

4.0 J (condone 1 sf answer)

A1

(2)

(ii) (useful) energy output = mgh

or

efficiency = useful energy out / energy input (in same time)

or

efficiency = useful power out / power input

C1

energy output = $0.15 \times 9.8 \times 0.8 = 1.18 \text{ J}$

C1

efficiency = 0.294 or 29.4% e.c.f. from (b)(i)

A1

(allow 29% – 30%)

(3)

[11]