Question Number	Answer	Mark
1(a)	(Trace) always positive/not negative/not below 0/ if it was AC the graph would be positive and negative Indicating one/same direction	**(1)** **(1)**
1(b)(i)	Capacitor stores charge/charges up (If voltage is constant) capacitor doesn't discharge	**(1)** **(1)**
1(b)(ii)	Recall of $E = ½ CV^2$ or use of $Q=CV$ and $QV/2$ Substitution of C and any reasonable V [ignore power of 10 for C] eg $= ½ 10 \times 10^{-6} \times 5.5^2/5.6^2$ $= 1.5 \times 10^{-4} - 1.6 \times 10^{-4}$ J	**(1)** **(1)** **(1)**
1(c)(i)	Capacitor charges up From the supply (then) Capacitor discharges Through circuit / exponentially	**(1)** **(1)** **(1)** **(1)** **(max 3)**
1(c)(ii)	Corresponding time interval for a change in V eg 6-7 ms for $\Delta V = 2V$ $V = V_o e^{-t/RC}$ or rearrangement seen [eg Ln $0.7 = 6 \times 10^{-3}$ /RC] R approx 1700 Ω (allow 1600 – 1800) or Time constant = 14 – 20 ms T = RC seen R approx 1700 Ω (allow 1600 – 1800) or Corresponding time interval for a change in V eg 6-7 ms for $\Delta V = 2V$ Q = C V and I = Q/t seen R approx 1700 Ω (allow 1600 – 1800)	**(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)** **(1)**
1(c)(iii)	Use larger capacitor	**(1)**
	Total for question 16	**14**

Question Number	Answer		Mark
2(a)	Use of $Q = CV$ $Q = 0.18$ C Example of calculation $Q = 150 \times 10^{-6}$ F $\times$ 1200 V $Q = 0.18$ C	**(1)** **(1)**	**2**
2(b)	Use of $W = ½ CV^2$ **Or** of $W = ½ QV$ **Or** of $W = ½ Q^2/C$ $W = 110$ J Allow ecf from (a) if $½ QV$ or $½ Q^2/C$ used Example of calculation $W = ½ \times 150 \times 10^{-6}$ F $\times$ $(1200 \text{ V})^2$ $W = 108$ J	**(1)** **(1)**	**2**
2(c)(i)	$R = 86$ (Ω) Example of calculation $R = V/I = 1200$ V / 14 A $R = 85.7$ Ω	**(1)**	
2(c)(ii)	$Q = 0.25\ Q_0$ **Or** $Q = 0.045$ C Use of RC (0.013 s) Use of $Q = Q_0 e^{-t/RC}$ to give $t = 0.018$ s (show that value will give $t = 0.019$ s) [Use of ln 4 gives the correct answer if the − sign is ignored , scores 1 for use of RC use of ¾Q →3.7×10^{-3} s scores 1 mark] **Or** Use of RC Use of $2 \times 0.69 \times RC$ $t = 0.018$ s Example of calculation $Q = 0.25\ Q_0$ $Q = Q_0 e^{-t/RC}$ $0.25\ Q_0 = Q_0 e^{-t/RC}$ $\ln (0.25) = - t/ (86\ \Omega \times 150 \times 10^{-6}$ F) $t = 0.0178$ s	**(1)** **(1)** **(1)**	**3**
2(c)(iii)	Same charge (flows for shorter time) **OR** (Same charge flows for) shorter time	**(1)**	**1**
	Total for question 15		**9**

Question Number	Answer		Mark
3(a)(i)	Capacitor charges up **Or** p.d. across capacitor becomes (equal to) p.d. of cell	**(1)**	
	Negative charge on one plate and positive charge on the other **Or** opposite charges on each plate **Or** movement of electrons from one plate and to the other (around the circuit) (Reference to positive charges moving or to charge moving directly between the plates negates the second mark)	**(1)**	**2**
3(a)(ii)	As capacitor charges current decreases **Or** As capacitor charges current drops to zero **Or** p.d. across capacitor becomes (equal to) p.d. of cell	**(1)**	
	No current through R (means no p.d.) **Or** $V_{cell} = V_{capacitor} + V_{resistor}$	**(1)**	**2**
***3(b)**	(QWC – Work must be clear and organised in a logical manner using technical wording where appropriate)		
	See Q=CV	**(1)**	
	As C increased then charge flows (**Or** more charge stored) on capacitor	**(1)**	
	So p.d. across R	**(1)**	
	Charge flow / current /output signal reversed when plates move apart	**(1)**	
	Or		
	See Q=CV	**(1)**	
	As C increased p.d. across capacitor decreased	**(1)**	
	So p.d. across R must increase	**(1)**	
	p.d. reverses when plates move apart	**(1)**	**4**
3(c)	Use of time constant $=RC$ **Or** attempt to find half life	**(1)**	
	Time constant = 0.005 (s) **Or** $t_{½}$ = 0.0035 (s)	**(1)**	
	Use of $T = 1/f$ (to give T = 0.05 s for the lowest audible frequency)	**(1)**	
	Capacitor completes discharging/charging during cycle of signal	**(1)**	**4**
	(last mark can only be gained if supported by calculations) ($f = 1/CR$ may be used to find the 'frequency of the microphone', rather than time. In this case candidates may just calculate f =200 Hz rather than a time. Only first 3 marks are available) <u>Example of calculation</u> $RC = 10 \times 10^6\ \Omega \times 500 \times 10^{-12}$ F $RC = 0.005$ s $F = 1/T = 1/20 = 0.05$ s		
	Total for question 16		**12**

Question Number	Answer		Mark
4(a)(i)	Discharges / loses charge Idea that discharge is not instantaneous [e.g. over period of time, gradually, exponential]	(1) (1)	**2**
4(a)(ii)	Decay curve starting on *y*-axis and not reaching x-axis [no rise at the end] Initial current marked 2 mA X-axis labelled such that $T_{½}$ = 0.02 to 0.06 s	(1) (1) (1)	**3**
4(a)(iii)	Same graph On negative side of current axis/current in the opposite direction	(1) (1)	**2**
4(b)	Use of $W = ½ CV^2$ / Use of $Q = CV$ and $W = ½ QV$ $W = 5 \times 10^{-4}$ J Example of calculation $W = ½ (10 \times 10^{-6}\text{ F}) (10\text{ V})^2$ $W = 5 \times 10^{-4}$ J	(1) (1)	**2**
4(c)	Use of $\ln V/V_0 = (-)\, t/RC$ or $V = V_0 e^{-t/RC}$ with V and V_0 correct t = 0.13 s Example of calculation $\ln(10\text{ V}/0.7\text{ V}) = t / 0.05$ s t = 0.13 s	(1) (1)	**2**
	Total for question 15		**11**