7(a)(i)	$T = 2\pi / 40\pi = 0.050$ s
7(a)(ii)	$V_{r.m.s.} = 18 / \sqrt{2}$ $= 13$ V
7(b)	sinusoidal curve of period 50 ms from $t = 0$ to $t = 100$ ms
	correct phase (V_{MAX} at $t = 0$, 50, 100 ms and $-V_{MAX}$ at 25, 75 ms etc.)
	maximum and minimum voltages shown as ± 18 V
7(c)	*Any three points from*: • rectification is full-wave • mean power = 14 W • resistance of R = 12 Ω • peak current in R = 1.6 A **or** r.m.s. current in R = 1.1 A • period of <u>output</u> voltage / power = 25 ms ***or*** frequency of <u>output</u> voltage / power = 40 Hz **or** angular frequency of <u>output</u> voltage / power = 250 rad s^{-1}

6(a)(i)	conversion of a.c. to d.c.
6(a)(ii)	full-wave (rectification)
6(a)(iii)	three diodes with correct symbols connected into the circuit
	lower-left diode shown pointing towards the right **and** upper-left and lower-right diodes both shown pointing towards the left
6(b)(i)	$\omega = 18$ (rad s^{-1})
	$T = 2\pi / 18 = 0.35$ s
6(b)(ii)	$V_{r.m.s.} = 34 / \sqrt{2}$ $= 24$ V
6(b)(iii)	sinusoidal 'humps' with minimum $V_{OUT} = 0$ and non-zero V_{OUT} all same sign
	peak V_{OUT} shown as 34 V **or** –34 V
	two 'humps' shown, with V_{OUT} always with same sign **and** $V_{OUT} = 0$ at $t = 0$, $t = 0.175$ s and $t = 0.350$ s **and** non-zero in between
6(c)(i)	correct circuit symbol for capacitor, connected in parallel with resistor
6(c)(ii)	time constant = RC
	$= 56 \times 10^{3} \times 12 \times 10^{-6}$ $= 0.67$ s
6(c)(iii)	$V_{min} = 34 \exp(-0.14 / 0.67)$
	$= 28$ V

8(a)	four diodes shown (one in each gap) with correct circuit symbols
	all four diodes connected in correct direction (pointing left to right)
8(b)(i)	three lines showing exponential decay from the peaks at $0.5T$, $1.0T$ and $1.5T$, ending at the point where the decay meets the next rising peak
	three curved lines rising along the upwards dotted lines from the minima to the peaks at $1.0T$, $1.5T$ and $2.0T$
	minimum V at $(2/3)\ V_0$
8(b)(ii)	from graph: discharge time (from V_0 to $(2/3)V_0$) = $(11/30)\ T$
	$(2/3)\ V_0 = V_0 \exp(-(11/30)T/\tau)$
	$\ln(2/3) = -11T/30\tau$ $\tau = 0.90\ T$
8(b)(iii)	time constant is increased
	line shows a larger minimum voltage **or** smaller difference between maximum and minimum voltages

1	**Defining the problem**
	vary f and measure V **or** f is the independent variable and V is the dependent variable
	keep E <u>constant</u>
	Methods of data collection
	labelled diagram of workable experiment including: • circuit with a.c. supply • oscilloscope connected in parallel with the resistor • workable circuit • oscilloscope and a.c. supply labelled
	labelled signal generator or <u>variable frequency</u> power supply connected across the terminals
	method to determine V or E from oscilloscope, e.g. multiply amplitude / height of wave by y-gain on oscilloscope
	method to determine f from oscilloscope, e.g. determine period T by multiplying number of divisions in 1 cycle or horizontal distance in 1 cycle by the time base **and** $f = 1/T$
	Method of Analysis
	plot a graph of $\frac{1}{V}$ against f or equivalent, e.g. f against $\frac{1}{V}$ Allow logarithms e.g. lg V against lg f.
	relationship valid <u>if</u> a straight line is produced <u>passing through the origin</u> (for lg V against lg f: relationship valid <u>if</u> a straight line is produced with <u>gradient = –1</u>)

1	<table><tr><td>$\frac{1}{V}$ against f</td><td>f against $\frac{1}{V}$</td></tr><tr><td>$K = \frac{lES}{AN^2} \times \text{gradient}$</td><td>$K = \frac{lES}{AN^2} \times \frac{1}{\text{gradient}}$</td></tr></table> (for lg V against lg f: $K = \frac{ElS}{AN^2} \times 10^{-y\text{-intercept}}$).
	Additional detail including safety considerations
	D1 precaution linked to <u>hot coil</u> or <u>hot resistor</u> or prevention of <u>burns</u> from <u>coil</u> or <u>resistor</u>, e.g. use gloves / switch off power supply when not measuring V to prevent burns from coil / resistor
	D2 keep N **and** A **and** l **and** S <u>constant</u>
	D3 method to keep S constant, e.g. switch off power supply between readings to prevent heating of resistor or to allow resistor to cool
	D4 method to determine A, e.g. use calipers / micrometer to measure diameter (of coil) / d **and** $A = \frac{\pi d^2}{4}$
	D5 repeat measurements of diameter d along the length of the coil / in different directions **and** determine the average value of d
	D6 method to determine the value of S, e.g. separate circuit diagram showing resistor connected to ohmmeter, or circuit diagram showing resistor connected to a power supply with an ammeter and voltmeter **and** $S = V / I$
	D7 measure l with a ruler / calipers
	D8 oscilloscope drawn connected across terminals / across signal generator **and** description to determine E
	D9 adjust y-gain for maximum amplitude **or** adjust time base for length of one wave or measure n waves and divide measured time by n
1	D10 method to keep E constant, e.g. check p.d. and alter supply **or** method to keep l constant, e.g. tape coil **or** method to keep A constant, e.g. wind wire on a cylinder