

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

7(a)	rectification (of the input voltage)
	full-wave
7(b)(i)	$P = V^2 / R$
	or maximum $V = 9.0 \text{ V}$
	$P_{\text{MAX}} = 9.0^2 / 370 = 0.22 \text{ W}$
7(b)(ii)	sinusoidal shape with minima sitting on the time axis
	correct frequency and phase, with minima at 0, 0.02, 0.04, 0.06 and 0.08 s and maxima at 0.01, 0.03, 0.05 and 0.07 s
	all maxima shown at 0.22 W
7(b)(iii)	mean power = peak power / 2 = $0.22 / 2$ $= 0.11 \text{ W}$
7(c)	power–time graph is identical
	(so) mean powers are equal

4(a)(i)	$\text{amplitude} = \frac{1}{2} \times 7.2 \times 10^{-15}$ $= 3.6 \times 10^{-15} \text{ m}$
4(a)(ii)	$\omega = 2\pi / (0.20 \times 10^{-6})$ $= 3.1 \times 10^7 \text{ rad s}^{-1}$
4(a)(iii)	$v_0 = \omega x_0$ $v_0 = 3.1 \times 10^7 \times 3.6 \times 10^{-15} = 1.1 \times 10^{-7} \text{ m s}^{-1}$
4(b)(i)	$I_0 = nAv_0e$ $= 8.5 \times 10^{28} \times 4.3 \times 10^{-4} \times 1.1 \times 10^{-7} \times 1.60 \times 10^{-19}$ $= 0.64 \text{ A}$
4(b)(ii)	sketch: two cycles of sinusoidal curve of amplitude I_0 and period $0.20 \mu\text{s}$ correct phase, with $I = +I_0$ at $t = 0$
4(b)(iii)	equation of form $I = I_0 \cos \omega t$ value of I_0 used matches answer to (b)(i) and value of ω used matches answer to (a)(ii) [if (a)(ii) and (b)(i) correct then $I = 0.64 \cos (3.1 \times 10^7 t)$]
4(b)(iv)	$I_{\text{r.m.s.}} = I_0 / \sqrt{2}$ $= 0.64 / \sqrt{2}$ $= 0.45 \text{ A}$

7(a)(i)	$P = I_0^2 R$
7(a)(ii)	$P = 4I_0^2 R$
7(b)	sketch: square wave of period T , with P always non-zero horizontal lines, from 0 to $0.5T$ and from $1.0T$ to $1.5T$, all at the same level that the scale indicates to be $I_0^2 R$ horizontal lines, from $0.5T$ to $1.0T$ and from $1.5T$ to $2.0T$, at a level that is four times higher than the lower lines
7(c)(i)	$\langle P \rangle = (5/2)I_0^2 R$
7(c)(ii)	$\langle P \rangle = I_{\text{r.m.s.}}^2 R$ $I_{\text{r.m.s.}}^2 R = (5/2)I_0^2 R$ $I_{\text{r.m.s.}} = \sqrt{(5/2)} I_0$