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}

7(a)	rectification (of the input voltage)
	full-wave
7(b)(i)	$P = V^2 / R$ **or** maximum $V = 9.0$ V
	$P_{MAX} = 9.0^2 / 370 = 0.22$ 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 W
7(c)	power–time graph is identical
	(so) mean powers are equal

4(a)(i)	amplitude $= \frac{1}{2} \times 7.2 \times 10^{-15}$ $= 3.6 \times 10^{-15}$ m
4(a)(ii)	$\omega = 2\pi / (0.20 \times 10^{-6})$ $= 3.1 \times 10^{7}$ rad s^{-1}
4(a)(iii)	$v_0 = \omega x_0$
	$v_0 = 3.1 \times 10^{7} \times 3.6 \times 10^{-15} = 1.1 \times 10^{-7}$ m s^{-1}
4(b)(i)	$I_0 = nAv_0e$ $= 8.5 \times 10^{28} \times 4.3 \times 10^{-4} \times 1.1 \times 10^{-7} \times 1.60 \times 10^{-19}$
	$= 0.64$ A
4(b)(ii)	sketch: two cycles of sinusoidal curve of amplitude I_0 and period 0.20 μs
	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)	$I_{r.m.s.} = I_0 / \sqrt{2}$ $= 0.64 / \sqrt{2}$ $= 0.45$ 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)	$\langle P \rangle = I_{r.m.s.}^2 R$
	$I_{r.m.s.}^2 R = (5/2) I_0^2 R$ $I_{r.m.s.} = \sqrt{(5/2)}\ I_0$