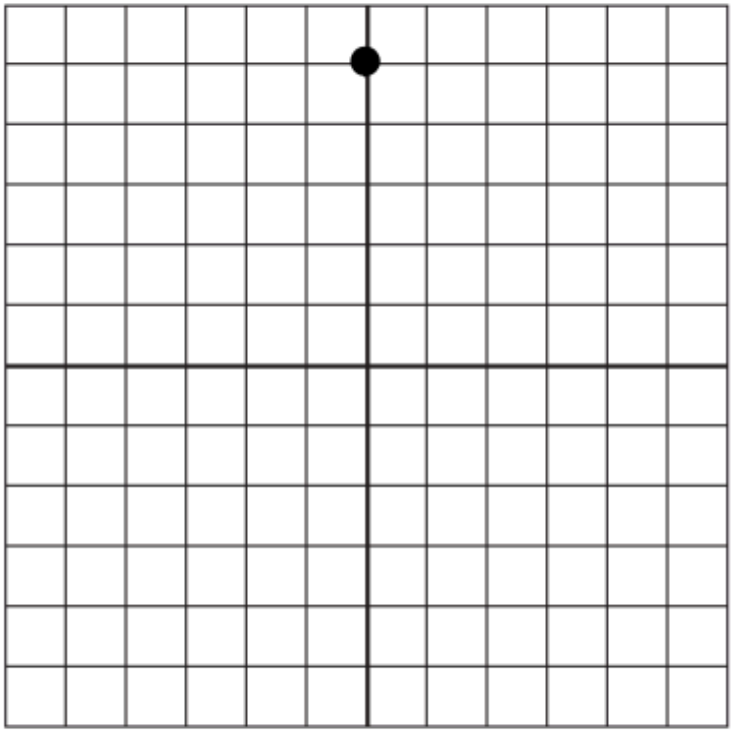
1)

	(i)	10.0 (V) ✓	**1**
	(ii)	V_{rms} = 10.0/√2 = 7.1 (V) ✓	**1**
	(iii)	time period = 3 × 2 = 6 (ms) ✓	**1**
	(iv)	frequency = 1/0.006 or 1/6 ✓ frequency = 167 ✓ (Hz)	**2**
		Total	**5**

2)

a			**1**
b	i	the **voltage reverse/changes** direction/sign ✓ this makes **the spot** move up and down **or** correct explanation of lack of horizontal movement ✓	**2**
b	ii	length of line = 8 divisions peak to peak = 8 × 0.5 = 4.0 V ✓✓	**2**
b	iii	(peak = 2.0 V) rms = 2.0/√2 ✓ = 1.4 V ✓	**2**
		Total	**7**

3)

(a) (i)	$230 \times \sqrt{2} = 325$ (V) ✓ (2 × 325 =) 650 to 651 V✓	 allow doubling their incorrect peak voltage (162.6 x 2) by use of $\sqrt{2}$ as an attempt to find peak-to-peak for 1 mark but not just 2 x 230	2
(a) (ii) Must see (a) (i)	(*use of* $P = V^2/R$) $P = 230^2/12$✓ $P = 4.4 \times 10^3$ (W)✓ cao 2 sig. figs. Incorrect <u>answer must be supported by working</u> ✓	Allow their incorrect answer (a)(i)$^2 \div 12$ **Or** $325^2 \div 12$ as a use of for 1 mark Alternative For first mark $I = \frac{V}{R}$ **and** $P = VI$ allowing their incorrect answer (a)(i) or 325 as sub for V *for 1 mark* Answers 8.8 kW (325V) and 35 kW (650V)	3
(b) (i)	there is a pd/voltage across the cable ✓ pd/voltage across cooker is 230 V minus this pd/voltage ✓ 2nd mark depends on 1st mark in all	The current is lower due to the resistance of cable / The current is lower as circuit resistance increases✓ pd across oven is lower <u>since</u> V=I x Resistance of element ✓ **or** Resistance of the cable is in series with element✓ Voltage splits (in ratio) across these resistances ✓	2
(b) (ii)	resistance of cable = 2 × 3.15 × 0.0150 = 0.0945✓ $V = \frac{12}{12 + R_{cable}} \times 230$✓ =228 V ✓ cao	Allow power 10 error here **Or** $I = \frac{230}{12 + R_{cable}}$ **and** $V = \left(\frac{230}{12 + R_{cable}}\right) \times 12$ Allow their incorrect R_{cable} correctly substituted for 2nd marking	3

(b) (iii)	230 – their (b) (ii) or 19 (A) quoted for current or equivalent seen in equation (230 / 12.0945)✓ (P =) 34.2 to 42.3(W) ✓ correct working ecf as P = (230- (b)(ii))^2 / their R_{cable}		2
(b) (iv)	minimise power loss / maximise efficiency of oven / ensure element gets as hot as possible✓ avoid overheating/fires✓	not just to carry a large current / larger pd across element Either order	2

4)

a		**The candidate's writing should be legible and the spelling, punctuation and grammar should be sufficiently accurate for the meaning to be clear.** The candidate's answer will be assessed holistically. The answer will be assigned to one of three levels according to the following criteria. **High Level (Good to excellent): 5 or 6 marks** The information conveyed by the answer is clearly organised, logical and coherent, using appropriate specialist vocabulary correctly. The form and style of writing is appropriate to answer the question. *The candidate states that the power supply is connected*	max 6

		to the input of the oscilloscope. The time base is switched off and the y gain adjusted until a complete vertical line is seen on the screen. The length of the line is measured and this is converted to peak to peak voltage using the calibration. The peak voltage is divided by root two to get the rms voltage and this is compared with the stated value. The time base is now switched on and adjusted until a minimum of one cycle is seen on the screen. The length of one cycle is measured and this is converted to time using the time base setting. Frequency is the reciprocal of this time. **Intermediate Level (Modest to adequate): 3 or 4 marks** The information conveyed by the answer may be less well organised and not fully coherent. There is less use of specialist vocabulary, or specialist vocabulary may be used incorrectly. The form and style of writing is less appropriate. *The candidate states that the power supply is connected to the input of the oscilloscope. The y gain adjusted. The length of the line/height of peak is measured. The peak voltage is divided by root two to get the rms voltage. The time base is now switched on and adjusted until a minimum of one cycle is seen on the screen. The length of one cycle is measured and this is converted to time using the time base setting.* **Low Level (Poor to limited): 1 or 2 marks** The information conveyed by the answer is poorly organised and may not be relevant or coherent. There is little correct use of specialist vocabulary. The form and style of writing may be only partly appropriate. *The candidate states that the power supply is connected to the input of the oscilloscope. The length of the line/height of peak is measured. The time base is now switched on and adjusted until a minimum of one cycle is seen on the screen. The length of one cycle is measured and this is converted to time.* **The explanation expected in a competent answer should include a coherent selection of the following points concerning the physical principles involved and their consequences in this case.** • power supply connected to oscilloscope input • time base initially switched off • y gain adjusted to get as long a line as possible • length of line used to find peak to peak voltage • rms voltage found • time base switched on and adjusted to get several cycles on the screen • use the time base setting to find period • use period to find frequency • compare vales with stated values	

b	i	*(use of P = IV)* I = 24/12 = 2.0 (A) ✓	1

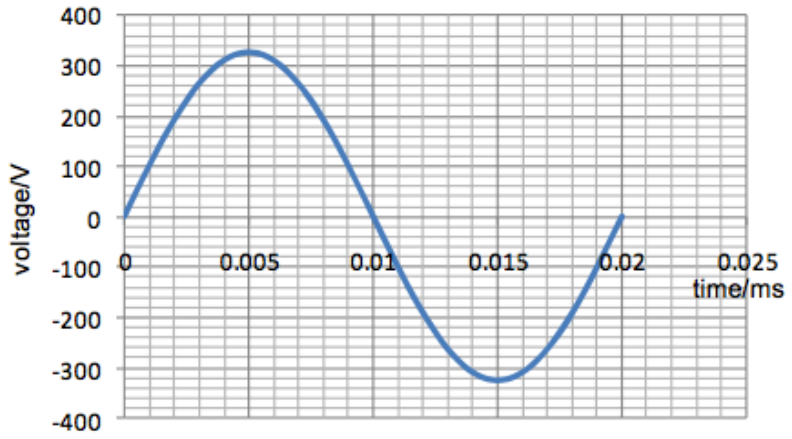
b	ii	peak current = √2 × 2.0 = 2.8 (A) ✓	1

b	iii	peak power = √2 × 12 × √2 × 2.0 ✓ = 48 (W) ✓	2

5)

(a)	(i)	128 V✓	1	
(a)	(ii)	64 V	1	CE from (i)
(a)	(iii)	V_{rms}= 64/√2 ✓=45.3 V✓	2	CE from (ii)
(a)	(iv)	frequency = 1/0.01✓= 100✓ Hz✓	3	do not accept kHz for unit mark unless correct for candidate value if use 10 s instead of 10 ms then can score second two marks
(b)		horizontal line✓ through y = 45 (44 – 48) x =0 ✓	2	CE from (a)(iii)+/- half square straight line must extend to at least to 6.0 ms
(c)		connect to *y-input*✓ adjust/change time base✓ so that each division is 2.0 ms OR 20 ms across screen✓ reference to y-gain/sensitivity✓	3_{max}	if inappropriate numbers quoted for y gain then lose last mark

6)

(a)		the square root of the mean of the squares of all the values of the voltage in one cycle ✓ **or** the equivalent dc/steady/constant voltage that produces the same **heating effect/power** ✓	**1**
(b)	(i)	peak voltage = 230 × √2 ✓ peak voltage = 325 V (or 324 V) ✓	**2**
(b)	(ii)	average power = 230 × 0.26 = 60 W ✓	**1**
(c)		 shape and symmetrical with consistent values of *x* at *y* = 0 and consistent y_{max} (must be at least one cycle) ✓ appropriate scale y-axis ✓ correct peak values (to within one 2 mm square) ✓ correct period (accept 0.02 **or** 20) ✓	**4**
		Total	**8**

7)

(a)	(i)	use of 1.5 cycles ✓ conversion to time eg time for 1.5 cycles = 10 × 1.5 = 15 ms ✓ calculation of frequency eg frequency = 1 / 0.010 = 100 ± 3 Hz ✓	**7**
	(ii)	peak voltage = 1.5 × 2 ✓ = 3.0 V ✓	
	(iii)	rms voltage = 3.0/√2 ✓ (ce from (a) (i)) rms voltage = 2.12 V ✓	
(b)		vertical line is formed ✓ of length equal to twice the peak voltage ✓ because trace no longer moves horizontally **or** spot moves **just** up and down ✓	**max 2**
		Total	**9**