AC Basics

Mark Scheme

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Alternating Currents
Sub Topic	AC Basics
Paper Type	Theory
Booklet	Mark Scheme

Time Allowed: **52 minutes**

Score: **/43**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1	**(a**	**(i)**	*either* heating effect in a resistor $\propto$ (current)^2	B1	
			square of value of an alternating current is always positive	B1	
			so heating effect	A0	
			or current moves in opposite directions in resistor during half-cycles	(B1)	
			heating effect is independent of direction	(B1)	[2]
		(ii)	that value of the direct current	M1	
			producing the same heating effect (as the alternating current) in a resistor	A1	[2]
	(b)	**(**	induced e.m.f. proportional to the rate	M1	
			of change of (magnetic) flux (linkage)	A1	[2]
		(ii)	flux in core is in phase with current in the primary coil	B1	
			(induced) e.m.f. in secondary because coil cuts the flux	B1	
			flux and rate of change of flux are not in phase	B1	[3]
2	**(a)**	**(i)**	period = 1/50	C1	
			t_1 = 0.03 s	A1	[2]
		(ii)	peak voltage = 17.0 V	A1	[1]
		(iii)	r.m.s. voltage = 17.0/√2		
			= 12.0 V	A1	[1]
		(iv)	mean voltage = 0	A1	[1]
	(b)		power = V^2/R	C1	
			= $12^2/2.4$		
			= 60 W	A1	[2]

3	(a) (i)	$2\pi f = 380$	C1	
		frequency = 60 Hz	A1	[2]
	(ii)	$I_{RMS} \times \sqrt{2} = I_0$	C1	
		$I_{RMS} = 9.9 / \sqrt{2}$		
		$= 7.0$ A	A1	[2]
	(b)	power = I^2R	C1	
		$R = 400 / 7.0^2$		
		$= 8.2\,\Omega$	A1	[2]

4	(a	power / heating depends on I^2	M1	
		so independent of current direction	A1	[2]
	(b)	*either* maximum power = I_0^2R *or* average power = I_{RMS}^2R	M1	
		$I_0 = \sqrt{2} \times I_{RMS}$	M1	
		maximum power = 2 × average power		
		ratio = 0.5	A1	[3]

5	**(a)**	*either*	the value of steady / constant voltage	M1	
			that produces same power (in a resistor) as the alternating voltage	A1	[2]
		or	if alternating voltage is squared and averaged	(M1)	
			the r.m.s. value is the square root of this averaged value	(A1)	
	(b)		220 V	A1	[1
	(ii)		156 V	A1	[1
	(iii)		60 Hz	A1	[1
	(c)		power = V_{rms}^2 / R	C1	
			R = 156^2 / 1500		
			= 16 Ω	A1	[2]

6	**(a**			the (value of the) direct current	M1	
				that dissipates (heat) energy at the same rate (in a resistor)	A1	**[2]**
				allow 'same power' and 'same heating effect'		
	(b)			$\sqrt{2}I_{rms} = I_0$	B1	**[1]**
	(c)	**(i)**		power $\propto I^2$ or $P = I^2R$ or $P = VI$	C1	
				ratio = 2.0 (allow 1 s.f.)	A1	**[2]**
		(ii)		advantage: e.g. easy to change the voltage	B1	
				disadvantage: e.g. cables require greater insulation		
				..... rectification – with some justification	B1	**[2]**
	(d)	**(i)**		3.0 A (allow 1 s.f.)	A1	
		(ii)		3.0 A (allow 1 s.f.)	A1	**[2]**
				Total		**[9]**