OCR
Oxford Cambridge and RSA

Cambridge Technicals

Engineering

Unit **4:** Principles of electrical and electronic engineering

Level 3 Cambridge Technical Certificate/Diploma in Engineering
05822 - 05825

Mark Scheme for June 2018

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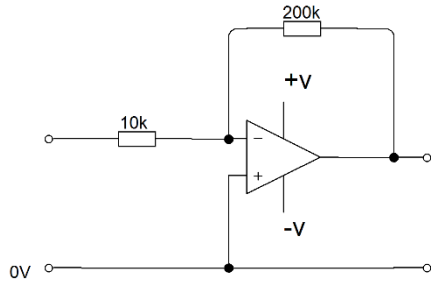
This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

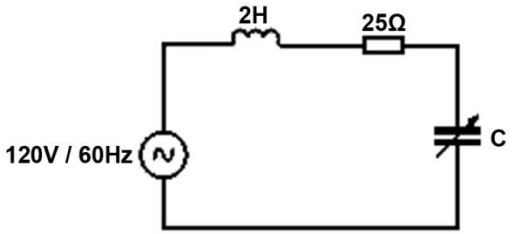
All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

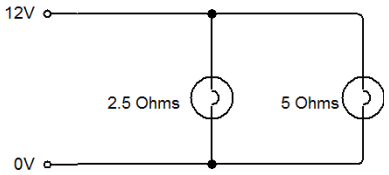
Mark schemes should be read in conjunction with the published question papers and the report on the examination.

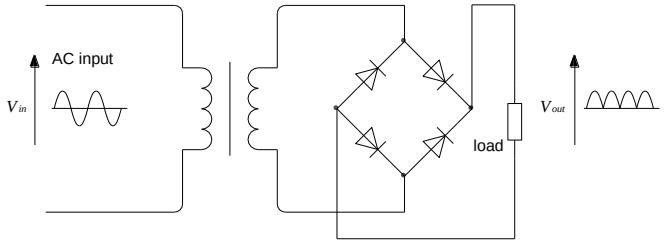
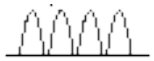
Annotations

Annotation	***Meaning***
tick	Correct response
cross	Incorrect response
Omission mark (carat)	Incomplete response
ECF	Error carried forward
BOD	Benefit of doubt
NBOD	No benefit of doubt
RE	Rounding error

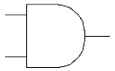
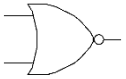
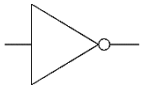
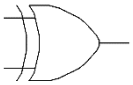
Question			Answer	Marks	Guidance
1	(a)	(i)	Select R_{input} – Any suitable value between 1KΩ and 100KΩ. For example: If R_{input} = 10 (KΩ) $R_{feedback} = -A_v R_{input}$ = - (-20x10KΩ) $R_{feedback}$ =200 (KΩ)	1 1 1 1	Note: $R_{feedback}$ could be selected and R_{input} calculated. Rearrangement Substitution Do not accept negative values of R
		(ii)	 Correct op amp symbol Correct position of R_{input} Correct position of $R_{feedback}$ Connection of non-inverting input to 0V Values correctly added.	 1 1 1 1 1	 Condone omission of power supply Allow ECF from 1(a)(i)

Question			Answer	Marks	Guidance
2	(a)	(i)	 Variable capacitor Resistor with value, Inductor with value, Supply with value, All components connected in series	1 1 1 1 1	Allow any sensible and unambiguous symbol for C_{var} Unit not required for the mark Unit not required for the mark Unit not required for the mark
		(ii)	$2\pi fL = \frac{1}{2\pi fC}$ $2.\pi\,.60.2 = \frac{1}{2.\pi.60.C}$ $(2.\pi\,.60.2)^2.2 = \frac{1}{C}$ $284245 = \frac{1}{C}$ C=3.5 **μF** **or** 0.00000035 **F** or $3.5\text{x}10^{-6}$ **F**	1 1 1 1 1	Correct formulae selection Substitution Rearrangement Correct answer Correct unit

Question			Answer	Marks	Guidance
3	(a)	(i)	 2 lamps in parallel Supply in parallel Correct values	 1 1 1	 Max 2 marks awarded if lamps are in series Award marks if units not stated.
		(ii)	$\frac{1}{R_{Total}} = \frac{1}{R_1} + \frac{1}{R_2}$ $\frac{1}{R_{Total}} = \frac{1}{2.5} + \frac{1}{5} = \frac{3}{5}$ R_{Total} =1.67 (Ω)	1 1 1	For applying knowledge from Unit 2 LO3 For applying knowledge from Unit 2 LO3 Substitution 1.7/1.67
		(iii)	$P=V^2/R$ $=12^2/5$ = 28.8**W** Or P=VI I=12/5=2.4A P=12 x 2.4A= 28.8**W**	1 1 1 (1) (1) (1)	For applying knowledge from Unit 2 LO3 For applying knowledge from Unit 2 LO3 Allow ECF 29/28.8 For applying knowledge from Unit 2 LO3 For applying knowledge from Unit 2 LO3 Allow ECF 29/28.8
		(iv)	W=PT W=28.8 x 1.5 W=43.2 **Wh**	1 1 1	For applying knowledge from Unit 2 LO3 For applying knowledge from Unit 2 LO3 Allow ECF **Allow correct numerical answers in 0.043/0.0432 kWh / 160000 J/ 155520 J / 160/156/155.5 KJ. Not (k)Ws**

Question			Answer	Marks	Guidance
4	(a)	(i)		1 1 1 1 1	Output voltage indicated correctly Input voltage indicated correctly 2 diodes in bridge. 2 diodes connected correctly 4 Diodes connected correctly.
		(ii)	V_{in} – Sine wave  V_{out} – Fully rectified sine wave 	1 1	At least one complete cycle must be seen At least one complete cycle must be seen
	(b)		$2\pi f = 126$ f = 126/2 π = 20.1 (Hz)	1 1	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>(a)</td><td></td><td>
<table>
<tr><th>A</th><th>B</th><th>Q</th></tr>
<tr><td>0</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td></tr>
</table>
</td><td>2</td><td>1 mark for every 2 correct rows</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(b)</td><td></td><td>
<table>
<tr><th>Logic Gate</th><th>Boolean Expression</th></tr>
<tr><td>  </td><td>$Q=A.B$</td></tr>
<tr><td>  </td><td>$Q = \overline{A + B}$</td></tr>
<tr><td>  </td><td>$Q = \overline{A}$</td></tr>
<tr><td>  </td><td>$Q = A \oplus B$
or
$\overline{A}.B + A.\overline{B}$</td></tr>
</table>
</td><td>1

1

1</td><td>The first logic gate expression has been completed in the question.</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>A</th><th>B</th><th>X</th><th>Y</th><th>Q</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
</table>
</td><td>6</td><td>1 mark for every 2 correct entries in the X column.
1 mark for every 2 correct entries in the Y column.
1 mark for every 2 correct entries in the Q column.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Exclusive Or or XOR</td><td>1</td><td>Allow ECF (if relevant)</td></tr>
</table>

Question			Answer	Marks	Guidance
6	(a)		Purpose of a motor starter: • To protect from overload or faults • A Motor Starter is used for the smooth starting of a motor. It consists mainly of a variable resistance placed in series with the armature The purpose of this resistance is: • To increase the resistance incrementally • Thus restricting the armature current to a safe value • To disconnect the motor in case of an overload • To disconnect the motor when the field current is reduced beyond limit Any four valid points (1 mark/point) stated.	4	
	(b)		Purpose and operation of a no volt coil: • To disconnect the motor if the supply voltage fails • Provide automatic tripping when when there is a major voltage dip • Prevents the motor restarting when the power supply is switched on • When the power supply is cut the coil demagnetises and the starter handle spring returns to the ‘off’ position. Any four valid points (1 mark/point) used to explain purpose and operation of the no volt coil.	4	

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