OCR
Oxford Cambridge and RSA

Level 3 Cambridge Technical in Engineering

05822/05823/05824/05825/05873

Unit 4: Principles of electrical and electronic engineering

Tuesday 23 May 2017 – Morning

Time allowed: 1 hour 30 minutes

You must have:
- the formula booklet for Level 3 Cambridge Technicals in Engineering (inserted)
- a ruler (cm/mm)
- a scientific calculator

First Name						Last Name					
Centre Number						Candidate Number					
Date of Birth	D	D	M	M	Y	Y	Y	Y			

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Where appropriate, your answers should be supported with working.
- Marks may be given for a correct method even if the answer is incorrect.
- An answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- This document consists of **12** pages.

FOR EXAMINER USE ONLY	
Question No	**Mark**
1	/12
2	/12
3	/6
4	/12
5	/6
6	/12
Total	**/60**

Answer **all** the questions.

1 Fig.1 shows a five resistor network.

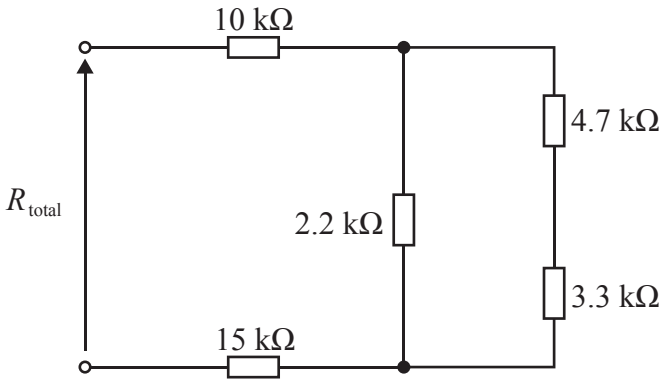

Fig.1

(a) Calculate the total resistance R_{total}.

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..... **[4]**

(b) Fig. 2 shows a circuit with two fixed resistors.

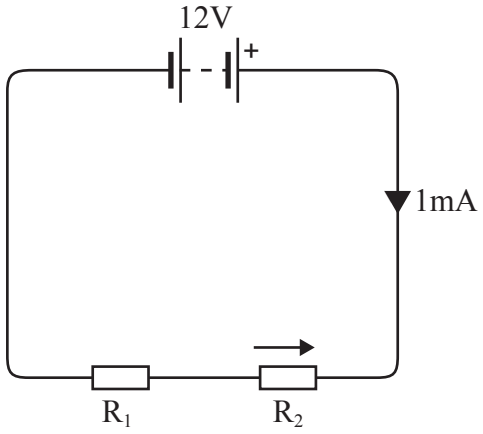

Fig. 2

Calculate V_2, the voltage drop across R_2, when $R_1 = 4.7\,k\Omega$.

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.....

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..... **[4]**

(c) A DC supply has an internal resistance of $3\,\Omega$ and an open circuit voltage of 24 V.

(i) State the value of the load that will enable maximum power transfer.

..... **[1]**

(ii) Calculate the power dissipated in the load.

.....

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..... **[3]**

2 Fig. 3 shows an AC circuit with a 70 Ω resistor, 33 μF capacitor and 0.5H inductor connected in series with a 240V, 50Hz supply.

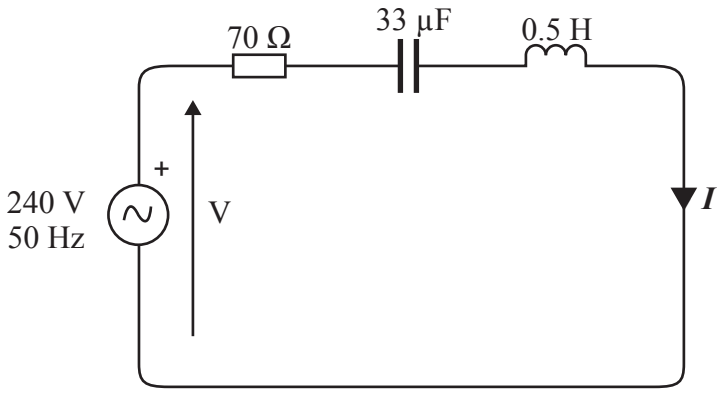

Fig. 3

(a) (i) Calculate the phase angle *ø*.

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.....

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..... **[4]**

(ii) Calculate ***I***.

..... **[1]**

(iii) Draw a phasor diagram to represent the circuit shown in Fig. 3.

Show the **values** of V, I and the phase angle ϕ clearly on this diagram.

[3]

(b) The instantaneous value of a voltage waveform is represented by $v = 25\sin 628.3t$.

(i) Calculate the frequency of the waveform.

.....

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..... **[2]**

(ii) Calculate the periodic time.

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..... **[2]**

3 Fig. 4 shows the circuit diagram for a shunt wound DC motor.

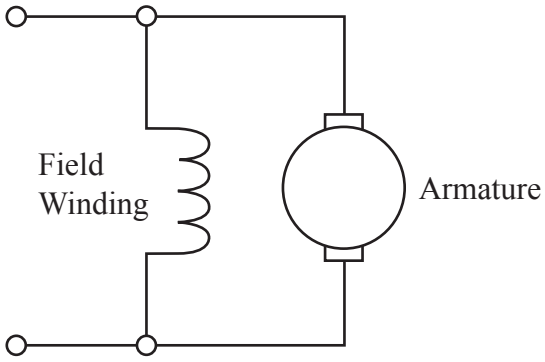

Fig. 4

(a) Explain with the aid of circuit diagrams **two** methods of controlling the speed of a shunt wound DC motor.

Method 1

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Method 2

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[6]

4 A star connected three phase four wire network is widely used as a system of three phase electricity supply in the UK.

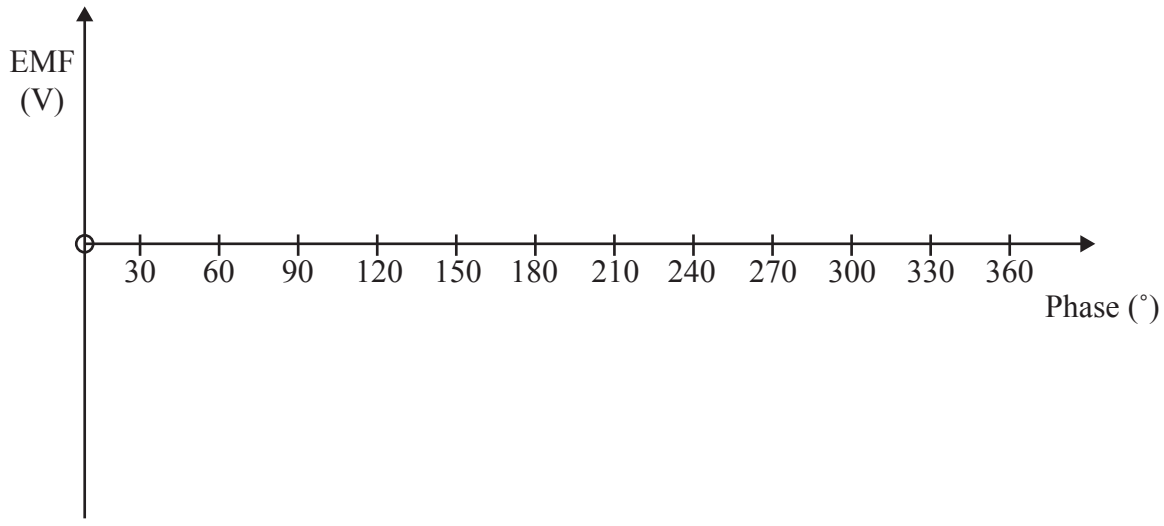
(a) Draw a circuit diagram that shows how this network is connected.

Indicate the phase voltages and the line voltages on the diagram.

[4]

(b) Sketch the waveforms which show one voltage cycle of a three phase supply.

Label phase 1, phase 2 and phase 3 on the sketch.



[4]

(c) State the typical voltage of a three phase supply in the UK.

..... **[1]**

(d) Explain with the aid of a circuit diagram how half wave rectification of an AC waveform can be achieved by using a single diode.

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..... **[3]**

5 A summing amplifier is required for use in an audio mixer circuit.

(a) Draw a circuit diagram of a **three** input summing amplifier.

[3]

(b) State the formula for V_{out} in a **three** input summing amplifier.

..... **[1]**

(c) The input resistors in a **three** input summing amplifier each have a value of 10 k Ω. The feedback resistor is 50K Ω.

Calculate the value of V_{out} if the input voltages are 0.2 V, 0.5 V and 0.25 V.

..... **[2]**

6 **(a)** Complete the table below by drawing the correct logic gate symbol for each Boolean expression.

Boolean Expression	Logic Gate Symbol
$Q = \overline{A.B}$	
$Q = A + B$	
$Q = A \oplus B$	
$Q = \overline{A}$	

[4]

(b) A digital system will only operate if three switches **X**, **Y** and **Z** are correctly set. An output signal, Q=1, will occur if switches **X and Y** are both in the ON position **or** if **X** is in the OFF position **and** Z is in the ON positon. Assume ON=1, OFF =0.

(i) Complete the truth table for the above system.

X	Y	Z	Q
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

(ii) Draw a circuit diagram of the combinational logic that will be required in the digital system.

[4]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question number(s) must be clearly shown – for example 1(d) or 6(b).