

## Level 3 Cambridge Technical in Engineering 05822/05823/05824/05825

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

**Tuesday 24 May 2016 – Afternoon**

**Time allowed: 1 hour 30 minutes**

**You must have:**

- the formula booklet for Level 3 Cambridge Technical in Engineering (inserted)
- a ruler (cm/mm)
- a scientific calculator

<b>First Name</b>						<b>Last Name</b>					
<b>Centre Number</b>						<b>Candidate Number</b>					
<b>Date of Birth</b>											

#### 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 **16** pages. Any blank pages are indicated.

FOR EXAMINER USE ONLY	
Question No	Mark
1	/10
2	/10
3	/11
4	/10
5	/8
6	/11
<b>Total</b>	<b>/60</b>

Answer **all** questions.

1 (a) An electrical fan is rated at 300 W and is connected to a 240 V mains supply for five hours.

(i) Calculate the energy used by the fan.

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

(ii) Calculate the current drawn by the fan motor.

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

(b) Fig. 1 shows a resistor network.

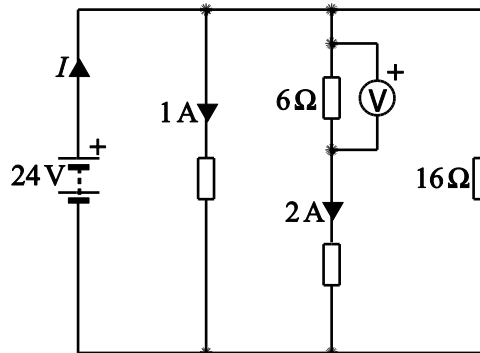


Fig. 1

(i) Calculate the value that will be displayed on the voltmeter.

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

(ii) Calculate the current  $I$ .

.....

.....

.....

..... [4]

2 (a) Draw a phasor diagram to represent a purely inductive AC circuit.

[2]

(b) A capacitor of  $22 \mu\text{F}$  is connected in series with a  $50 \Omega$  resistor across a supply of frequency  $60 \text{ Hz}$ .

Calculate the impedance ( $Z$ ).

.....

.....

.....

..... [4]

(c) Calculate the phase angle for the circuit shown in Fig. 2.

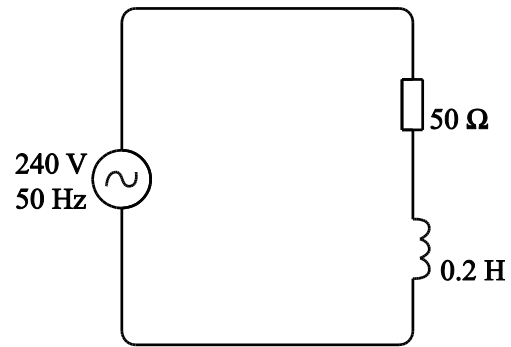


Fig. 2

.....

.....

.....

..... [4]

3 (a) State the function of a simple generator.

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

(b) Explain with the aid of labelled diagrams the difference between a series-wound DC motor and a shunt-wound DC motor.

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

(c) A 240 V shunt wound DC motor draws a current of 30 A. The motor has a field winding resistance of  $100\ \Omega$  and the armature resistance  $0.4\ \Omega$ .

(i) Calculate the current in the field winding.

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

(ii) Calculate the e.m.f. ( $E$ ) that occurs in the DC motor.

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

4 (a) Explain with the aid of labelled diagrams how a power supply **or** electrical components can be protected by:

(i) the use of a fuse.

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

(ii) the use of a diode.

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



- (b) An AC voltage is input into a full wave rectifier. Sketch the output voltage of the rectifier on labelled axes.

[2]

- (c) Explain with the aid of a labelled diagram how full wave rectification of an AC waveform can be achieved by using two diodes.

.....

.....

.....

..... [4]

5 (a) Describe the difference between a digital signal and an analogue signal.

.....

..... [2]

(b) Fig. 3 shows an electronic circuit used as a preamplifier in a domestic audio system.

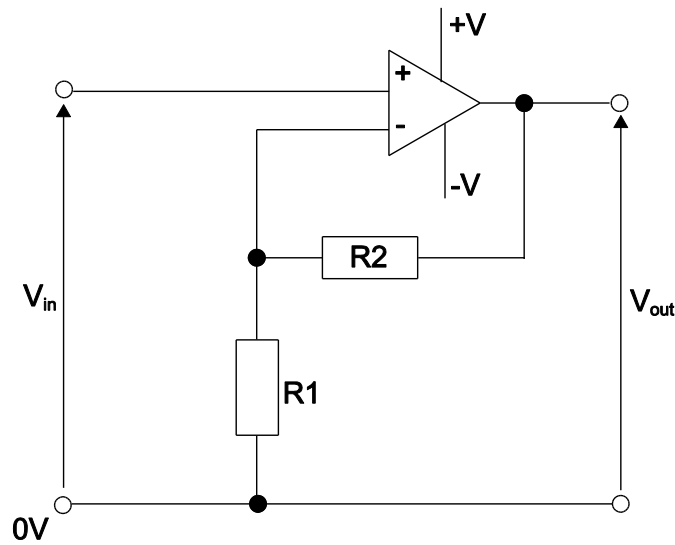


Fig. 3

(i) State the name of the circuit and explain the function of the resistors in this circuit.

Name of circuit.....

.....

.....

.....

..... [3]

- (ii) The voltage gain for the circuit in Fig. 3 is given by:

$$\mathbf{Voltage\ Gain = 1 + \frac{R2}{R1}}$$

If  $R1 = 10\text{ K}\Omega$ ,  $R2 = 100\text{ K}\Omega$  and the input voltage is  $0.2\text{ V}$ , calculate the output voltage of the circuit.

.....

.....

..... [3]

6 (a) Complete the table below by drawing the circuit symbol for each of the logic gates identified.

Logic Gate Name	Circuit Symbol
NAND	
XOR	

[2]

(b) Fig. 4 shows part of a combinational logic circuit used in an engine management system.

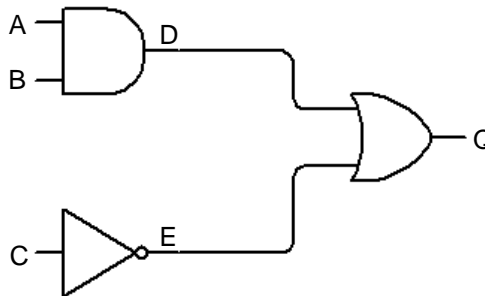


Fig. 4

Complete the truth table for this logic circuit, giving the logic levels at A, B, C, D, E and Q.

A	B	C	D	E	Q

[4]

- (c) Draw the combinational logic circuit represented by the Boolean expression

$$Q = \overline{(A + B)} \cdot C.$$

[2]

- (d) Explain with the aid of a circuit symbol the function of a T-type bistable.

.....

.....

..... [3]

**END OF QUESTION PAPER**

**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown.

This section of the page is a large, empty area for writing answers. It is bounded on the left by a solid vertical line and on the top, bottom, and right by horizontal dotted lines. The dotted lines are spaced evenly down the page, providing a guide for writing. There are 25 horizontal dotted lines in total, creating 24 rows of writing space.

A vertical solid line is positioned on the left side of the page. From this line, 25 horizontal dotted lines extend across the page, creating a series of rows for writing.

A large rectangular area with a solid vertical line on the left side and horizontal dotted lines extending across the page, providing a grid for writing answers.



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