OCR
Oxford Cambridge and RSA

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

First Name		Last Name	
Centre Number		Candidate Number	
Date of Birth			

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
Total	**/60**

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.

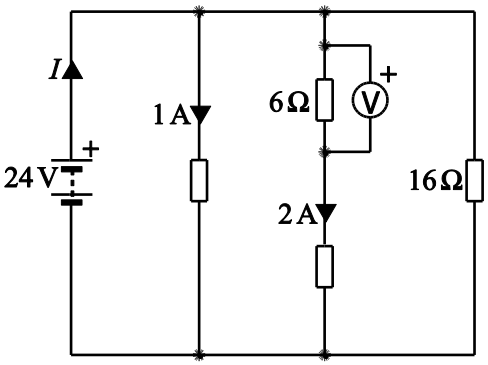

Fig. 1

(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 μF is connected in series with a 50 Ω resistor across a supply of frequency 60 Hz.

Calculate the impedance (Z).

.....

.....

.....

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

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

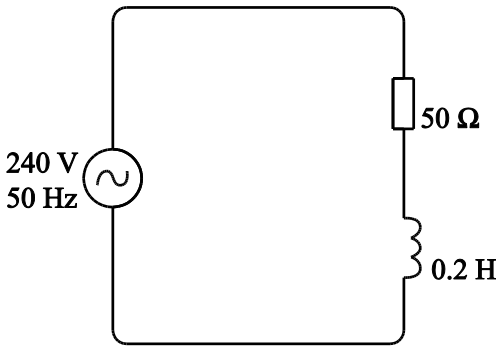

Fig. 2

.....

.....

.....

..... **[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 Ω and the armature resistance 0.4 Ω.

(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.

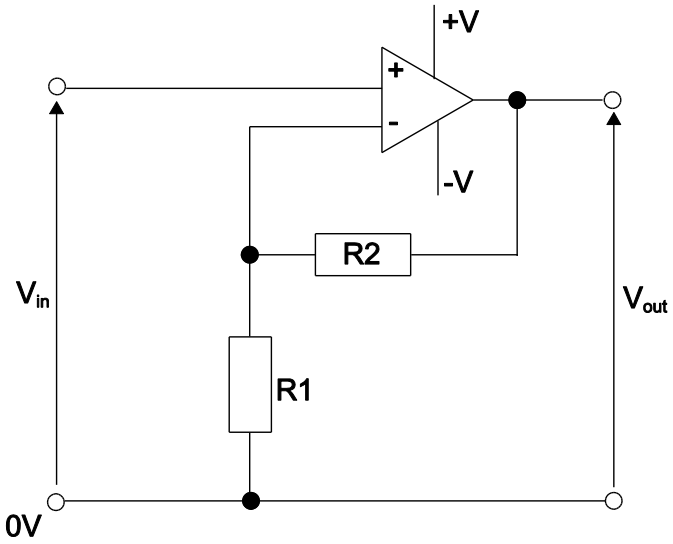

Fig. 3

(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:

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

If $R1$ = 10 KΩ, $R2$ = 100 KΩ and the input voltage is 0.2 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.

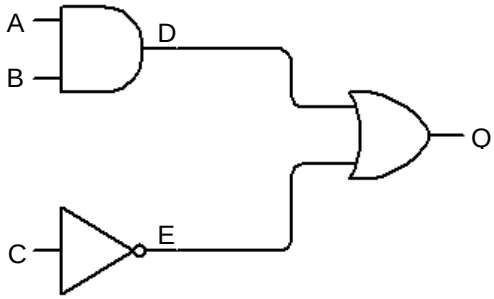

Fig. 4

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

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

[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.