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 17 January 2017 – Morning

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 **12** pages.

FOR EXAMINER USE ONLY	
Question No	**Mark**
1	/12
2	/12
3	/10
4	/6
5	/8
6	/12
Total	**/60**

Answer **all** questions.

1 **(a)** An ammeter with an internal resistance of 25 Ω is used to measure the current in a 150 Ω load resistor. The supply voltage is 24 V.

(i) Calculate the expected reading on the ammeter.

Do not include the ammeter resistance in this calculation.

.....

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

(ii) Calculate the actual value of current in the circuit.

.....

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

(iii) Calculate the power dissipated in the ammeter.

.....

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

(b) The digital multimeter in Fig. 1(a) is used to measure the value of resistance between points **X** and **Y** in the resistor network shown in Fig. 1(b).

Fig. 1(a)

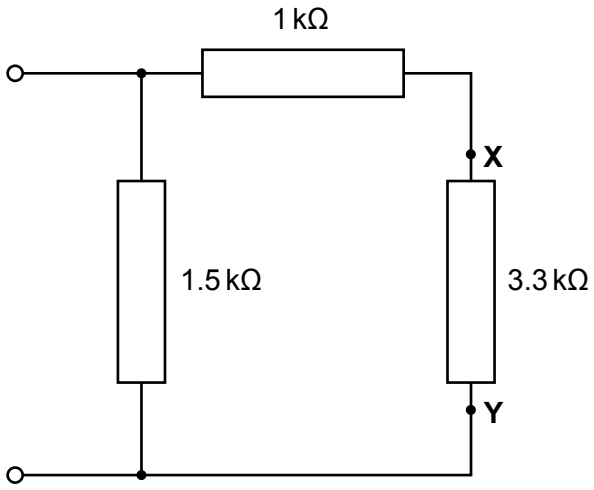

Fig. 1(b)

(i) A pair of multimeter probes have been supplied.

Explain how to connect the probes to measure the value of resistance between points **X** and **Y**.

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.....

.....

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

(ii) Calculate the value of resistance that will be displayed on the multimeter.

.....

.....

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

(iii) State the multimeter range that should be selected when taking the resistance measurement. The selected range should allow the maximum number of significant figures to be displayed.

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

2 A coil with an inductance of 0.2 mH and a resistance of 75 Ω is connected across an AC supply of $v = 210\sin 314.2t$.

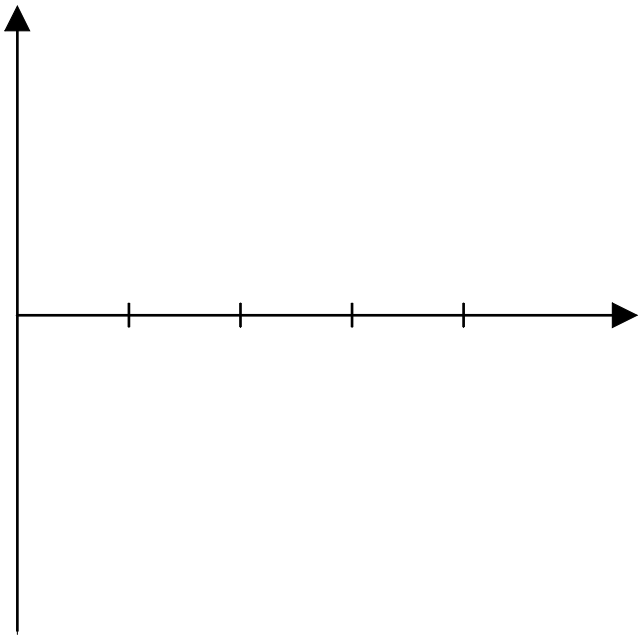
(a) Draw the circuit diagram for the AC circuit described above.

Include component and supply values on the diagram.

[3]

(b) On the axes below sketch the voltage waveform for the AC supply used in the circuit.

Include values of peak voltage and periodic time on your sketch.



[4]

(c) Calculate the current flowing through the coil.

.....

.....

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

(d) Calculate the voltage drop across the inductance.

.....

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

3 A series wound DC motor has an armature resistance of 0.25 Ω and a field resistance of 0.5 Ω. The motor is under load and is drawing a current of 10 A. The motor is connected to a 240 V supply.

(a) Draw a circuit diagram to represent the motor circuit.

Include resistor, voltage and current values on your diagram.

[5]

(b) Calculate the e.m.f (***E***) generated by the motor.

.....

.....

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

(c) State **one** application of a series wound DC motor and give **one** reason why it would be suitable for this application.

Application: .....

Reason: .....

.....

[2]

4 **(a)** Draw the circuit diagram of a three-phase three wire delta connected electricity system. Indicate the line voltages on the diagram.

[3]

(b) State the UK convention for the phase sequence of a three-phase supply.

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

(c) State **two** advantages of a three-phase system over a single phase system.

1 .....

.....

2 .....

.....

[2]

5 **(a)** Draw a labelled circuit symbol of an operational amplifier.

[3]

(b) An inverting amplifier is connected with an input resistor R_{in}=10 kΩ and a feedback resistor R_f = 120 kΩ. The voltage gain of the inverting amplifier is given as = $\frac{-R_f}{R_{in}}$.

(i) Calculate the voltage gain of the inverting amplifier.

.....

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

(ii) Calculate the output voltage when the input voltage is 0.2 V.

.....

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

(iii) Calculate the output voltage when the input voltage is -1.5 V.

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

6 The circuit symbol for a rising edge triggered D-type bistable is shown in Fig. 2.

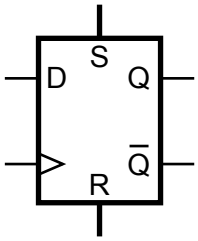
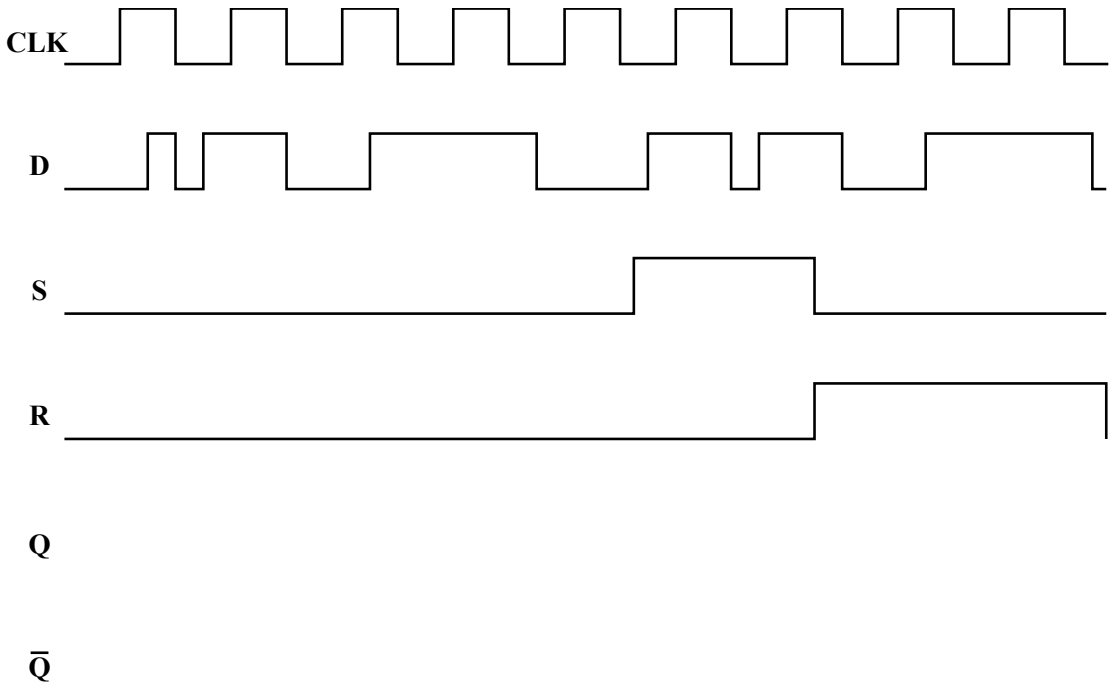


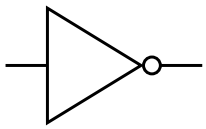
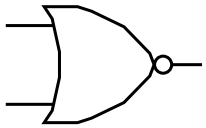
Fig. 2

(a) Complete Q and $\overline{Q}$ on the timing diagram below which represents the operation of the bistable shown in Fig. 2.



[5]

(b) Complete the table below.

Circuit Symbol	Logic Gate Name
	
	

[2]

(c) Draw the truth table for the Boolean expression = $\overline{A.B + A.C}$

[5]

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).

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