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Level 3 Cambridge Technical in Engineering
05822/05823/05824/05825/05873

Unit 4: Principles of electrical and electronic engineering

Tuesday 22 May 2018 – Morning

Duration: 1 hour 30 minutes

C304/1806

C304/1806

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	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 answer 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	/9
2	/10
3	/12
4	/9
5	/12
6	/8
Total	**/60**

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Answer **all** the questions.

1 **(a)** An inverting operational amplifier is required for a preamplifier circuit. The amplifier must have a closed loop voltage gain of -20.

(i) For an inverting operational amplifier circuit

$$Voltage\ gain = A_v = -\frac{R_{feedback}}{R_{input}}$$

Give suitable values for $R_{feedback}$ and R_{input} in the inverting amplifier circuit.

$R_{feedback}$ = ... $K\Omega$

R_{input} = ... $K\Omega$

[4]

(ii) Draw the circuit diagram for the inverting operational amplifier circuit.
Add the resistor values to the circuit diagram.

[5]

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2 **(a)** An AC circuit has an inductor of 2 H connected in series with a resistor of 25 Ω and a variable capacitor. The supply voltage is 120 V, 60 Hz.

(i) Draw the circuit diagram. Include all component values.

[5]

(ii) Calculate the value of capacitance in the circuit when $X_L = X_C$. Indicate the units used in your answer.

Capacitance = ... **[5]**

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3 **(a)** In a low voltage lighting system, **two** filament lamps are connected in parallel to a 12 V DC supply. The resistance of one lamp is 5 Ω and the resistance of the other 2.5 Ω.

(i) Draw the circuit diagram. Indicate all values on the diagram.

[3]

(ii) Calculate the total resistance of the circuit.

Total resistance = ... Ω **[3]**

(iii) Calculate the power dissipated in the 5 Ω filament lamp. Indicate the units used in your answer.

Power dissipated = ... **[3]**

(iv) Calculate the energy used by the 5 Ω filament lamp if the circuit is operational for 1.5 hours. Indicate the units used in your answer.

Energy used = ... **[3]**

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4 **(a)** Fig. 1 shows an incomplete bridge rectifier circuit.

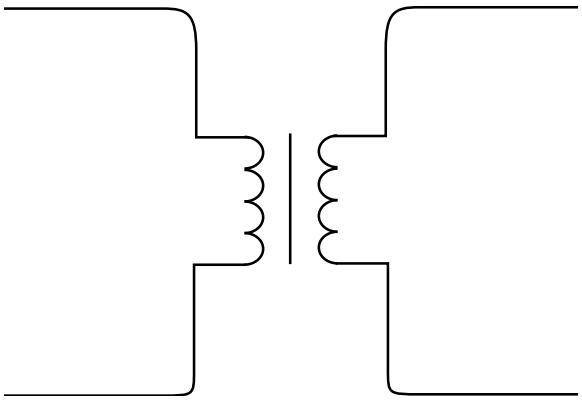
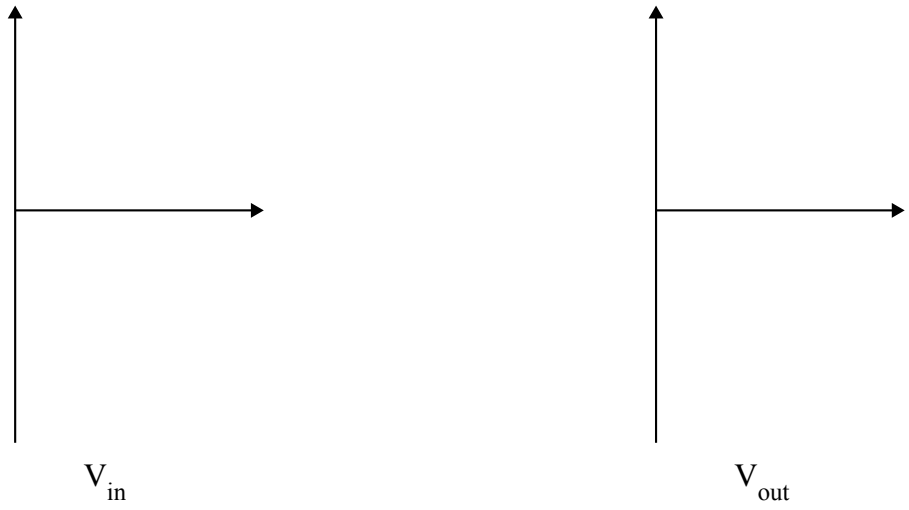


Fig. 1

(i) Complete the circuit diagram in Fig.1 to show the bridge rectifier. Indicate the input voltage (V_{in}) and the output voltage (V_{out}) on the diagram.

[5]

(ii) Sketch the waveforms for V_{in} and V_{out} on the axes below.



[2]

(b) The instantaneous value of the input voltage to the bridge rectifier is v volts where v=100sin126t. Calculate the frequency of the voltage signal.

Frequency = ...Hz **[2]**

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5 **(a)** The circuit symbol for a two input logic gate is shown in Fig. 2.

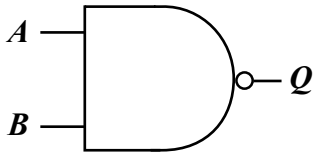


Fig. 2

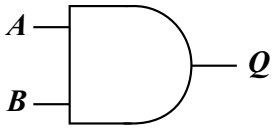
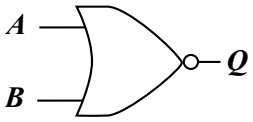
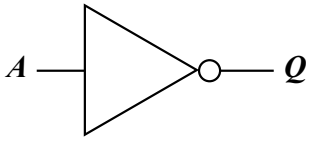
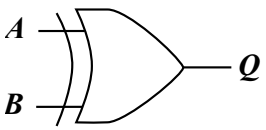
Complete the truth table below for the logic gate shown.

A	*B*	*Q*
0	0	
0	1	
1	0	
1	1	

[2]

(b) Complete the table below.

The first one has been done for you.

Logic Gate	Boolean Expression
	*Q=A.B*
	
	
	

[3]

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(c) A combinational logic circuit is shown in Fig. 3.

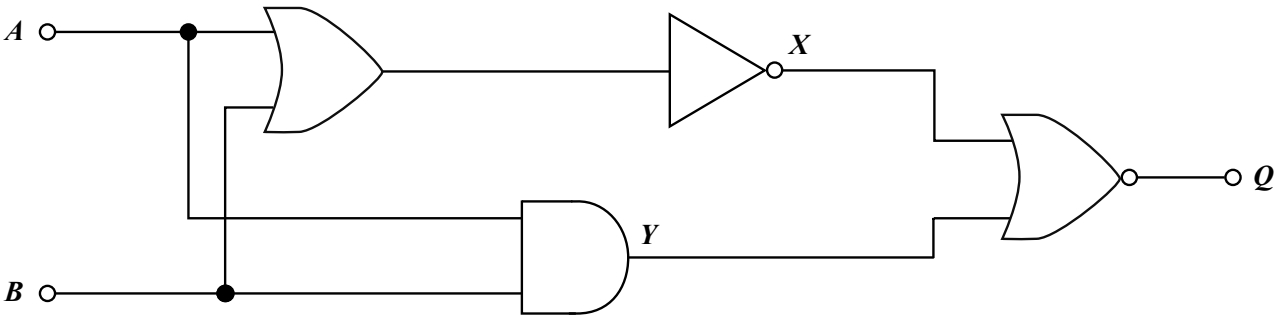

Fig. 3

(i) Complete the truth table for the circuit shown in Fig. 3.

A	*B*	*X*	*Y*	*Q*
0	0			
0	1			
1	0			
1	1			

[6]

(ii) State the name of the logic gate equivalent to the combinational logic circuit shown in Fig. 3.

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

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6 **(a)** Give **four** reasons why starters are used in DC motors.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

(b) Fig. 4 shows the diagram of a two point starter, used in a series wound DC motor.

[4]

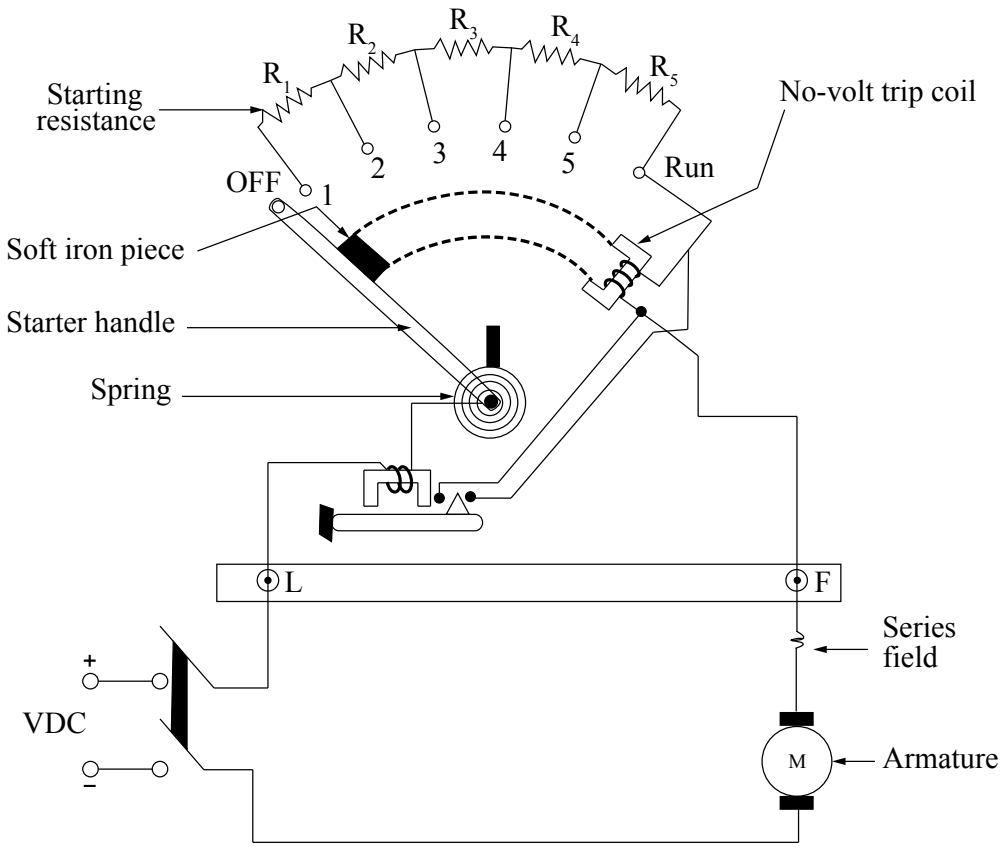

Fig. 4

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Explain the purpose and operation of the no-volt trip coil in the motor starter shown in Fig. 4.

.....

.....

.....

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.....

.....

.....

END OF QUESTION PAPER

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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 6(a) or 6(b).

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