

X025/11/01

NATIONAL
QUALIFICATIONS 2012

WEDNESDAY, 6 JUNE
9.00 AM – 11.30 AM

ELECTRONIC AND
ELECTRICAL
FUNDAMENTALS
INTERMEDIATE 2

100 marks are allocated to this paper.

Answer **all** questions in Section A (50 marks).

Answer **two** questions from Section B (25 marks each).

In all your answers to questions requiring calculations, all working **must** be shown.



Section A

Attempt all the questions in this section (50 marks)

1. Convert the following numbers.

(a) 21_{10} Decimal to Binary 2

(b) $B9_{16}$ Hexadecimal to Binary 2

(c) 10011001_2 Binary to Decimal 2

(6)

2. With reference to Figures Q2(a) and Q2(b) name the components shown and state **one** application for each.

(a)

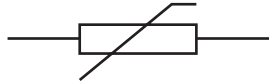


Figure Q2(a)

2

(b)

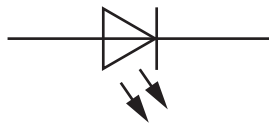


Figure Q2(b)

2

(4)

3. In an experiment to plot the magnetic field between two magnetic poles, a brass ring and an iron ring were placed in the field and the field pattern recorded. The results are shown in Figures Q3(a) and Q3(b).

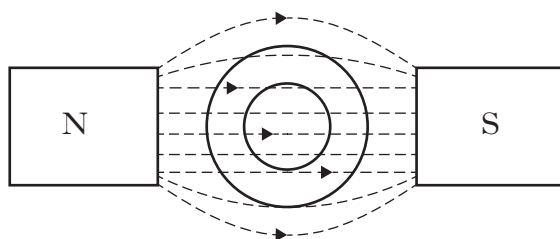


Figure Q3(a)

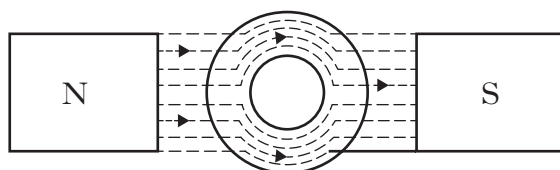


Figure Q3(b)

- (a) State which result shows the experiment with the brass ring and justify your answer. 4
- (b) A 500 mm conductor carrying a current of 10 A is placed in a magnetic field of 5 T. Determine the force acting upon the conductor. 3

(7)

4.

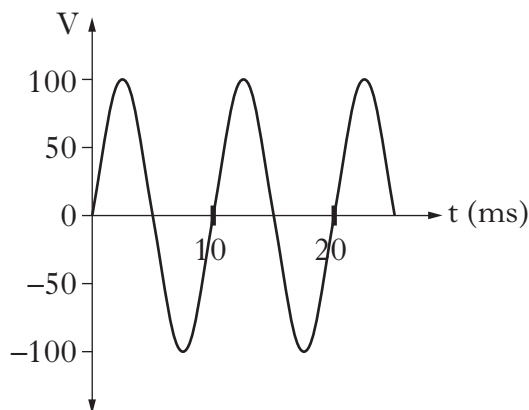


Figure Q4

The waveform shown in Figure Q4 was obtained from a display instrument. Determine the following.

- (a) The peak to peak value of the waveform. 1
- (b) The r.m.s. value of the waveform. 2
- (c) The period of the waveform. 1

(4)

5. One possible circuit configuration using an operational amplifier is shown in Figure Q5. The supply voltages are not shown.

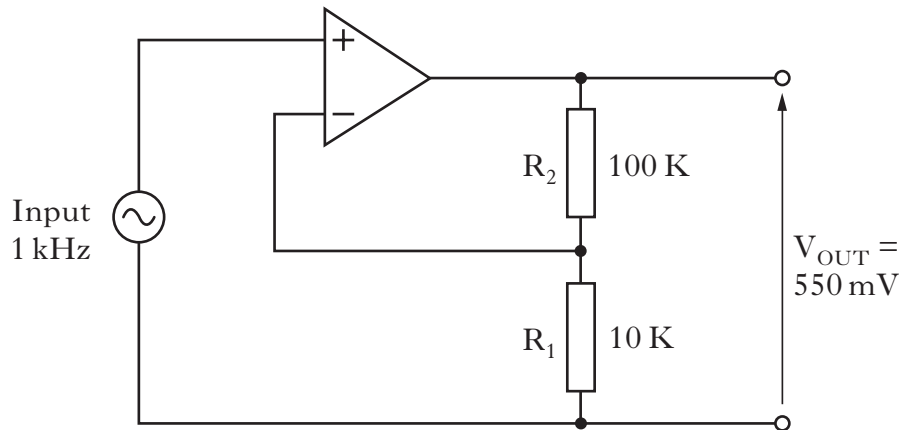


Figure Q5

- | | |
|---|------------|
| (a) Name the circuit configuration. | 1 |
| (b) Calculate the gain of the circuit. | 2 |
| (c) Calculate the input voltage to the circuit. | 3 |
| | (6) |
-
- | | |
|--|------------|
| 6. Draw, using BS symbols, the logic diagrams for the following expressions. | |
| (a) $Z = (A + \bar{B} + C) \cdot (A + B + \bar{C})$ | 3 |
| (b) $Z = \overline{(\bar{A} + \bar{B} + C) \cdot (A + \bar{B} + \bar{C})}$ | 3 |
| | (6) |

7. A diode is connected as shown in Figure Q7. Using the information provided, and assuming the volt drop across the diode is 0.7 V:

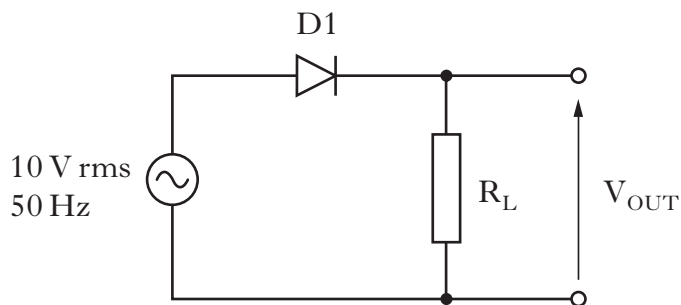


Figure Q7

- (a) Sketch the input and output voltage waveforms; 3
- (b) Explain the difference between the two waveforms. 3
- (6)**

8. The circuit shown in Figure Q8 is a common emitter amplifier.

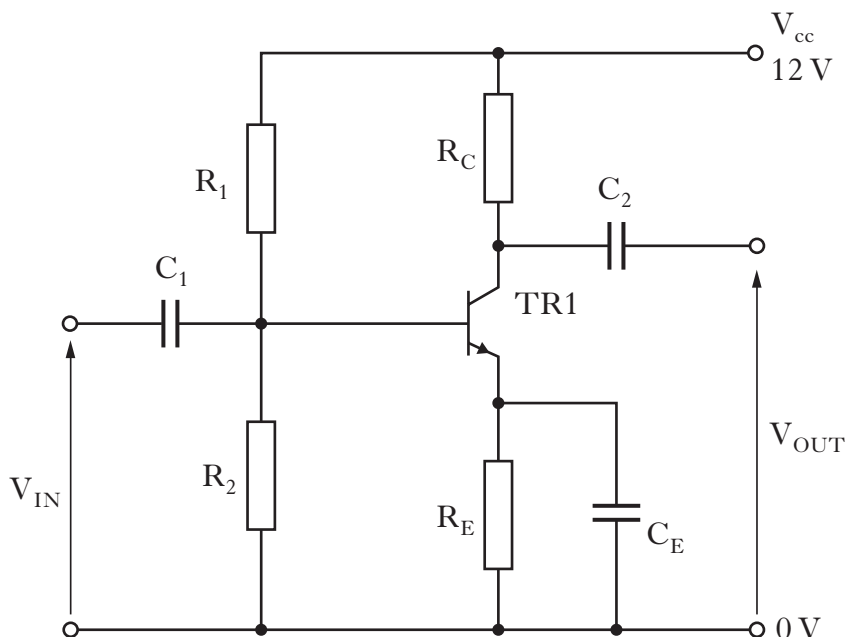


Figure Q8

- (a) State the phase angle between V_{IN} and V_{OUT} . 1
- (b) When component C_E is removed, the gain of the circuit falls drastically. Explain why the gain of the amplifier falls when C_E is removed. 3
- (c) State the purpose of R_1 and R_2 in Figure Q8. 1
- (5)**

9.

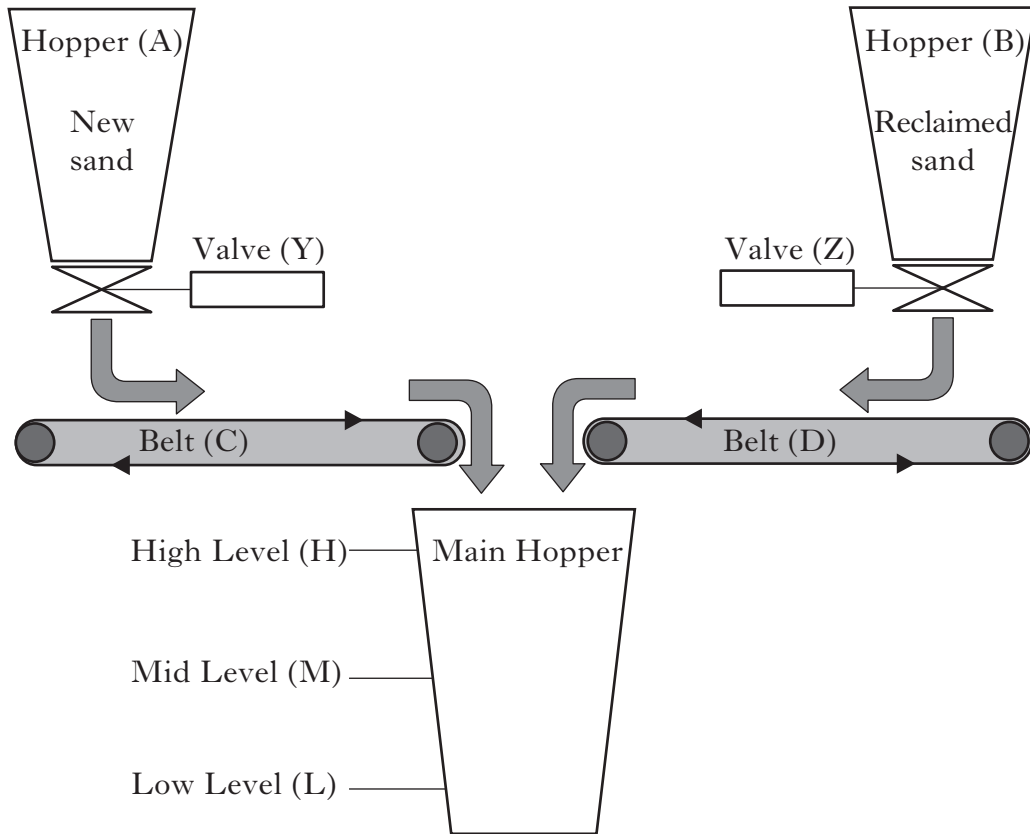


Figure Q9

The sketch in Figure Q9 shows an industrial sand mixing system. The valve (Z) on the reclaimed sand hopper (B) can only be opened if the belt (C) is stopped and the belt (D) is running and the main sand hopper is at Mid Level (M) but not at High Level (H).

(a) Determine the logic output required to open the valve (Z). 3

(b) Draw, using BS symbols, a logic diagram for this system using only 2-input gates. 3

(6)

Total Marks (50)

Section B

Attempt any TWO questions in this section (50 marks)
Each question is worth 25 marks

10. (a) Figure Q10(a) shows the currents in a circuit. Determine the currents I_1 , I_2 , I_3 , I_4 , I_5 and I_6 .

6

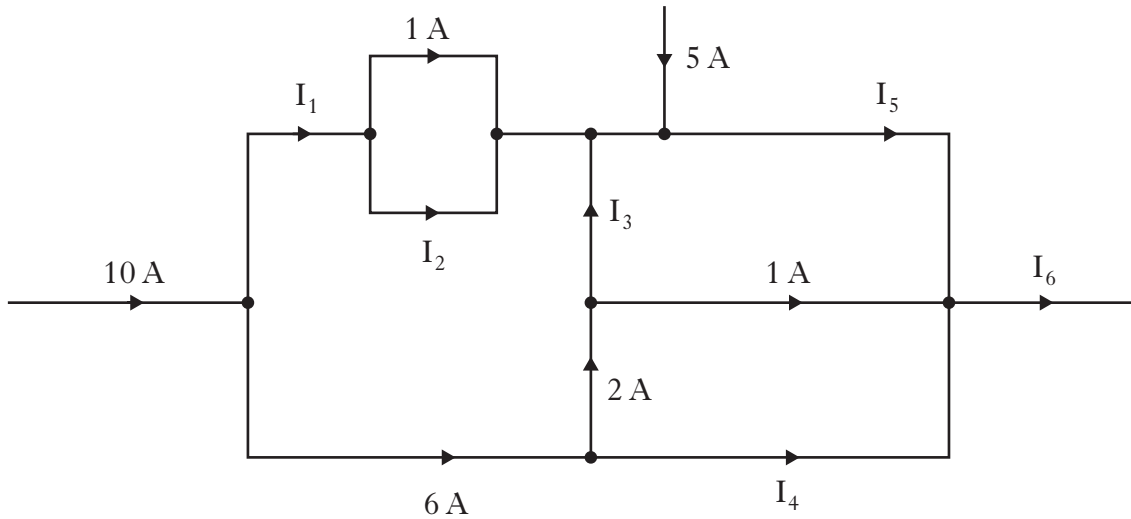


Figure Q10(a)

- (b) Figure Q10(b) shows the voltages in a circuit. Determine the voltages V_1 , V_2 , and V_{IN} .

3

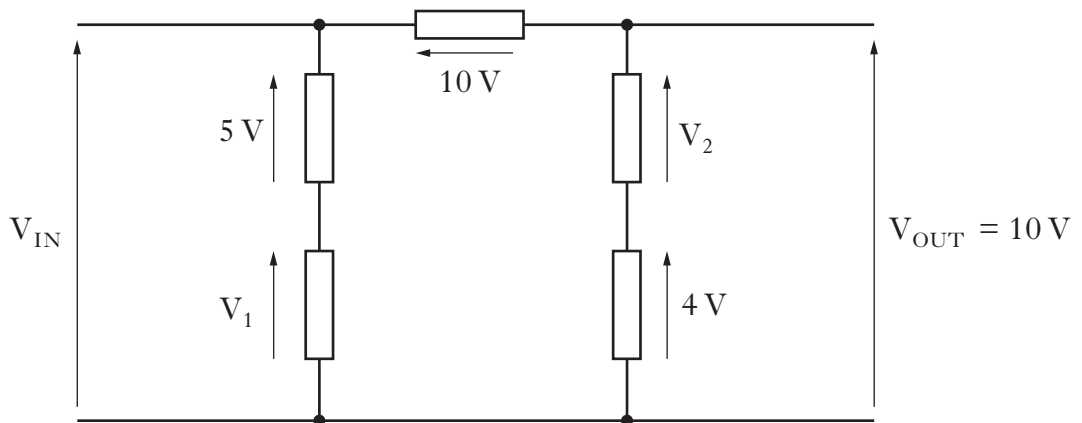


Figure Q10(b)

[Turn over

10. (continued)

- (c) For the circuit shown in Figure Q10(c) below, the variable resistor (R_V) can be varied between $15\ \Omega$ and $25\ \Omega$.

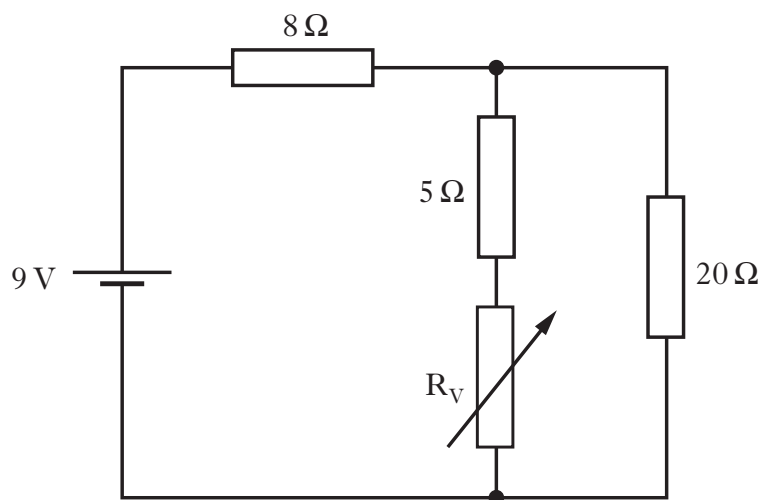


Figure Q10(c)

Determine:

- | | |
|---|-------------|
| (i) the maximum circuit resistance; | 3 |
| (ii) the minimum circuit resistance; | 3 |
| (iii) the maximum supply current; | 2 |
| (iv) the minimum supply current; | 2 |
| (v) the maximum circuit power; | 2 |
| (vi) the maximum power dissipated by the $8\ \Omega$ resistor; | 2 |
| (vii) the maximum energy consumed by the $8\ \Omega$ resistor in 1.5 hours. | 2 |
| | (25) |

11. (a) Add the following binary numbers.

(i) $1100_2 + 0101_2$

2

(ii) $0111_2 + 1101_2$

2

(b) Draw the logic circuit using ANSI symbols for the following logic expression.

$$Z = \bar{A}.B + \bar{A}.C + \bar{A}.\bar{B}.\bar{C}$$

4

(c) For the circuit shown in Figure Q11(c),

(i) state the type of gate used;

1

(ii) determine the logic level at points A and C when point B is Low (logic 0).

2

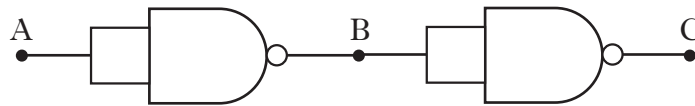


Figure Q11(c)

(d) For the circuit shown in Figure Q11(d),

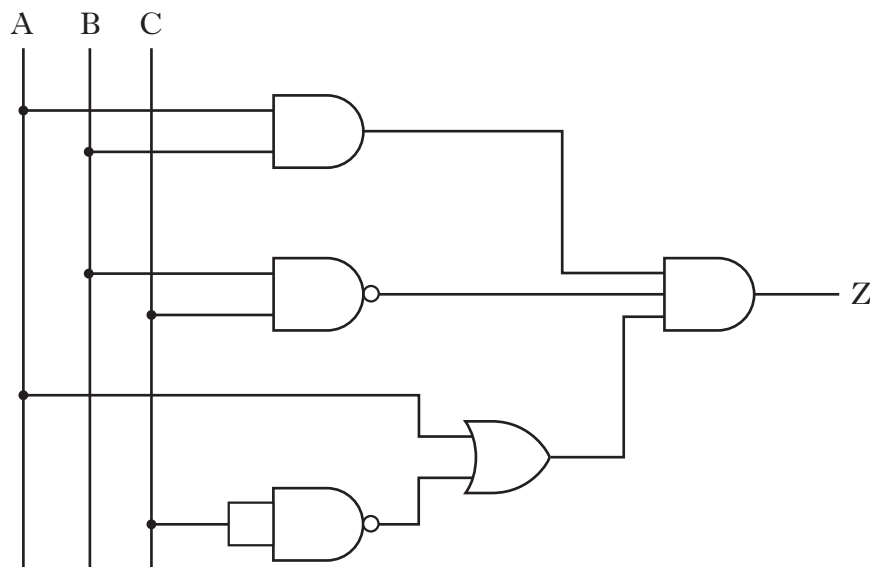


Figure Q11(d)

(i) determine the circuit Boolean expression;

3

(ii) construct the circuit truth table.

8

A fault condition causes all the NAND gate outputs to be High (logic 1).

(iii) Determine the new outputs for Z.

3

(25)

12. (a) For the circuit shown in Figure Q12(a) below, the variable resistor (R_V) can be varied between $5\text{ k}\Omega$ and $15\text{ k}\Omega$.

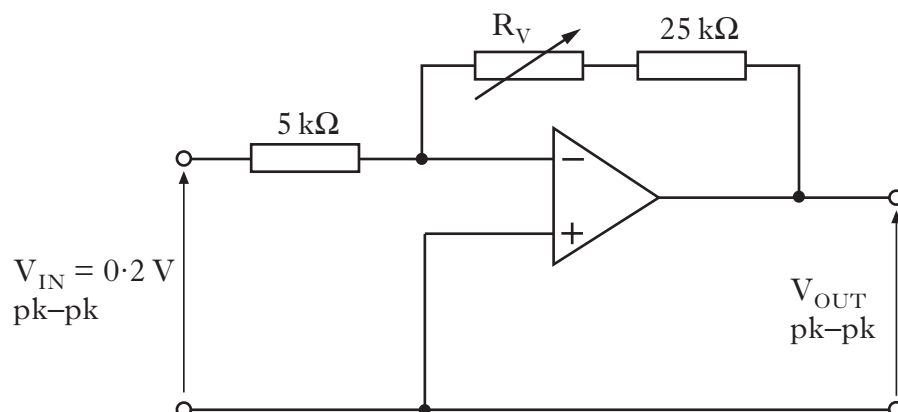


Figure Q12(a)

- | | |
|---|----------|
| (i) Name the circuit configuration. | 1 |
| (ii) State the names given to the input terminals labelled ‘-’ and ‘+’. | 2 |
- Determine:
- | | |
|--|----------|
| (iii) the maximum $V_{OUT\text{ pk-pk}}$; | 2 |
| (iv) the minimum $V_{OUT\text{ pk-pk}}$; | 2 |
| (v) the value of R_V required to give a $V_{OUT\text{ pk-pk}}$ of 1.4 V . | 3 |

12. (continued)

(b) For the circuit shown in Figure Q12(b) below,

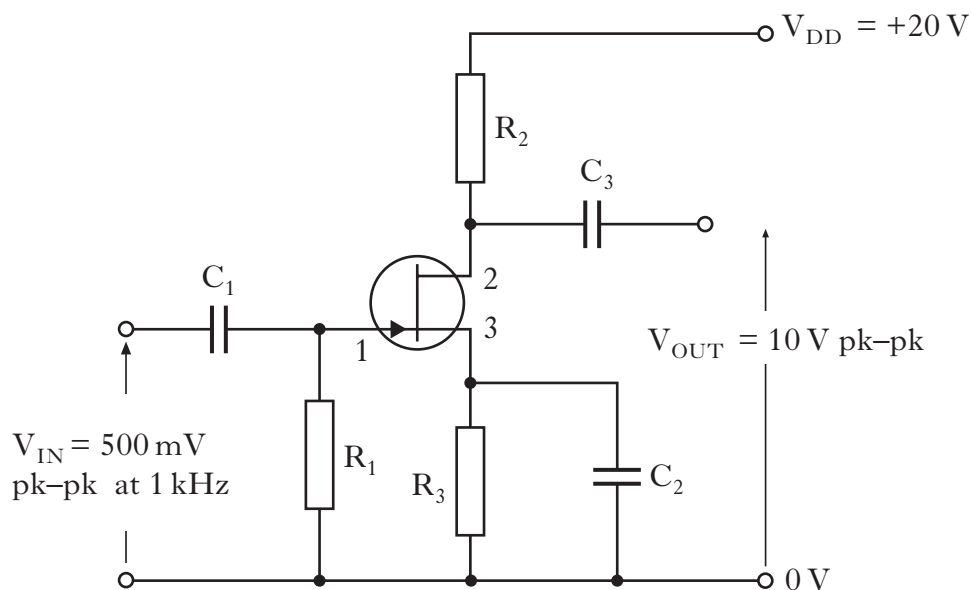


Figure Q12(b)

- | | |
|--|---|
| (i) name the circuit configuration; | 2 |
| (ii) name the transistor terminals 1, 2 and 3; | 3 |
| (iii) determine the circuit gain; | 2 |
| (iv) determine the peak (pk) output voltage; | 1 |
| (v) state the purpose of capacitor C_3 . | 2 |

[Turn over for Question 12(c) on Page twelve

12. (continued)

- (c) The circuit shown in Figure Q12(c) is used to control the power supplied to a lamp.

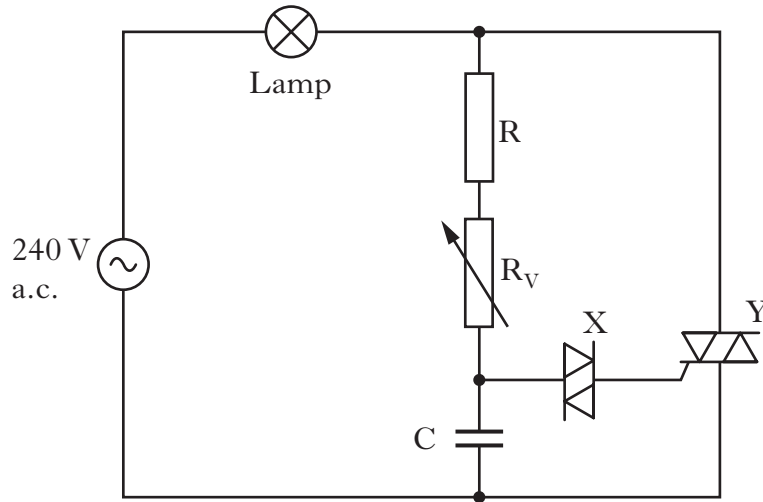


Figure Q12(c)

- | | |
|--|-------------|
| (i) Name the components labelled X and Y. | 2 |
| (ii) Explain the purpose of R _V . | 3 |
| | (25) |

[END OF QUESTION PAPER]