X025/201

NATIONAL QUALIFICATIONS 2008

WEDNESDAY, 11 JUNE 1.00 PM – 3.30 PM

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).

A Datasheet is provided for questions 5 and 10.

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

PB X025/201 6/570

Marks

Section A

Attempt all the questions in this section (50 marks)

1. Add the following binary numbers.

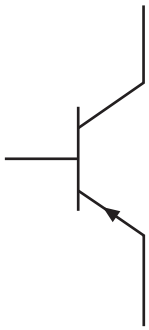
(*a*) 1101 + 1010 **2**

(*b*) 101101 + 110011 **2**

(4)

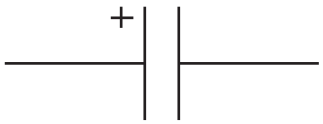
2. Identify each of the following symbols.

(*a*)



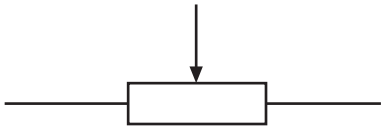
2

(*b*)



1

(*c*)



2

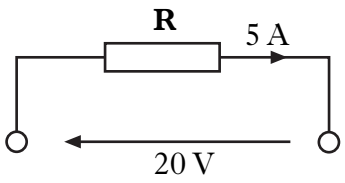
(5)

Marks

3. (*a*) State, in words, Ohms Law. **2**

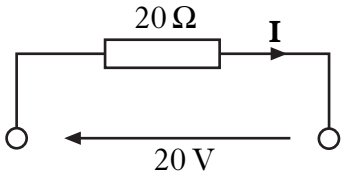
(*b*) Determine the unknown quantity in each of the following examples.

(i)



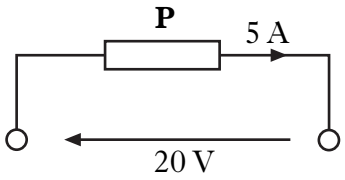
2

(ii)



2

(iii)

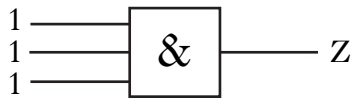


2

(8)

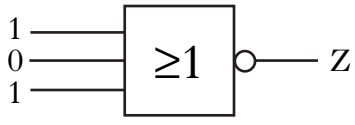
4. For each of the logic diagrams below, determine the output state.

(*a*)



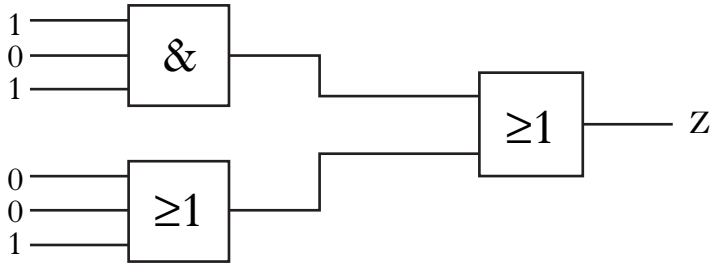
1

(*b*)



1

(*c*)



2

(4)

Marks

5. With reference to Figure Q5 and the datasheet provided,

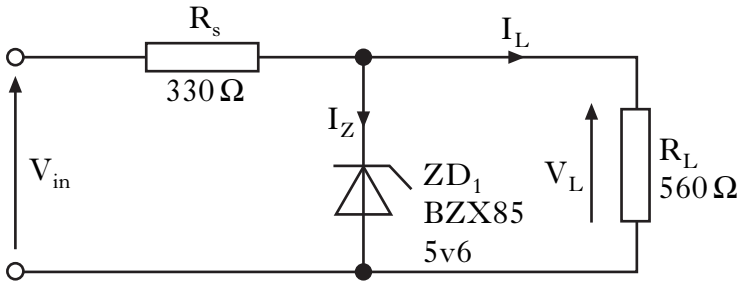


Figure Q5

(*a*) Determine:

(i) the maximum power the diode, ZD_1 can handle; **1**

(ii) the load current I_L when $V_L = 5{\cdot}6$ V. **1**

(*b*) Calculate the value of supply voltage when $I_Z = 12$ mA and $V_L = 5{\cdot}6$ V. **2**

(4)

6. Draw, using BS symbols, the logic diagrams for the following Boolean expressions.

(*a*) $Z = A.B + \overline{A}.C$ **2**

(*b*) $Z = \overline{A.C} + B.C$ **2**

(*c*) $Z = (A+B).(B+C)$ **1**

(5)

Marks

7.

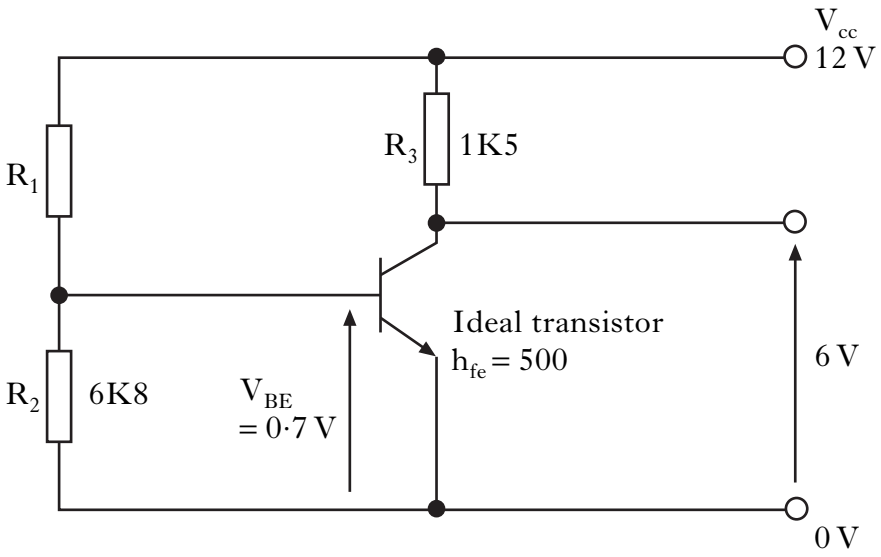


Figure Q7

For the transistor circuit shown in Figure Q7, calculate:

(*a*) the voltage across R_3; **1**

(*b*) the base current of the transistor; **3**

(*c*) the value of resistor R_1 required for the bias circuit. **4**

(8)

8. A voltage waveform is described by the formula

$$v = 50\sin\phi \text{ volts.}$$

Determine:

(*a*) the rms voltage; **2**

(*b*) the peak-peak voltage; **2**

(*c*) the voltage when angle $\phi = 35°$. **2**

(6)

[Turn over

Marks

9.

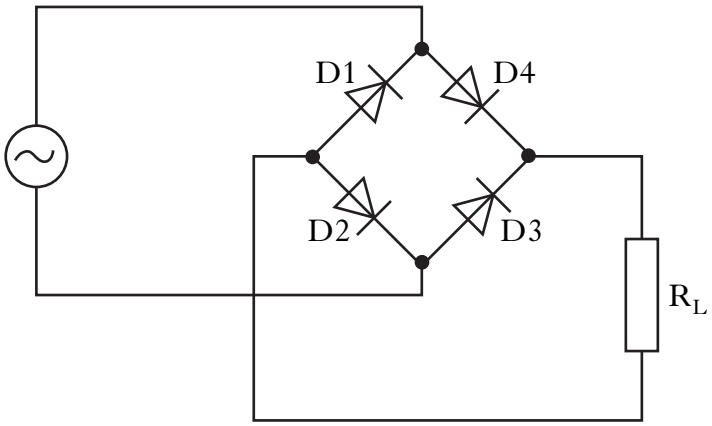
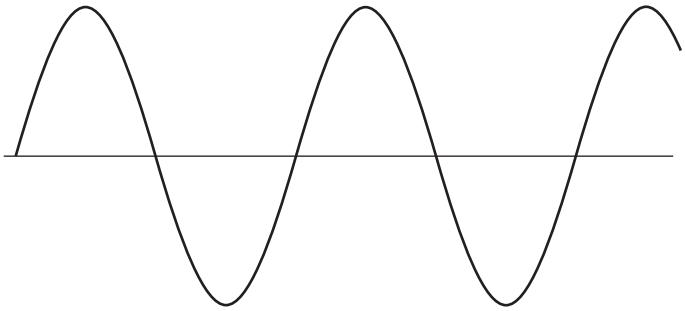


Figure Q9

(*a*) For the circuit shown in Figure Q9, state the name of the circuit. **1**

(*b*) The input waveform is a sine wave.



Sketch the output waveform that will appear across the output resistor R_L. **2**

(*c*) If a capacitor is connected across the resistor as shown in Figure Q9(*c*), explain the effect that it will have on the output waveform.

Include a waveform diagram as part of your answer.

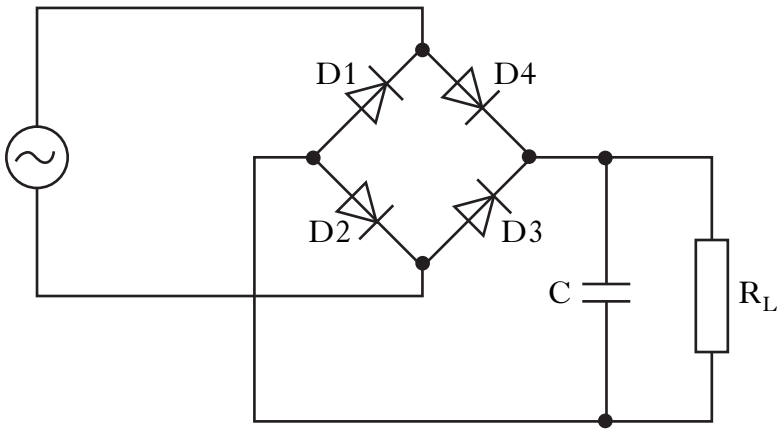


Figure Q9(*c*) **3**

(6)

[Turn over for Section B on *Page eight*

Section B

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

10. (*a*) Convert the following binary numbers:

(i) $1101\ 1010_2$ to decimal; **2**

(ii) $1001\ 1011_2$ to hexadecimal. **2**

(*b*) Using the datasheet provided, for the circuit shown in Figure Q10(*b*) below,

(i) Draw the logic circuit diagram and label all gate inputs and outputs with the appropriate pin connection. **6**

(ii) Construct the truth table for the circuit. **6**

(iii) During testing it was found that for input condition A = 1, B = 1 and C = 0, the corresponding output (Z) = 0. All other outputs were correct. Identify which gate (input or output) was at fault and state the nature of the fault. **4**

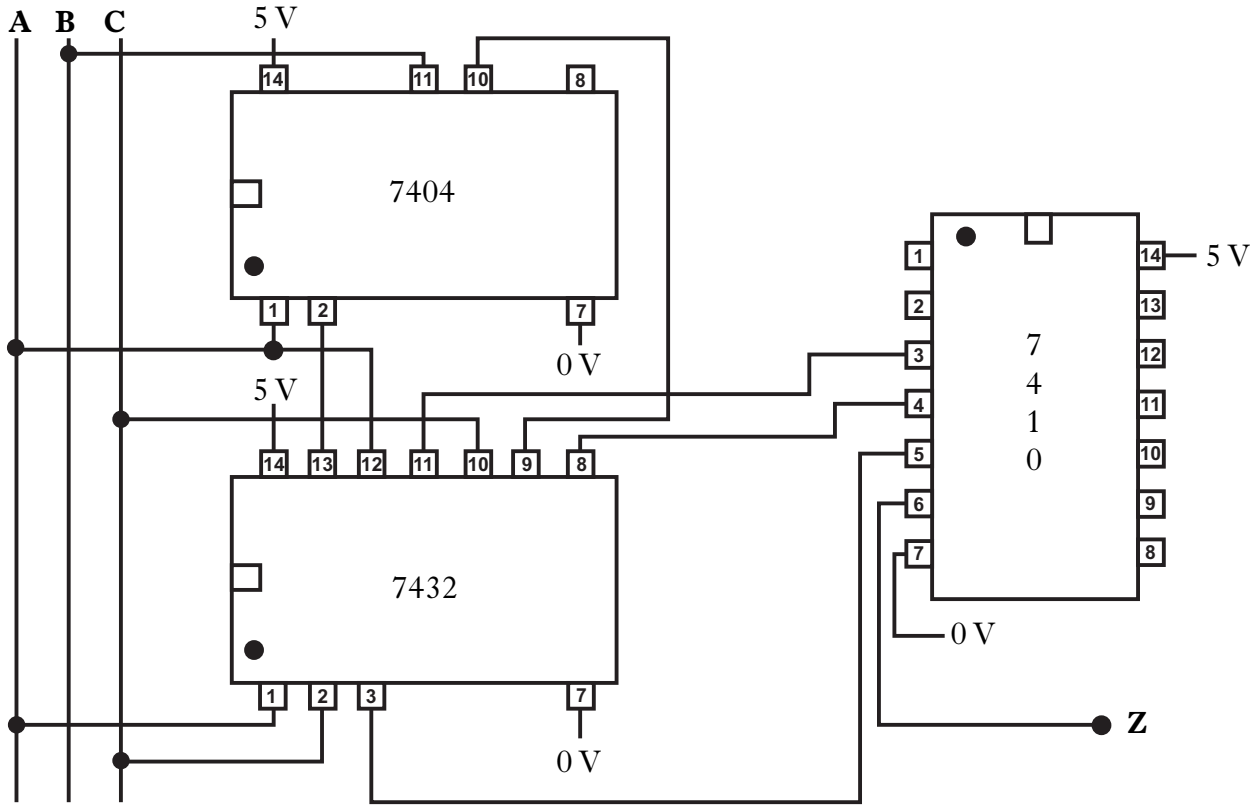


Figure Q10(*b*)

Marks

10. (continued)

(*c*) A combinational logic circuit has to be designed that will activate a flashing LED on a printer, when any of the following conditions occur.

Printer is out of paper (P) denoted by a logic 1
There is a paper jam (J) denoted by a logic 1
Printer is out of ink (I) denoted by a logic 0

Draw the logic circuit to meet the design specification and state the Boolean expression. **5**

(25)

[Turn over

Marks

11. (*a*) For the circuit shown in Figure Q11(*a*) below, assuming switch S is closed, determine:

(i) the current through the 12 Ω resistor; **2**

(ii) the value of resistor R_2; **2**

(iii) the supply current; **2**

(iv) the value of resistor R_1; **2**

(v) the voltage across the 8 Ω resistor; **2**

(vi) the total circuit resistance; **2**

(vii) the value of resistor R_3 if the supply current is 0·8 A when switch S is opened. **3**

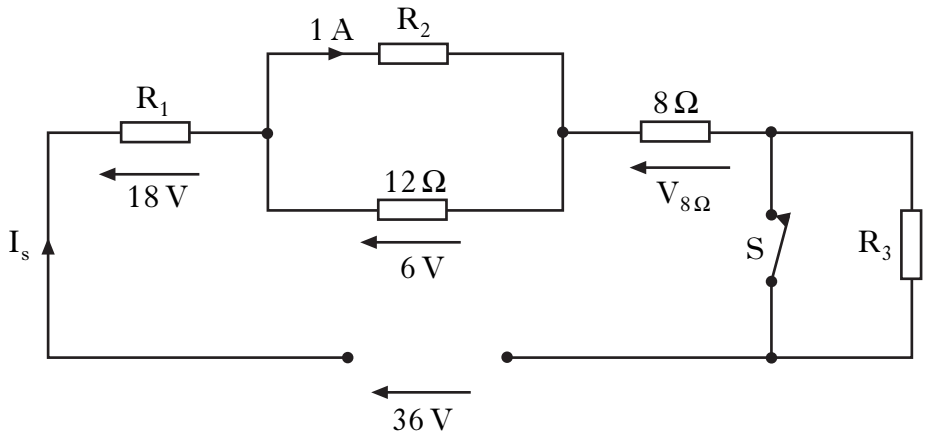


Figure Q11(*a*)

(*b*) The coil A shown in Figure Q11(*b*) moves at a constant speed of 6 $m\,s^{-1}$ through a magnetic field with a flux density of 0·5 T. The coil has an effective length of 0·8 m.

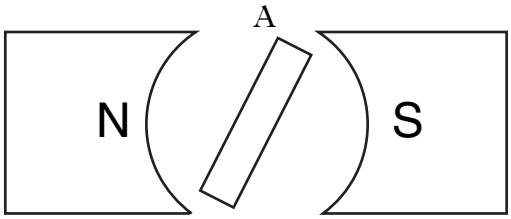


Figure Q11(*b*)

(i) Calculate the maximum value of the induced voltage. **2**

(ii) Calculate the rms value of the induced voltage. **1**

(iii) Calculate the induced voltage when the coil cuts the field at an angle of 75 ° relative to the vertical. **2**

(iv) State the angles relative to the vertical at which the maximum voltage will occur. **2**

11. (continued)

(*c*) Figure Q11(*c*)(i) shows a current carrying conductor placed within a magnetic field.

Figure Q11(*c*)(i)

(i) If the current in the conductor halves, by what factor does the force on the conductor change? **1**

(ii) State the effect, compared to Figure Q11(*c*)(i), to the size and direction of the force acting upon the conductor as a result of the change shown in Figure Q11(*c*)(ii) below. **2**

Figure Q11(*c*)(ii)

(25)

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Marks

12. (*a*)

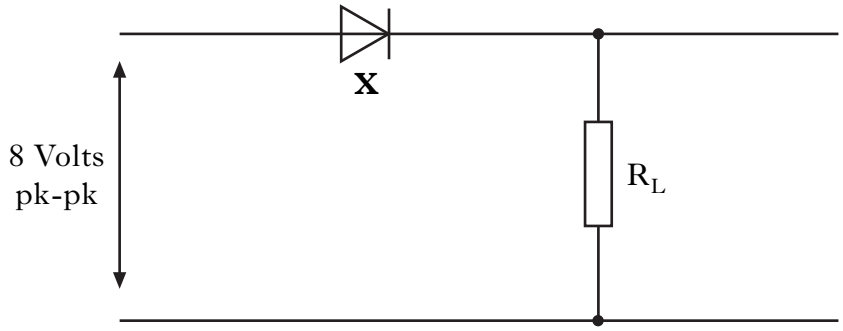

Figure Q12(*a*)

With reference to the circuit shown in Figure Q12(*a*):

(i) identify component **X**; **1**

(ii) assuming component **X** is made from silicon, state the typical forward conducting voltage drop; **1**

(iii) state the function this circuit performs; **2**

(iv) determine the maximum voltage across R_L; **2**

(v) state the minimum voltage across R_L. **2**

(*b*)

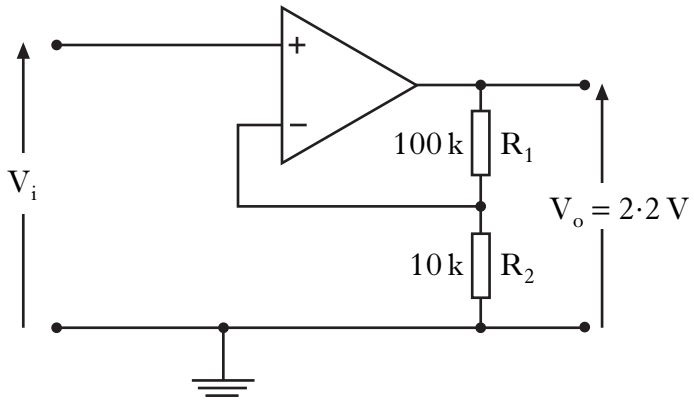

Figure Q12(*b*)

With reference to the circuit shown in Figure Q12(*b*):

(i) identify the circuit configuration; **2**

(ii) determine the circuit gain; **2**

(iii) determine the input voltage V_i; **3**

(iv) if a variable resistor is placed in parallel with R_1, determine the range of output voltage if the resistor can be varied between 25 kΩ and 100 kΩ. **6**

12. (continued)

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

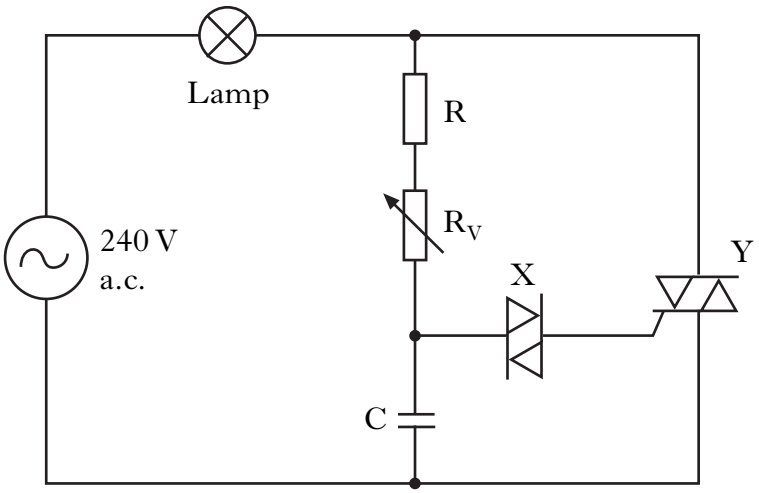

Figure Q12(*c*)

(i) Identify the components labelled X and Y. **2**

(ii) Explain the purpose of R_V. **2**

(25)

[*END OF QUESTION PAPER*]

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