X025/201

NATIONAL QUALIFICATIONS 2009

TUESDAY, 9 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 question 10(*c*).

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

PB X025/201 6/420

Marks

Section A

Attempt all the questions in this section (50 marks)

1. Convert the following numbers.

(*a*) 10001101_2 binary to decimal **2**

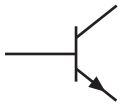
(*b*) 171_{10} decimal to hexadecimal **2**

(*c*) $B7_{16}$ hexadecimal to binary **2**

(6)

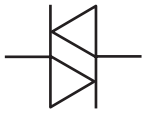
2. Identify the following circuit symbols.

(*a*)



2

(*b*)



2

(4)

3. For the circuit shown in Figure Q3 below, determine:

(*a*) the voltage V_{CD}; **2**

(*b*) the voltage V_{BC}. **2**

(4)

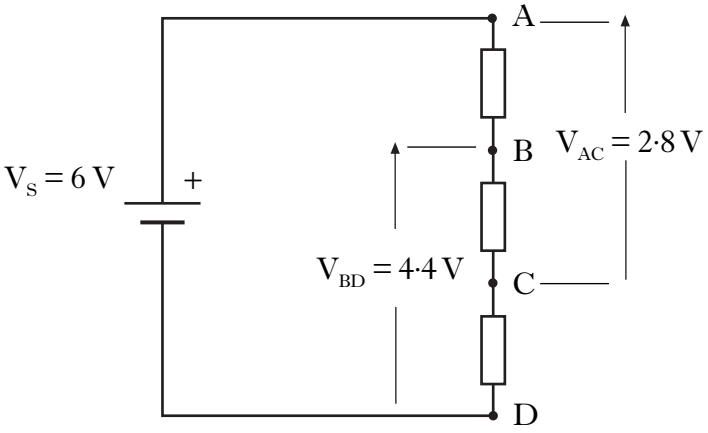


Figure Q3

Marks

4. Referring to Figure Q4 shown below,

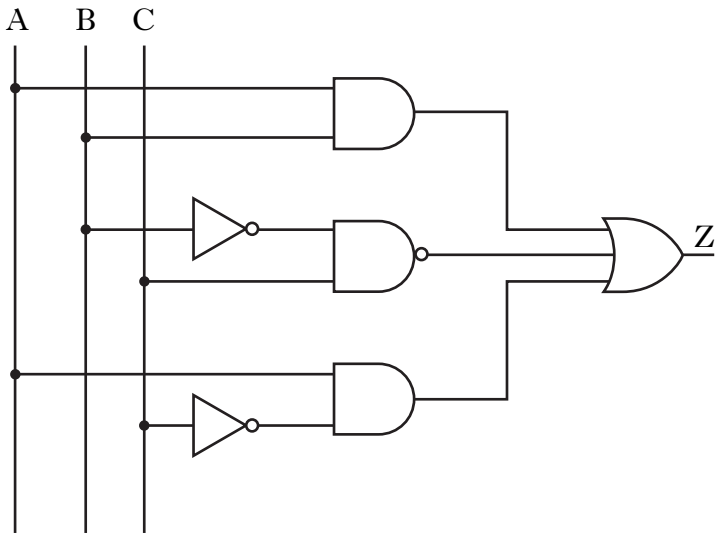


Figure Q4

(*a*) determine the Boolean expression for output Z; **3**

(*b*) draw the truth table for the circuit. **4**

(7)

5. For the circuit shown in Figure Q5 below:

(*a*) identify the circuit configuration; **1**

(*b*) state the circuit voltage gain in terms of input and output voltages; **2**

(*c*) state the circuit voltage gain in terms of resistors R_1 and R_2; **2**

(*d*) state the phase relationship between input and output voltage. **1**

(6)

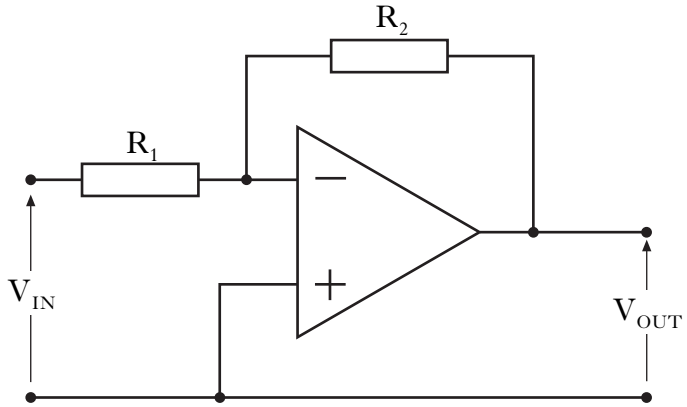


Figure Q5

[Turn over

Marks

6. Figure Q6(*a*) and Figure Q6(*b*) show a current carrying conductor placed between the poles of a magnet. For each Figure, sketch the resultant magnetic field around each conductor.

State whether you are using 'conventional' or 'electron' current flow.

2

Figure Q6(*a*)

2

(4)

Figure Q6(*b*)

7. With reference to the circuit shown in Figure Q7:

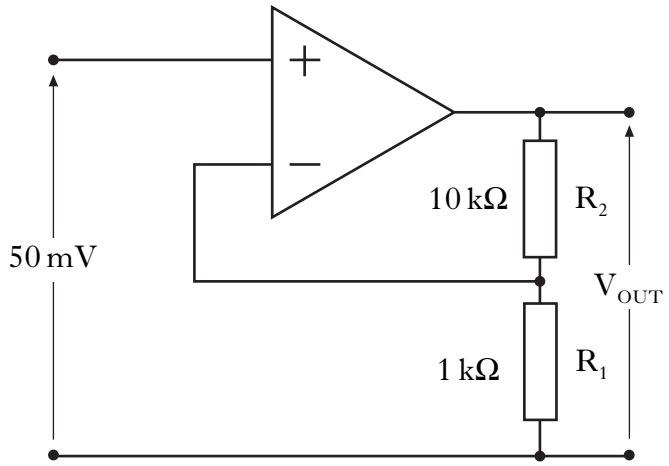


Figure Q7

(*a*) identify the circuit configuration; **1**

(*b*) calculate the circuit gain; **2**

(*c*) calculate the output voltage; **2**

(*d*) state the phase relationship between input and output voltages. **1**

(6)

Marks

8. (*a*) For the Boolean expression,

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

draw the logic circuit diagram. **3**

(*b*) Show by diagram how two 2-input AND gates can be connected to perform the logic function of a 3-input AND gate. **2**

(5)

9. For the circuit shown in Figure Q9, determine:

(*a*) the voltage across resistor R_2; **1**

(*b*) the current through resistor R_2; **1**

(*c*) the value of resistor R_1; **1**

(*d*) the voltage across resistor R_4; **2**

(*e*) the value of resistor R_4; **1**

(*f*) the supply current. **2**

(8)

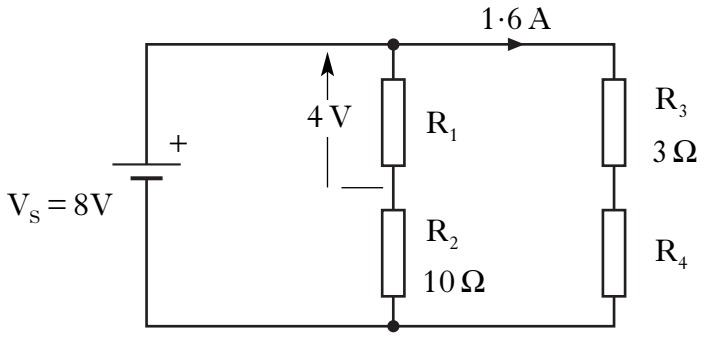


Figure Q9

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Section B

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

10. (*a*) For the circuit shown in Figure Q10(*a*),

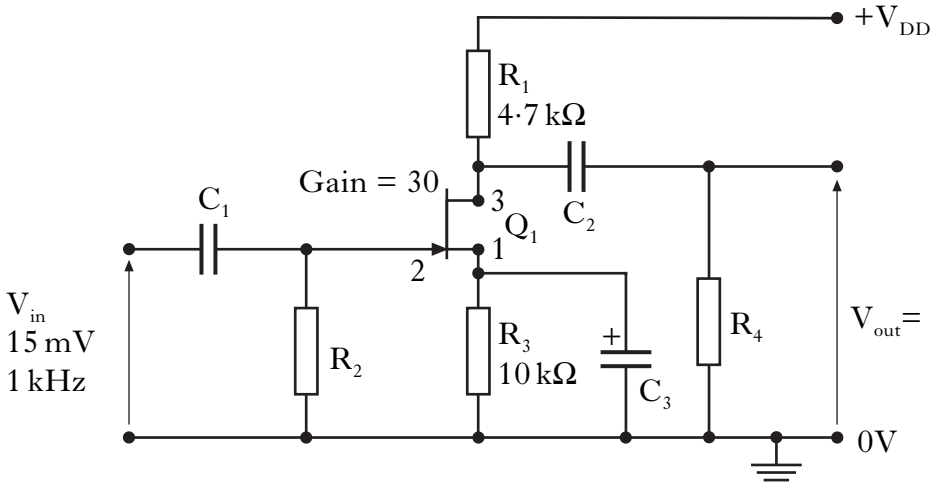


Figure Q10(*a*)

(i) name the circuit and its configuration; **2**

(ii) name terminals 1, 2 and 3 of component Q_1; **3**

(iii) calculate the output voltage; **2**

(iv) sketch the input and output waveforms to show the phase relationship between them (numerical values are not required); **2**

(v) state the purpose of capacitors C_1 and C_2. **2**

(*b*) With reference to the circuit shown in Figure Q10(*b*):

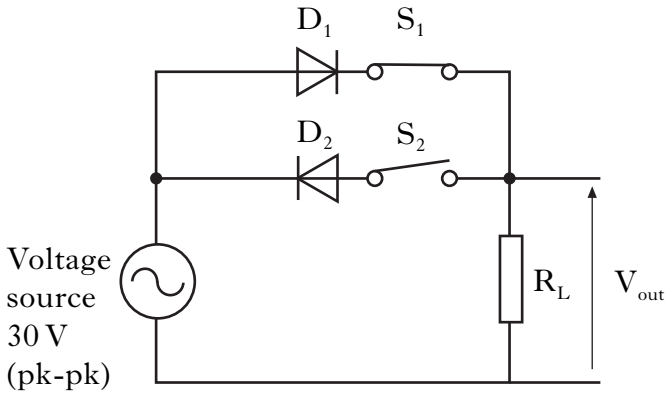


Figure Q10(*b*)

(i) what is the purpose of the diode D_1? **1**

(ii) explain the operation of the circuit when switch S_1 is closed and switch S_2 is open; **2**

(iii) the forward voltage drop of diodes D_1 and D_2 is 0·7 V. Sketch the input and output waveforms showing peak values for each. **4**

10. (continued)

(*c*) The waveform shown in Figure Q10(*c*) is fed into the input of the circuit shown in Figure Q10(*d*).

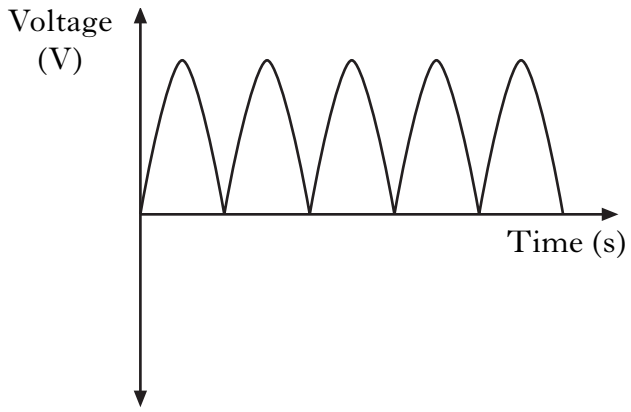


Figure Q10(*c*)

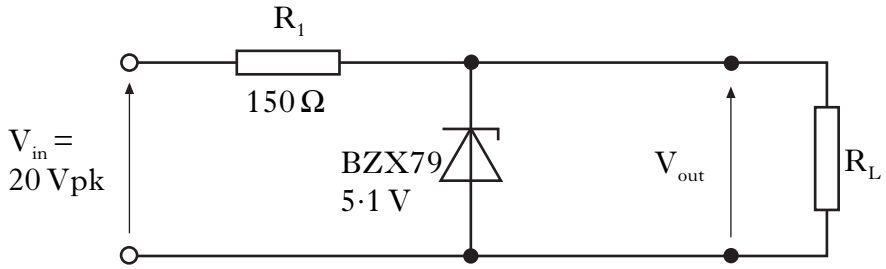


Figure Q10(*d*)

(i) State the operating voltage of the zener diode. **1**

(ii) Sketch the output waveform across the load resistor R_L. **3**

(iii) Using the data sheet provided:

(A) determine the maximum power rating of the zener diode; **1**

(B) calculate the maximum current rating of the zener diode. **2**

(25)

[Turn over

Marks

11. (*a*) An a.c. sinusoidal voltage is given by $e = 20\sin\theta$ mV.

(i) State the maximum value of this voltage. **1**

(ii) Calculate the rms value of the voltage. **2**

(iii) Calculate the instantaneous value of the voltage when $\theta = 45°$. **2**

(*b*) The coil AB shown on Figure Q11(*b*) has an effective length of 4·5 m. The conductor moves at a constant speed of 6 m s^{-1} through a uniform magnetic field of flux density 0·45 T.

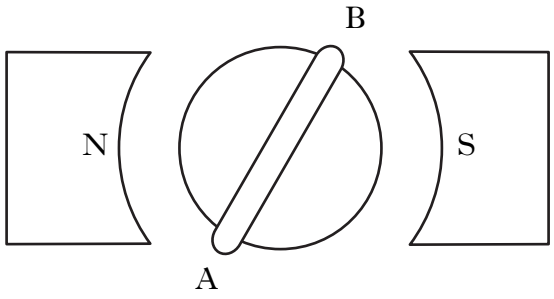


Figure Q11(*b*)

(i) Determine the induced emf when the coil cuts the magnetic field at 45°. **2**

(ii) State the angle relative to the vertical at which the minimum voltage will occur. **1**

11. (continued)

(*c*) For the circuit diagram in Figure Q11(*c*),

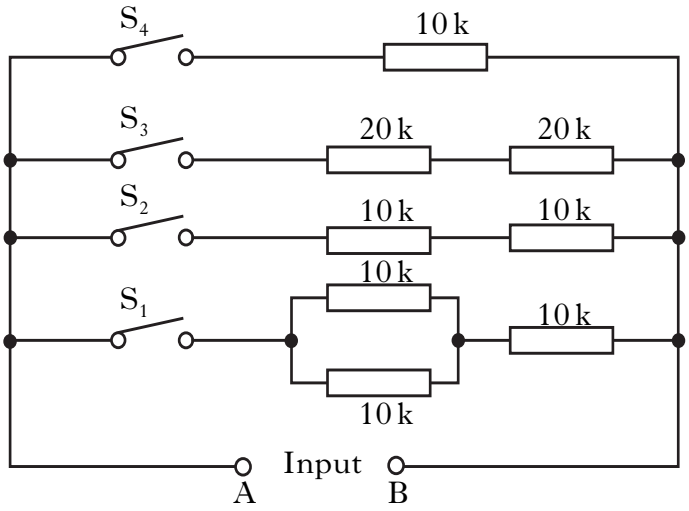


Figure Q11(*c*)

(i) Calculate the total resistance of the circuit when switches S_1 and S_2 are closed and switches S_3 and S_4 are open. **2**

(ii) Calculate the total resistance when switches S_2 and S_3 are closed and switches S_1 and S_4 are opened. **2**

(iii) Which switches should be left open to give the highest resistance between A and B? **1**

(iv) Which switches should be closed to give the lowest resistance between A and B? **2**

(v) If only one switch can be closed, which switch would give the lowest current? **2**

(*d*) (i) Calculate the power dissipated in a 15 kΩ resistor when the current is 2 mA. **2**

(ii) Calculate the energy used, in joules, if this current continues for 45 minutes. **2**

(iii) The power rating of the resistor is 0·125 W. Calculate the maximum current that can flow through the resistor without exceeding the power rating. **4**

(25)

[Turn over

Marks

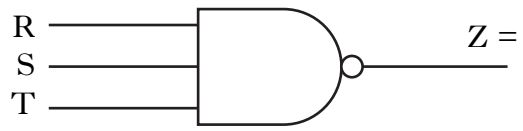
12. (*a*) Add the following binary numbers.

(i) $1011_2 + 1001_2$ **2**

(ii) $0101_2 + 0011_2$ **2**

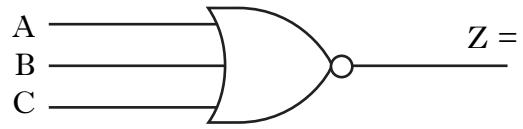
(*b*) State the Boolean expression and construct the truth table for the following logic gates.

(i)



4

(ii)



4

(*c*) Draw, using BS symbols, the logic diagram for the following Boolean expression.

$Z = (R+\overline{S}+\overline{T}).(R+S+\overline{T}).(R+\overline{S}+T)$ **4**

(*d*) The circuit shown in Figure Q12(*d*) is used to control a warning lamp, which operates when the output of the circuit is on.

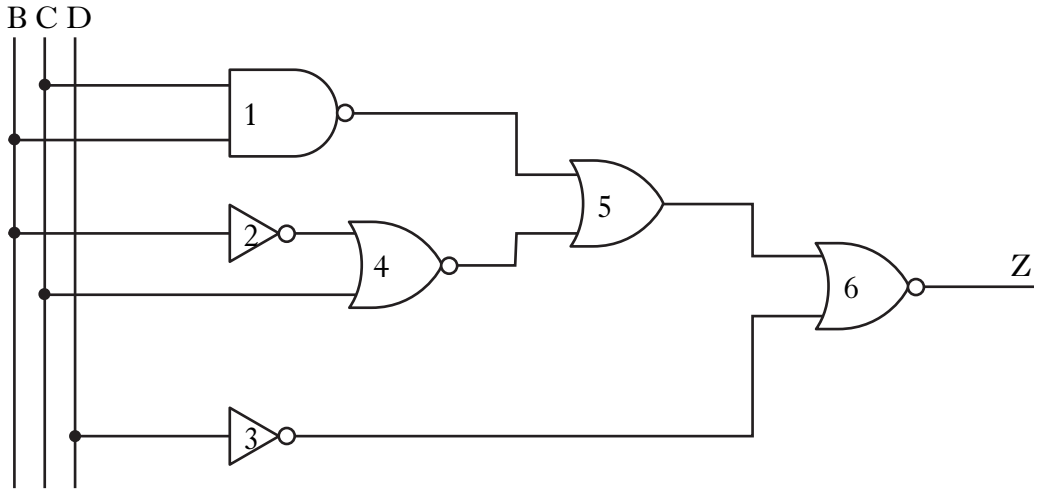


Figure Q12(*d*)

(i) Determine the Boolean expression for the circuit. **3**

(ii) Construct the truth table for the circuit. **4**

(iii) Use the truth table to determine an alternative Boolean expression. **2**

(25)

[*END OF QUESTION PAPER*]

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ELECTRONIC AND ELECTRICAL FUNDAMENTALS
INTERMEDIATE 2
Datasheet for Q10(*c*)

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Datasheet for Question 10 (*c*)

ZENER DIODES

Diode Series	*Zener Voltage Range* (V)	*Power* (mW)	*Non Repetitive Power* (W)	*Max Junction Temp* (°C)
UDZ (SMT)	2·02 – 36·87	200	N/A	N/A
PLVA400A	5·2 – 7·0	400	30	175
BZX79	2·4 – 75	500	30	200
BZX85	2·7 – 200	1300	N/A	175
BZX284(SMT)	2·4 – 75	400	N/A	N/A
BZT03C	6·2 – 150	3·25W	N/A	N/A
1N5333	3·9 – 120	5W	N/A	N/A
1N53	3·3 – 200	5W	N/A	N/A
BZY93	8·2 – 75	20W	N/A	N/A

LEDs

Diode Type	*Part No*	I_F mA (max)	V_F V (typ)	V_R V (max)	*Intensity* @ 10 mA *mcd*		*View Angle* (deg)	*Peak wavelength* (nm)
					min	*max*		
Red	L424HDT	25	2	5	0·5	3·2	100	700
H E red	L424DT	30	2	5	3·2	12·5	100	625
Pure orange	L424NDT	30	2	5	3·2	12·5	100	610
Green	L424GDT	25	2·2	5	1·3	8	100	565
Yellow	L424YDT	30	2·1	5	1·3	8	100	590

[*END OF DATASHEET*]