

SECTION 1 – DC power supplies

Question 1

Which one of the following statements **A.–D.** below is correct for a DC power supply in a digital circuit?

- A. The output voltage should have a high level of AC ripple voltage.
- B. The output current should be constant for a change in load.
- C. The output voltage should vary for a change in load.
- D. The output voltage should be constant for a change in load.

1 mark

Refer to Figure 1 to answer Question 2 parts a. and b.

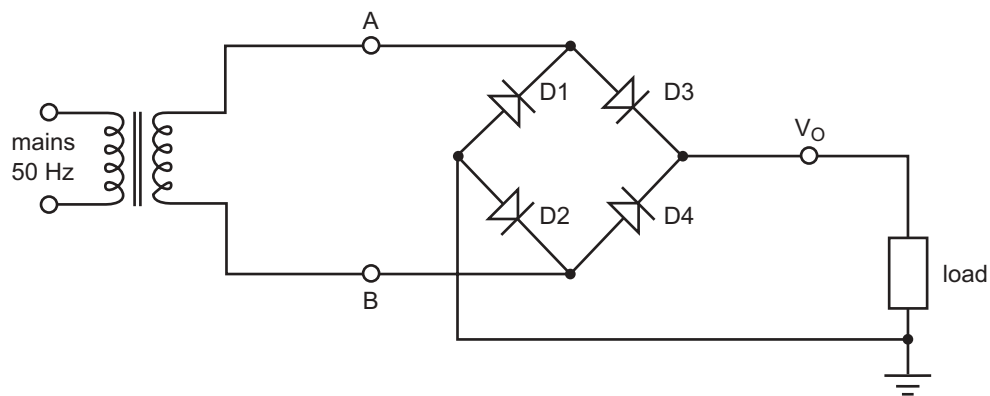


Figure 1

Question 2

- a. State the diodes that conduct on the half cycle when B is more positive than A.

1 mark

- b. State the effect on the average level of voltage at V_O when there is an open circuit fault condition for diode D1.

1 mark

Refer to Figure 2 to answer parts c., d. and e.

Cathode Ray Oscilloscope (CRO) display

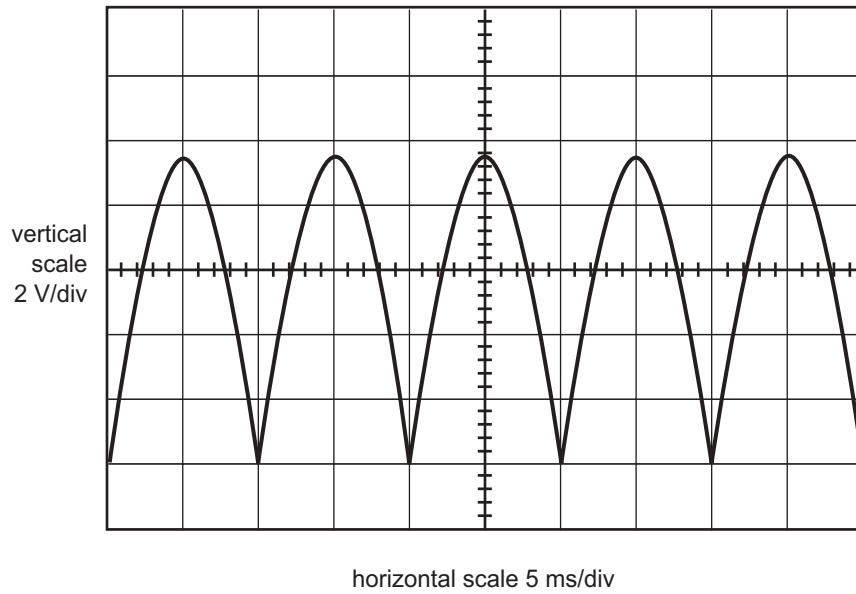


Figure 2

The output, V_O , as displayed on a Cathode Ray Oscilloscope (CRO), is shown in Figure 2.

- c. What is the period (T) of the waveform as displayed on the CRO in Figure 2?
Express the answer with correct units.

1 mark

- d. Determine the peak voltage of the waveform as displayed on the CRO in Figure 2.

1 mark

- e. Use the peak voltage obtained in **part d.** above to calculate the RMS voltage of the waveform as displayed on the CRO (Figure 2). State the formula used and show substitution and working out.

3 marks

Question 3

A 10 VA transformer with ‘multiple tapped’–secondary outputs is shown in Figure 3.

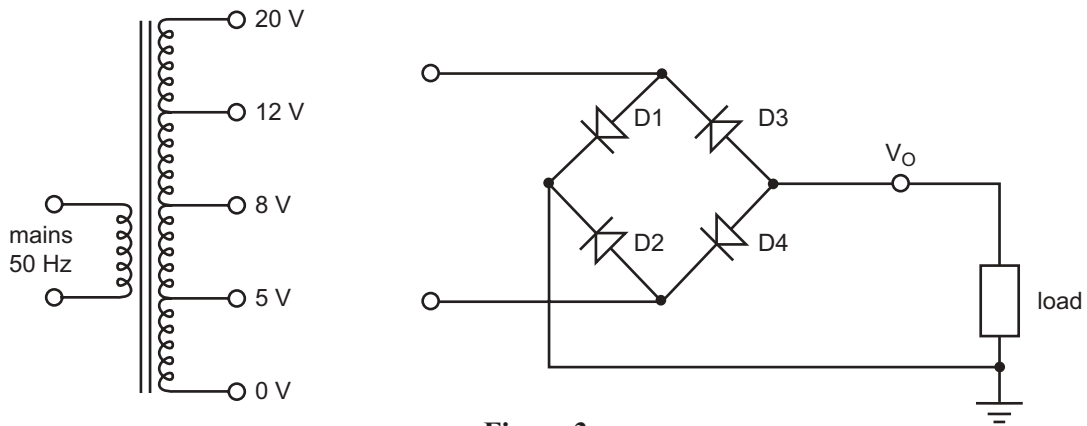


Figure 3

- a. On Figure 3 draw in the two circuit connections that are required to produce a **peak** secondary voltage input approximately 17 V to the bridge rectifier.

2 marks

- b. Calculate the maximum rated secondary current when a 5 V secondary connection is chosen.

2 marks

Question 4

The peak voltage between A and B in Figure 4 is 11.3 V. Assume a conducting loss of 1 V in each diode and calculate the peak conducting current through the diodes.

State the formulas used and show substitution and working out.

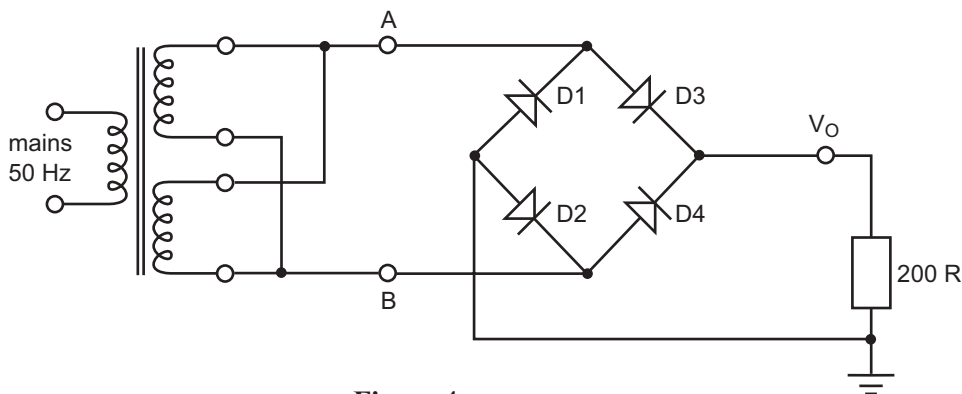
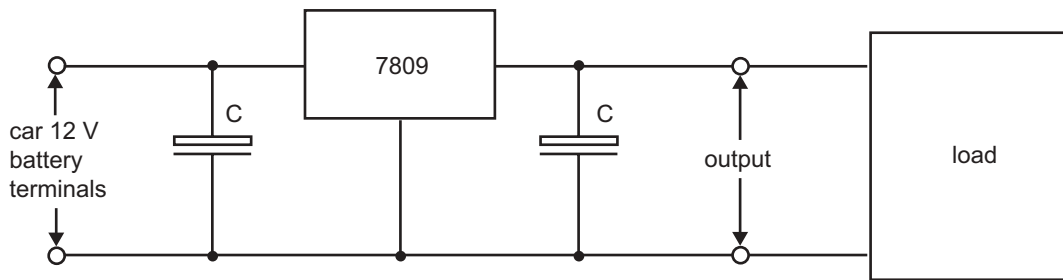


Figure 4

3 marks

Question 5

A three terminal regulator is used to obtain a 9 volt DC output in an automobile application. A diagram of the circuit is shown in Figure 5. The maximum current required by the load is 200 mA.

**Figure 5**

- a. On the diagram (Figure 5) label the positive (+) and negative (–) terminals of the car battery. 1 mark
- b. Determine the voltage reduction across the 7809 three terminal regulator, as shown in Figure 5.
-
-
- 1 mark
- c. Calculate the approximate maximum power that the three terminal regulator has to dissipate. Express the answer in correct units.
-
-
-
- 2 marks
- d. What step should be taken to protect the regulator, at maximum power dissipation, against an excessive temperature rise?
-
-
- 1 mark
- e. Name one electronic device that could be powered by the regulator circuit (Figure 5).

1 mark

Question 6

A simple DC power supply is shown in Figure 6.

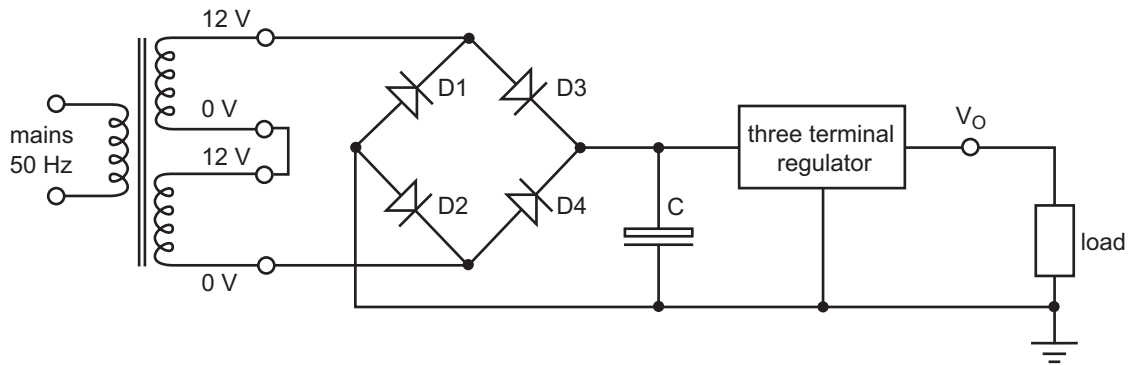


Figure 6

- a. Determine the RMS voltage that is supplied to the bridge rectifier.

1 mark

- b. The value of capacitor C is increased. What is the effect on the AC ripple and average level of voltage at the input to the regulator?

Tick (✓) the boxes indicating the correct responses for both.

	Increased	Decreased	Unchanged
AC ripple			
average level of voltage			

1 + 1 = 2 marks

- c. What component is usually used to protect the transformer against a short circuit diode fault?

1 mark

- d. Show clearly, on the circuit diagram (Figure 6), where the component in part c. above would be placed.

1 mark

Question 7

A switch mode regulator and a three terminal regulator were compared. Identify the characteristics of each type of regulator by placing a tick (✓) in each appropriate box.

Characteristics	Switch mode	Three terminal
more efficient		
produces switching spikes		

2 marks

Question 8

a. Name a device where a switch mode regulator is used.

1 mark

b. From the following list of components select the appropriate answers for **parts b.i., b.ii. and b.iii.**

- resistor
- LED
- transistor
- inductor
- diode

With respect to switch mode power supplies

i. select the component that is usually used to switch the current through to the load

ii. select the component that is used as an energy store

iii. select the component that can provide indication of electric power being present.

1 + 1 + 1 = 3 marks

SECTION 2 – Analogue systems

Question 1

- a. A resistor has the following colour bands.
 yellow violet brown gold

The nominal resistance value is

- A. 472 Ω
- B. 470 R
- C. 4 k7
- D. 47 k

1 mark

- b. A capacitor has the figures 104K printed on it.
 The nominal capacitance value is

- A. 100 μF
- B. 10.4 nF
- C. 104 pF
- D. 0.1 μF

1 mark

- c. A square wave is applied to an RC circuit as shown in Figure 7. On the axes provided below, sketch the expected waveform that would be seen at the output. The input waveform is provided as a reference.

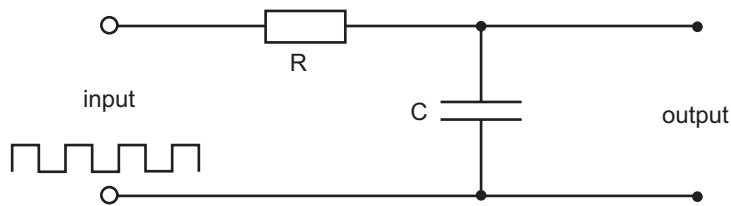
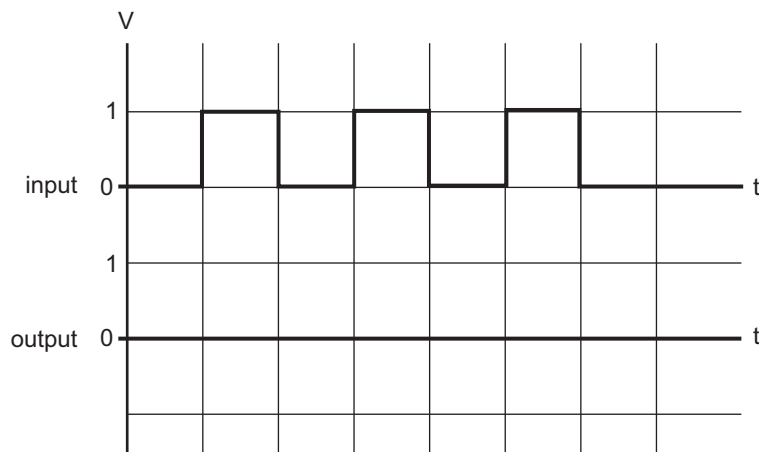








Figure 7



2 marks

d. A list of capacitor types is provided below. Match each capacitor type to its correct picture. Indicate if the capacitor is usually polarised.

- electrolytic capacitor
- ceramic disc capacitor
- variable tuning capacitor
- polyester capacitor
- trimming capacitor
- tantalum capacitor

picture of capacitor	type	polarised or non-polarised
		
		
		
		
		
		

6 marks

Question 2

A circuit diagram is shown below (Figure 8).

Refer to this circuit to answer questions a.–e.

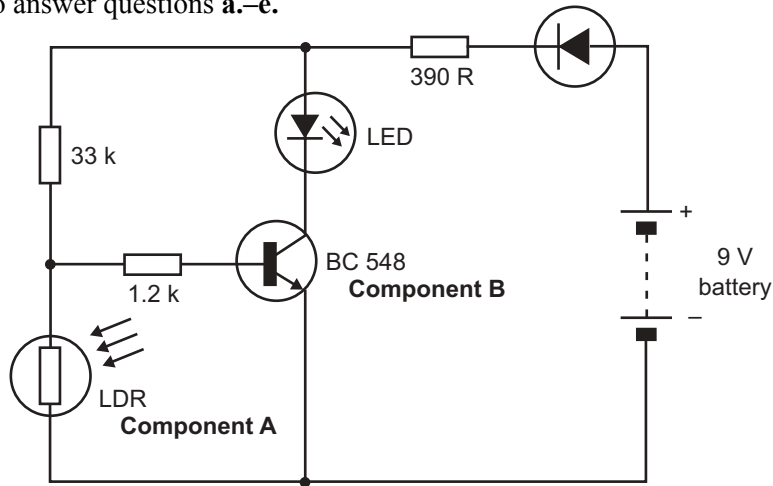


Figure 8

Component A is an LDR.

a. What do the letters LDR stand for?

_____ 1 mark

b. For what practical application could this circuit be used?

 _____ 1 mark

c. What is **Component B**?

_____ 1 mark

d. What input condition to the LDR would turn ON the LED?

_____ 1 mark

e. Describe, **in detail**, the sequence of circuit functions that would turn ON the LED.

3 marks

Refer to Figure 9 to answer Question 3 parts a. and b.

A signal source is connected to the input of an amplifier as shown below.

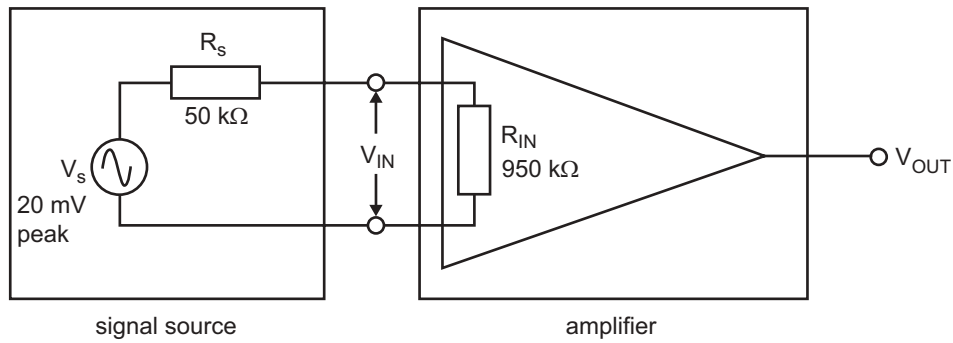


Figure 9

Question 3

- a. R_{IN} is a much higher value than R_s . Why is this important?

1 mark

- b. Calculate the peak input voltage to the amplifier V_{IN} .
State the formula used, show substitution and express the answer in correct units.

3 marks

- c. Given that V_{OUT} is measured at 285 mV peak, what is the voltage gain (A_v) of the amplifier?
State the formula used and show substitution.

2 marks

- d. Refer to the diagram of a dynamic microphone below (Figure 10). Briefly describe how the microphone works to produce an output signal.

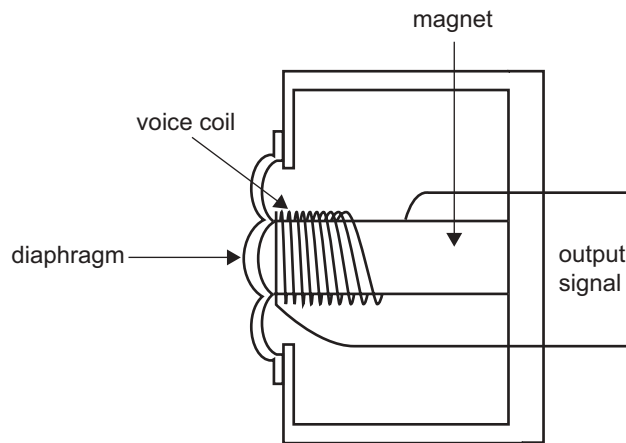


Figure 10

3 marks

Refer to Figure 11 to answer Question 4.

Question 4

Below is a block diagram of an AM radio transmitter.

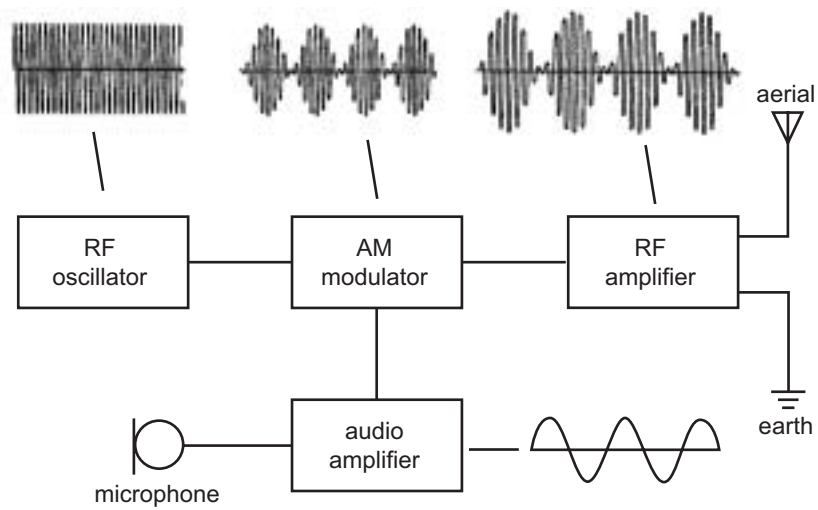


Figure 11

- a. What do the letters AM stand for?

1 mark

- b. i. Briefly explain the function of the microphone.

- ii. To what device group of components does the microphone belong?

1 + 1 = 2 marks

- c. A function of the AM modulator section is to
- A. vary the frequency of the carrier wave.
 - B. vary the amplitude of the carrier at the audio signal rate.
 - C. increase the transmitter power level.
 - D. tune the aerial.

1 mark

- d. The RF amplifier is designed to amplify
- A. all frequencies.
 - B. both audio and radio frequencies.
 - C. audio frequencies only.
 - D. tuned radio frequencies only.

1 mark

- e. A typical carrier frequency for an AM broadcast station would be
- A. 90 Hz.
 - B. 900 Hz.
 - C. 900 KHz.
 - D. 90 MHz.

1 mark

SECTION 3 – Digital electronics 1 and Digital systems

Refer to Figure 12 to answer Question 1.

Question 1

The gates below have been connected to perform a specific logic function. LEDs have been connected at outputs P and Q.

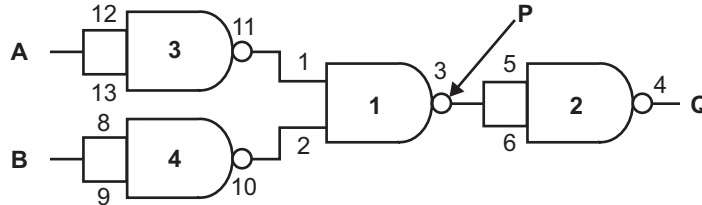


Figure 12

- a. i. Complete on the truth table the unsimplified Boolean expressions for the outputs **P** and **Q**.
- ii. Complete the truth table indicating a **1** or **0** for the outputs, P and Q.

B	A	\bar{A}	\bar{B}	P = _____	Q = _____
0	0	1	1		
0	1	0	1		
1	0	1	0		
1	1	0	0		

4 marks

- b. i. In the boxes below, name the simplified logic gate function being performed at **output P**. Draw the simplified logic gate.

Output P	
simplified logic gate type	draw the simplified logic gate

- ii. Name the simplified logic gate function being performed at **output Q**. Draw the simplified logic gate.

Output Q	
simplified logic gate type	draw the simplified logic gate

2 + 2 = 4 marks

Prototyping Breadboard

c. State two advantages of using the Breadboard technique to construct a circuit rather than using the conventional PCB manufacture.

1. _____
2. _____

2 marks

The circuit diagram, Figure 14, was partly constructed as shown in Figure 13.

d. Complete the circuit wiring of the 4011 IC in the diagram below (Figure 13).

A connection between pin 3 and 5 has been made. You must make a further **seven** additional connections.

It is recommended that a grey lead pencil be used first, before completing with a pen.

Each vertical row of five pin connections (A – E and F – J) are common connections.

Keep the wiring as short and neat as possible.

The required gate connections (Figure 14) and the pin out of the 4011 (Figure 15) are provided below.

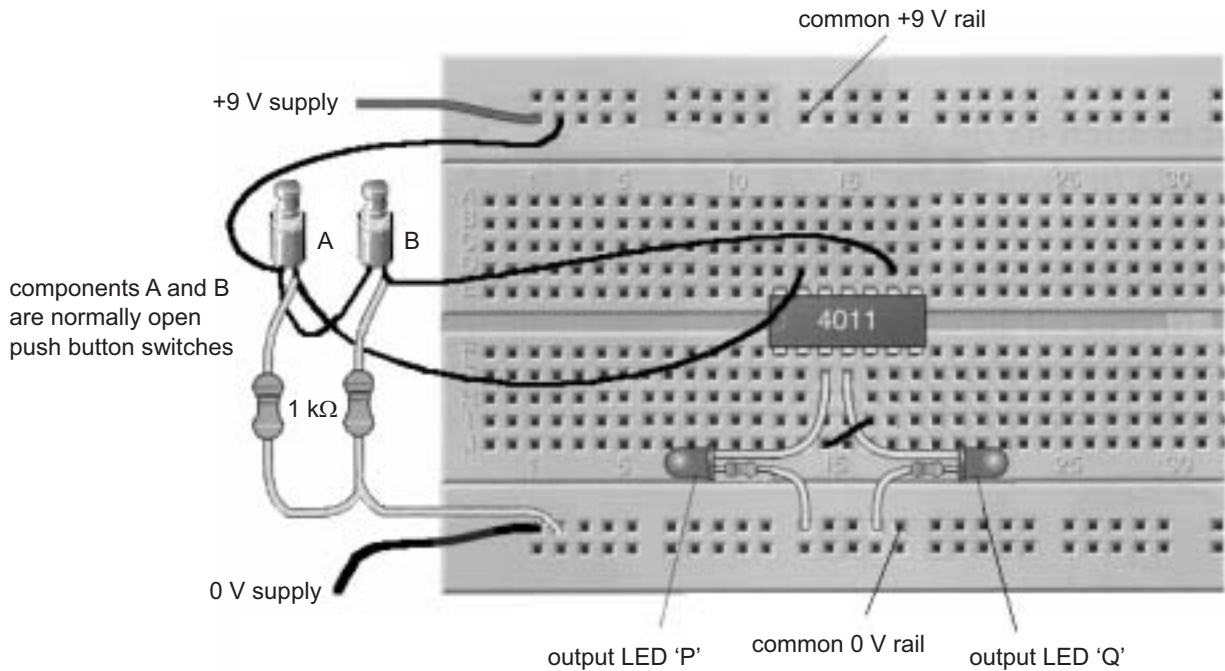


Figure 13

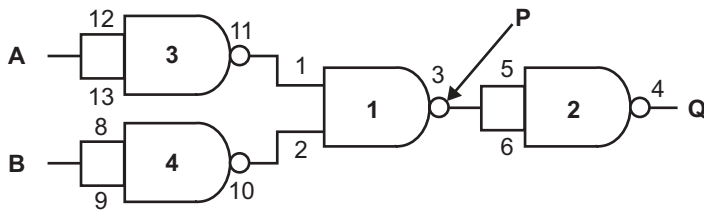


Figure 14

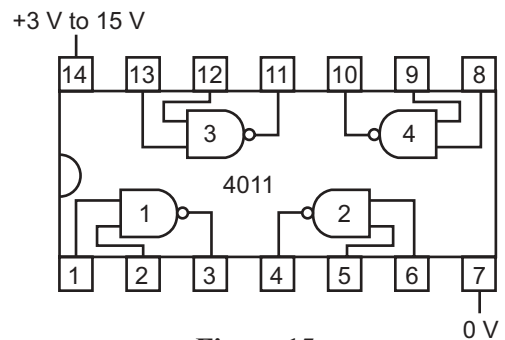


Figure 15

14 marks

- e. Switches A and B have **1 k Ω** resistors connected to 0 volts.
What is the function of these resistors?

2 marks

- f. To what device logic family does the 4011 belong?

1 mark

CONTINUED OVER PAGE

Question 2

ASCII Code

Most significant hexadecimal digit

Least significant hexadecimal digit

	2	3	4	5	6	7
0	SP	0	@	P	'	p
1	!	1	A	Q	a	q
2	"	2	B	R	b	r
3	#	3	C	S	c	s
4	\$	4	D	T	d	t
5	%	5	E	U	e	u
6	&	6	F	V	f	v
7	'	7	G	W	g	w
8	(	8	H	X	h	x
9	)	9	I	Y	i	y
A	*	:	J	Z	j	z
B	+	;	K	[	k	{
C	.	<	L	\	l	|
D	-	=	M	]	m	}
E	_	>	N	^	n	~
F	/	?	O	-	o	DEL

- a. Refer to the ASCII Code above and complete the following table. Convert between the character produced, ASCII Hex Code, and ASCII Binary Code, as required.

Character	N				e		
ASCII Hex		75		62		72	
ASCII Binary Code			110 1101				011 1111

14 marks

- b. Complete the following number conversions.

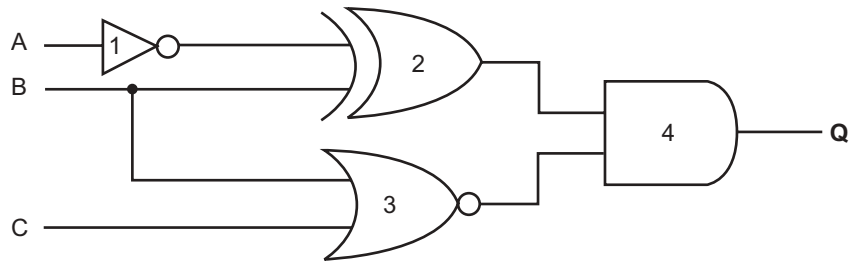
decimal	binary	BCD
256		

hexadecimal	binary	decimal
C1A		

2 + 2 = 4 marks

Question 3

Logic gates

**Figure 16**

- a. Identify the gate types in Figure 16.

Gate number	Gate type
gate 1	
gate 2	
gate 3	
gate 4	

4 marks

- b. Determine the unsimplified Boolean expression at **Q** for the circuit shown in Figure 16.

4 marks

Question 4

Recently LCD screens have been introduced for home computers.



List three distinct advantages of the LCD screens over conventional Cathode Ray Tube type screens.

1. _____
2. _____
3. _____

3 marks

**END OF SECTION 3
TURN OVER**

Formulas

$$V = IR \quad I = \frac{V}{R} \quad V_{\text{RMS}} = \frac{V_{\text{pk}}}{\sqrt{2}}$$

$$V_{\text{peak}} = \sqrt{2} V_{\text{RMS}}$$

$$P = V \times I$$

$$V_{\text{IN}} = \frac{R_{\text{IN}}}{R_{\text{IN}} + R_{\text{S}}} \times V_{\text{S}}$$

$$AV = \frac{V_{\text{OUT}}}{V_{\text{IN}}}$$

END OF QUESTION AND ANSWER BOOK