**Victorian Certificate of Education
2007**

STUDENT NUMBER

Letter

Figures

Words

VCE VET ELECTROTECHNOLOGY
Written examination

Thursday 8 November 2007

Reading time: 9.00 am to 9.15 am (15 minutes)
Writing time: 9.15 am to 10.45 am (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Section	Number of questions	Number of questions to be answered	Number of marks
A	20	20	20
B	11	11	80
			Total 100

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied
- Question and answer book of 23 pages including a formula sheet on page 23.
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student number** in the space provided above on this page.
- Check that your **name** and **student number** as printed on your answer sheet for multiple-choice questions are correct, **and** sign your name in the space provided to verify this.

- All written responses must be in English.

At the end of the examination
- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – Multiple-choice questions
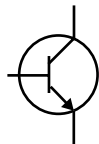
Question 1

How many individual cells are contained in a standard 12 volt lead-acid battery?

A.   2

B.   6

C.   8

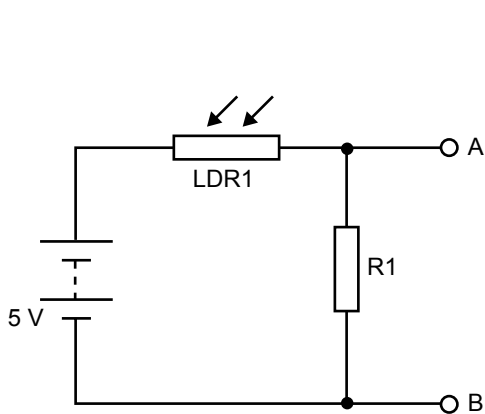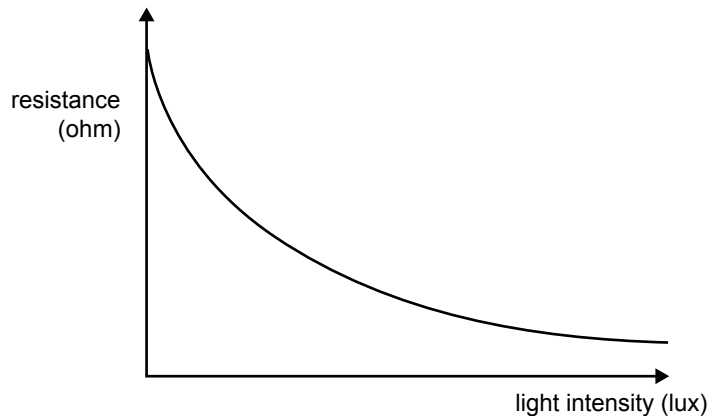**D.**   10

Question 2
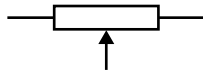
What is the name of the device represented by the symbol above?

A.   potentiometer

B.   thermistor

C.   light-dependent resistor

D.   fusible link

Question 3

What is the name of the device represented by the symbol above?

A.   single pole switch

B.   opto-coupler

C.   diode

D.   transistor

Question 4

Figure 1a   **Figure 1b**

The light-dependent resistor LDR1 in Figure 1a has the resistance characteristic shown in Figure 1b.

If the light intensity falling upon LDR1 increases, the voltage across R1 will

A.   increase.

B.   become negative.

C.   decrease.

D.   equal 0 V.

Question 5

A remote-controlled model electric racing car is powered by rechargeable batteries. Under acceleration, the motor draws up to 1.0 amp.

If the car is operated for an average of one hour per week over a 12-month period, the most suitable type of battery for this application is

A.   sealed lead acid.

B.   carbon zinc.

C.   alkaline.

D.   nickel metal hydride.

Question 6

The main reason for fitting a residual current detector (RCD) to a switchboard is to

A.   protect people from possible electrocution.

B.   protect the circuit wiring against the effects of excessive fault currents.

C.   balance the current being drawn by the active and neutral conductors.

D.   remove earth leakage currents.

Question 7

Before disassembling mains-powered computer equipment, you should ensure that

A.   one of your hands is touching the equipment case at all times.

B.   one of your hands is behind your back at all times.

C.   all test equipment is effectively earthed.

D.   the equipment is unplugged from the power outlet.

Question 8

A metal object inside a piece of equipment becomes loose and makes contact between the mains active conductor and the earthed metal case.

What is the most likely consequence?

A. The equipment will continue to operate.

B. The switchboard circuit breaker will immediately activate.

C. The equipment will stop working but the circuit breaker will not activate.

D. The neutral wire will provide a bypass circuit for the fault current.

Question 9

To provide personal protection against electric shock, double-insulated portable power tools rely on

A. motor winding resistance opposing fault current.

B. the switchboard fuse blowing before the fault current is harmful.

C. insulation layers blocking fault currents to the operator.

D. effective earthing offering a low resistance path for fault currents.

Question 10

Which truth table summarises the logical operation of gate 1?
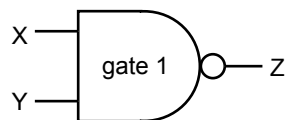
A.

X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

B.

X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	0

C.

X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	0

D.

X	Y	Z
0	0	1
0	1	1
1	0	1
1	1	0

Question 11

What is the base number of the hexadecimal number system?

A. 2

B. 8

C. 16

D. 60

Question 12

The term BIOS, when related to a PC operating system, is used to describe

A. firmware code run when the PC is first powered on.

B. application software installed on the PC.

C. hardware code programmed into the CPU chip and executed on system boot-up.

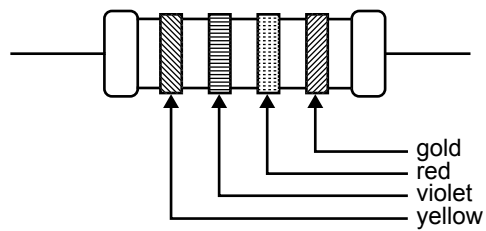D. a BASIC software interpreter installed on the system board.

Question 13

Which one of the following memory types is volatile?

A. ROM

B. Flash

C. RAM

D. EPROM

Question 14

What type of capacitor is shown above?

A. electrolytic

B. ceramic

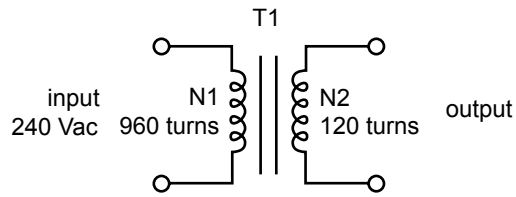**C.** polystyrene

D. polyester

Question 15

A resistor has coloured bands as shown above.

What is the value of the resistor?

A. 2 k7

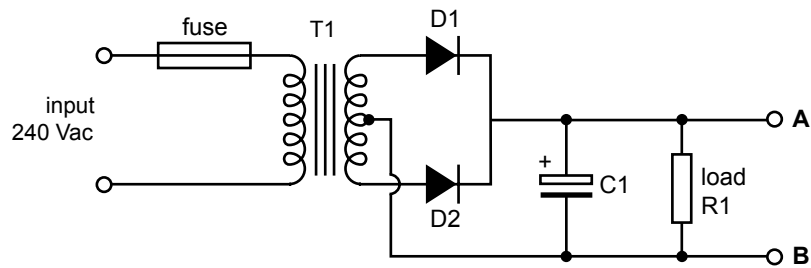**B.** 4 k7

C. 270 k

D. 470 k

Question 16

Figure 2

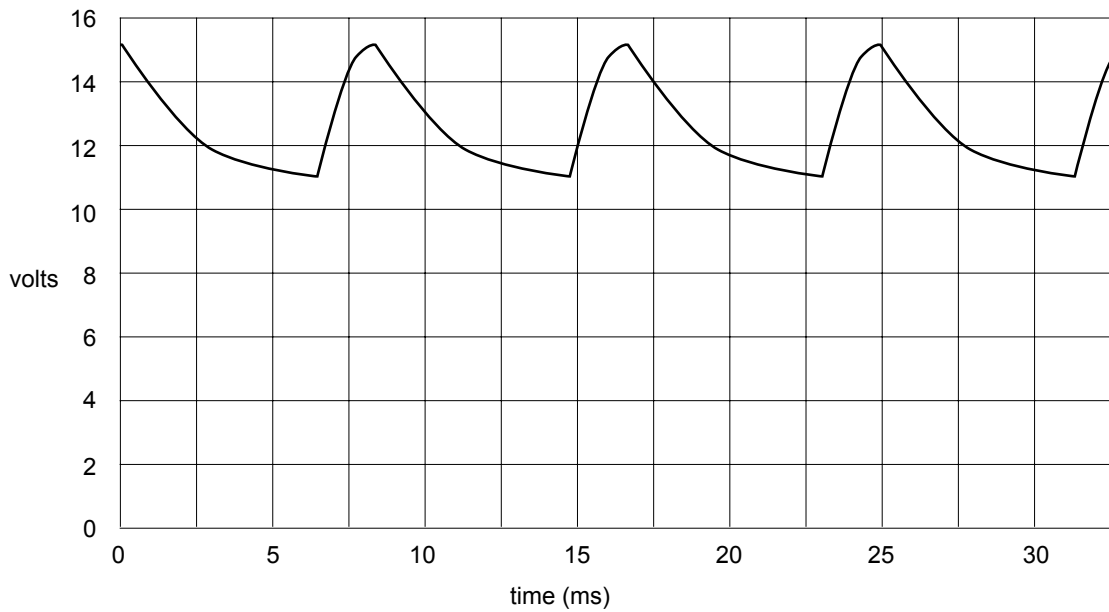Given the primary turns, secondary turns and input voltage shown above, what is the output voltage?

A. 3.75 V

B. 30.0 V

C. 120 V

D. 1.92 k V

Use the following information to answer Questions 17–20.

The voltage waveform across the load resistor R1 in Figure 3a is shown in Figure 3b.

Figure 3a

Figure 3b

Question 17

The name of the rectifier circuit in Figure 3a is a

A.   half-wave rectifier.

B.   capacitive rectifier.

C.   full-wave bridge rectifier.

D.   centre tapped full-wave rectifier.

Question 18

The appropriate voltage rating for capacitor C1 is

A.   11 V

B.   13 V

C.   15 V

D.   25 V

Question 19

The frequency of the 240 V input voltage is

A.   120 Hz

B.   60 Hz

C.   50 Hz

D.   30 Hz

Question 20

What is the most likely consequence if the load resistor R1 becomes a short circuit?

A.   The load voltage will equal 15 V.

B.   Capacitor C1 may overheat.

C.   The fuse will blow.

D.   The output voltage will rise.

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

State all formulas and calculations.

All units must be specified in the answers.

Question 1
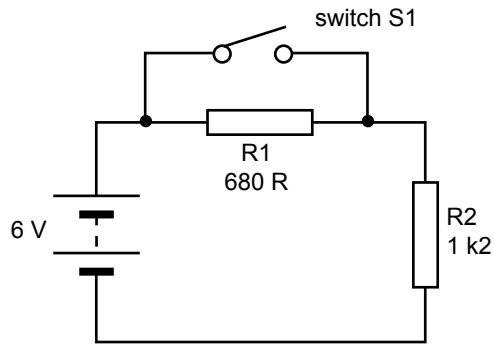
Figure 4

Refer to the circuit in Figure 4.

a. Calculate the current through R2 when switch S1 is open (as shown).

4 marks

b. Calculate the voltage across R1 when switch S1 is open (as shown).

2 marks

c.   What is the current through R1 when switch S1 is closed?

_____

_____

                                                                                    1 mark

d.   Determine the current through R2 when switch S1 is closed.

_____

_____

_____

_____

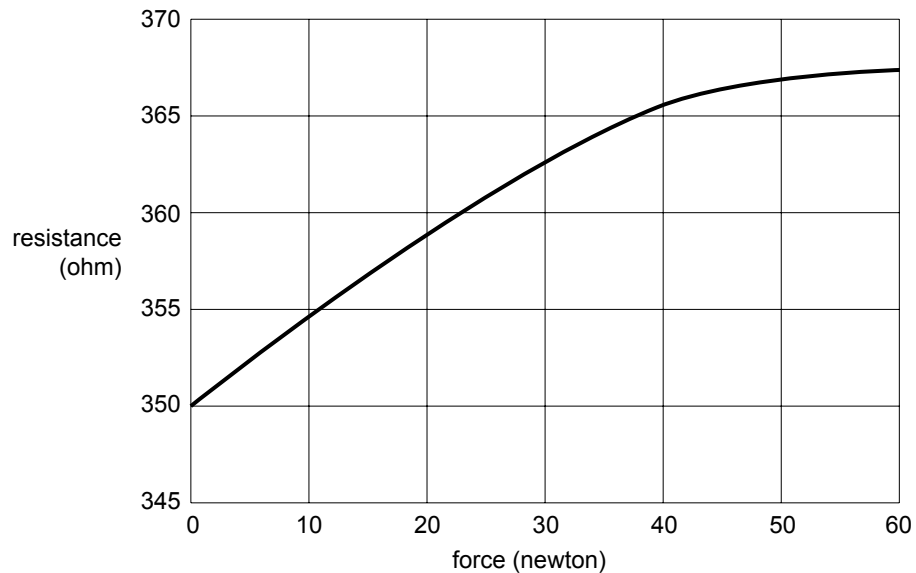   2 marks

Question 2

Figure 5

The resistance–force characteristic of a strain gauge is displayed in Figure 5.

a.   What is the resistance of the strain gauge when zero force is applied?

_____

                                                                                    1 mark

b.   What is the applied force when the strain gauge resistance is 360 ohm?

_____

                                                                                    1 mark

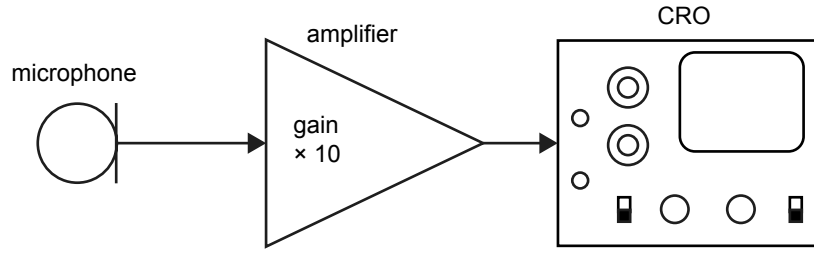**c.**   State the approximate range of applied forces over which the resistance varies linearly.
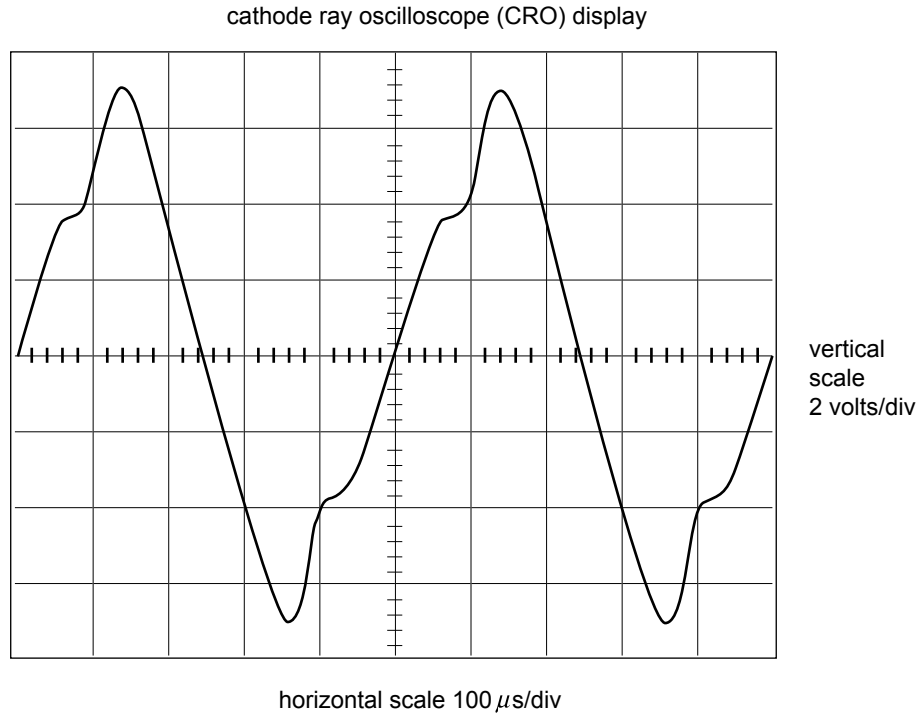
_____

                                                                                    1 mark

Question 3

Figure 6a

cathode ray oscilloscope (CRO) display

vertical
scale
2 volts/div

horizontal scale 100 μs/div

Figure 6b

a. Determine the approximate peak-to-peak voltage of the signal on the oscilloscope display.

_____

_____

_____

_____

2 marks

b.   Determine the frequency of the signal on the oscilloscope display.

_____

_____

_____

_____

                                                                        3 marks

c.   What is the approximate peak-to-peak voltage of the signal from the microphone?

_____

_____

                                                                        1 mark

d.   What is the frequency of the signal from the microphone?

_____

_____

                                                                        1 mark
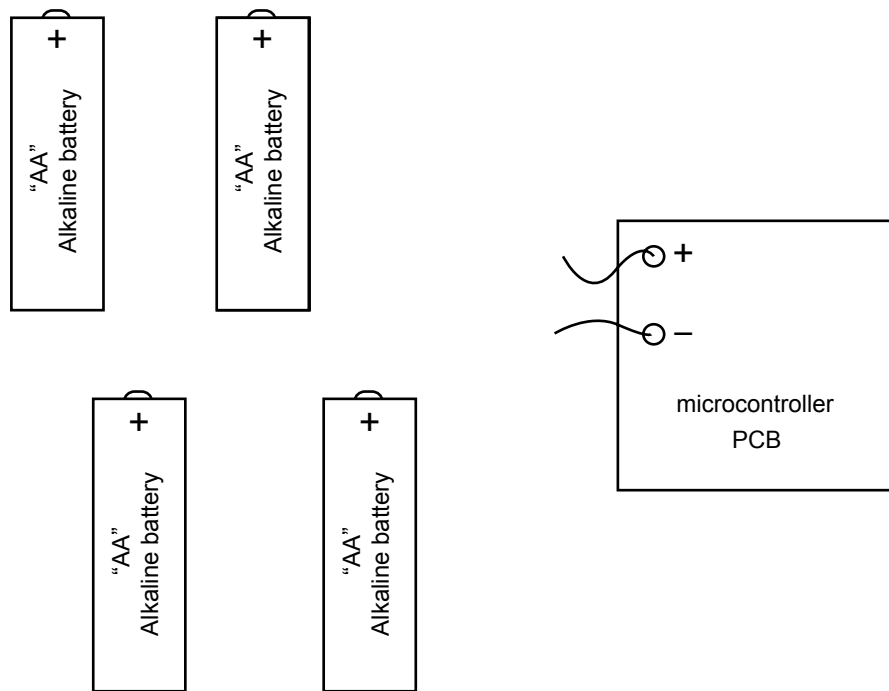
Question 4

a. List three dangers associated with the incorrect handling of batteries. For each danger, explain one possible effect it may have on personnel.

Danger	Explanation of effect on personnel

6 marks

b. The microcontroller circuit in Figure 7 requires a supply of 3.0 volts.

Draw the appropriate connections between the cells and the microcontroller PCB. All cells are to be used.
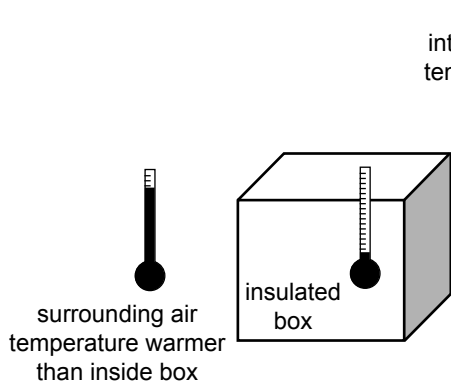
Draw your connection lines on Figure 7.
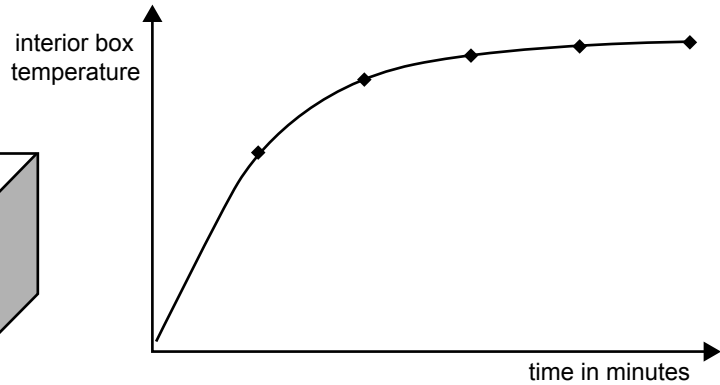
Figure 7

2 marks

Question 5

An insulated box was recently removed from a refrigerator. Measurements of the interior temperature of the box were taken as the box was warmed by the surrounding air. A plot of the interior temperature of the box against time is shown in the graph of Figure 8b.
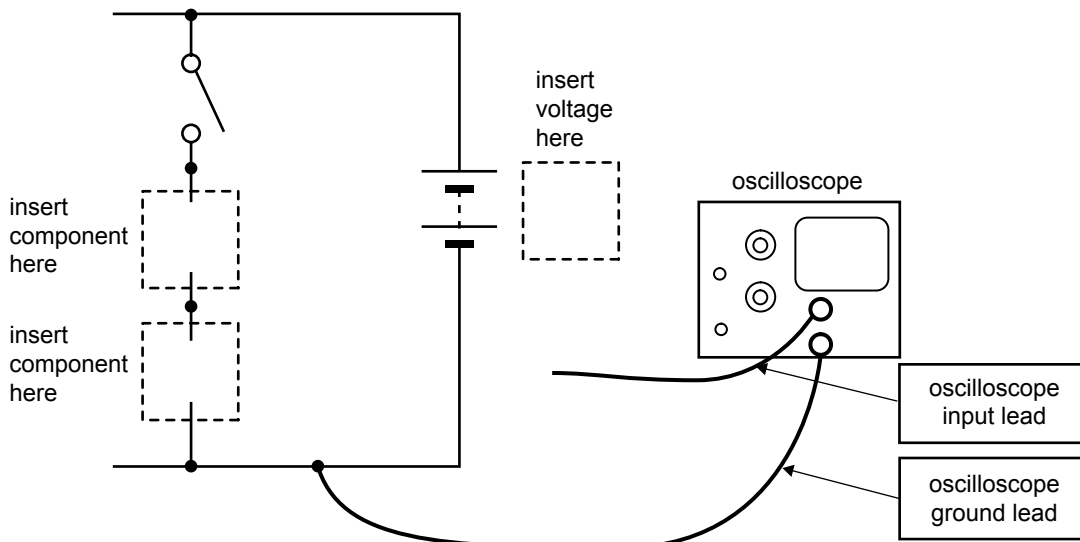

Figure 8a   **Figure 8b**

a.   You are required to design an electric circuit that models the thermal system described above. The maximum voltage in your model circuit is limited to +5 V. Complete the circuit in Figure 8c to show your design.

Figure 8c

3 marks

b.   Show on Figure 8c where the oscilloscope input lead should be connected to the circuit in order to display a voltage graph similar to Figure 8b.

1 mark

c.   If the voltage waveform takes 15 minutes to reach the battery voltage, determine the time constant of the circuit.
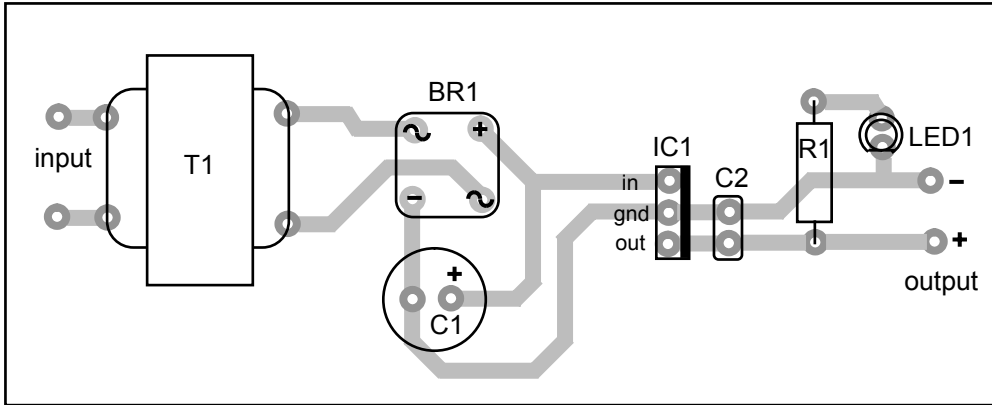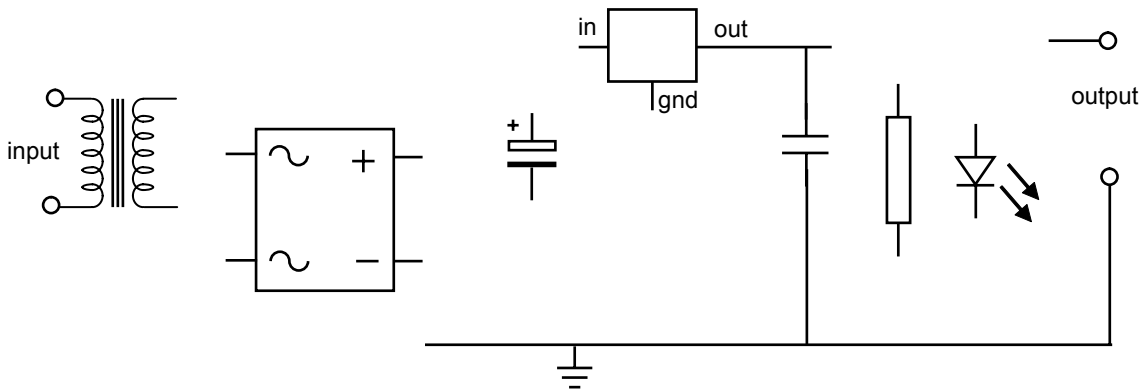
_____

_____

_____

2 marks

Question 6

Figure 9

The component-side view of a printed circuit board layout is shown in Figure 9.

a. Complete the schematic diagram for this circuit board on the diagram below.

5 marks

b. Explain the function of BR1.

_____

_____

2 marks

SECTION B – Question 6 – continued

c.   Name the component IC1.

_____

1 mark

d.   Explain the function of component IC1.

_____

_____

2 marks

e.   IC1 is found to be failing due to overheating under operational conditions. Identify two strategies that could be implemented to overcome this problem.

_____

_____

_____

_____

2 marks

Question 7

The boom gate on a car park entrance is controlled by a microcontroller system as shown in Figure 10.
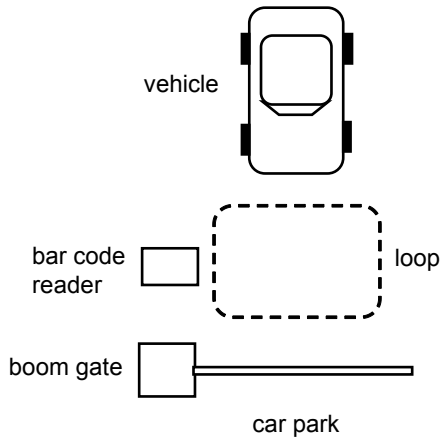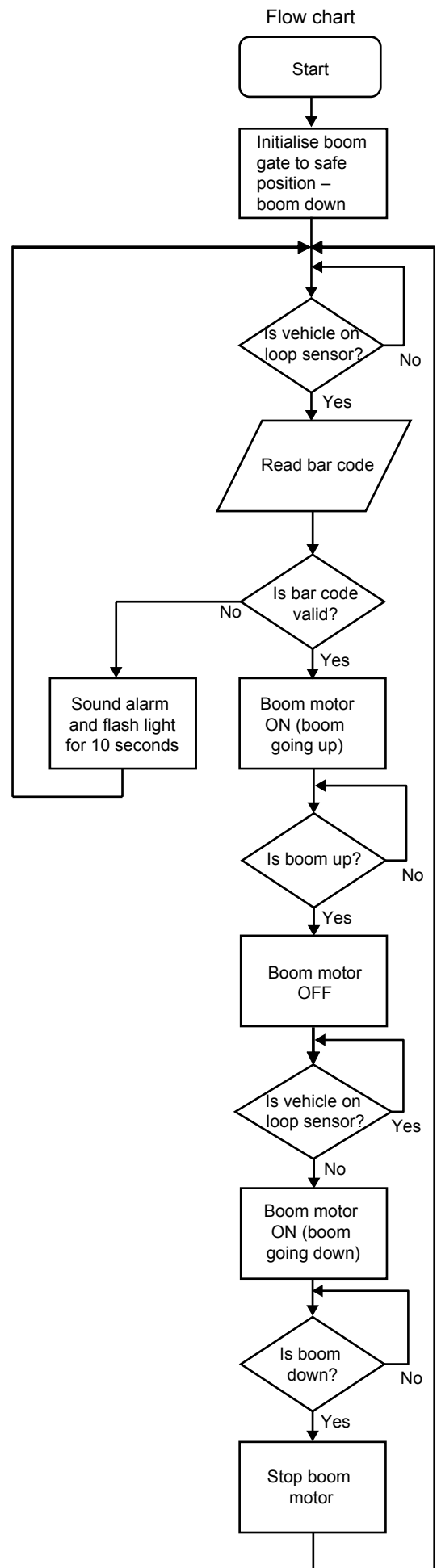

Figure 10

The system consists of the following hardware components.

1. microcontroller
2. inground loop vehicle sensor
3. boom motor to raise and lower boom
4. boom up limit switch
5. boom down limit switch
6. ID-card bar code reader

The operating sequence is summarised in the flow chart shown.

Flow chart

a.   The presence of a vehicle is detected by the loop sensor. What actions must occur and what condition(s) must be met before the boom gate goes to the up position?

_____

_____

_____

_____

                                                                          3 marks

b.   The boom up limit switch fails. As a result the microcontroller does not receive a signal to indicate the boom has reached the up position. What effect does this fault have on the operation of the boom gate?

_____

_____

                                                                          2 marks

c.   To allow vehicles to leave the car park via the boom gate, what additional hardware is required and where might it be located?

Additional hardware   _____

Location   _____

                                                                          2 marks

Question 8

A farmer wants an electronic system that will turn on a heater in his barn if the temperature at night falls below 6°C.

a. The truth table below summarises the operating conditions of the farmer's barn. Complete the truth table shown below.

Temperature Logic 0 = below 6°C Logic 1 = equal to or above 6°C	Time of day Logic 0 = night-time Logic 1 = daytime	Heater Logic 0 = heater off Logic 1 = heater on
0	0	
0	1	
1	0	
1	1	

4 marks

b. Name the logic gate that can perform this logical function.

_____

1 mark

c. Draw the logic symbol of the gate that can perform this logic function.

1 mark

Question 9

Analogue to digital converters (ADCs) and digital to analogue converters (DACs) are used in many digital devices and systems; for example in the sound card of a PC. A sound card converts analogue audio signals into digital data and digital data into analogue audio signals.

a. Other than the sound card in a PC, state two systems or devices that use a DAC.

_____

_____

2 marks

b. Other than the sound card in a PC, state two systems or devices that use an ADC.

_____

_____

2 marks

c. State the number of output codes possible from an 8-bit ADC.

_____

1 mark

d. Name the connection interface which is most commonly used when interfacing an MP3 player to a PC.

_____

1 mark

Question 10

ASCII code chart

least significant nibble

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2	SP	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	|	}	~	DEL

most significant nibble

byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
01001000	**01000101**	**01001100**	**01010000**	**00100000**	**01101101**	**01000101**

The data bytes 1–7 listed above represent a message in ASCII code.

a. State the character represented by byte 1.

_____

1 mark

b. State the character represented by byte 6.

_____

1 mark

c. Determine the decimal value of byte 7.

_____

_____

_____

3 marks

d. Express the number 927 in BCD (binary coded decimal).

_____

_____

_____

3 marks

Question 11

By accessing the device manager on a PC you may view details of devices used by a personal computer.

a.   Name an external device that may be connected to a NIC adaptor.

_____

1 mark

b.   What is the purpose of a NIC adaptor?

_____

_____

_____

_____

2 marks

c.   What does I/O stand for?

_____

1 mark

d. What is meant by the term 'device conflict'?

_____

_____

_____

_____

2 marks

e. How many memory locations are used by this device?

_____

_____

2 marks

END OF SECTION B

Formula sheet

resistor code

D_1 D_2 D_3

— multiplier

— digit 2

— digit 1

value is in ohm

capacitor code

D_1 D_2 D_3

— multiplier

— digit 2

— digit 1

value is in picofarad
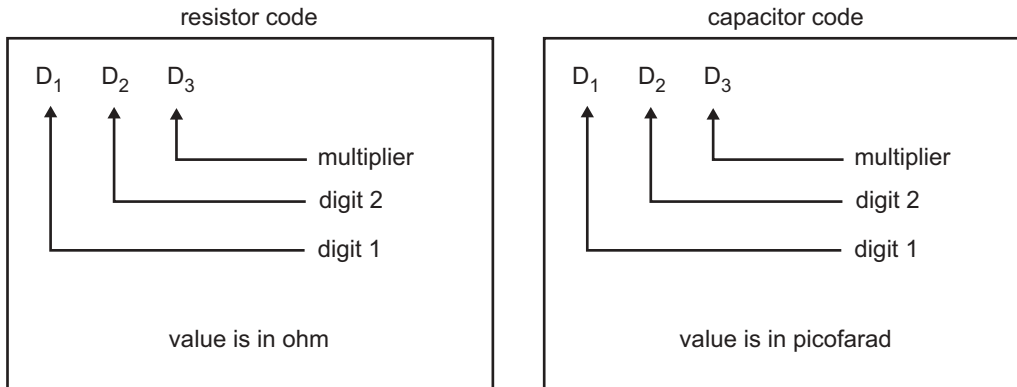
$$R_T = R_1 + R_2 + R_3$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$V = I \times R$$

$$P = V \times I$$

$$Q = C \times V$$

$$V_{PK} = \sqrt{2} \times V_{RMS}$$

$$\text{Turns ratio} = \frac{N1}{N2}$$

$$\frac{V_{primary}}{V_{secondary}} = \frac{N_{primary}}{N_{secondary}}$$

$$V_{REG} = V_{IN} - V_{OUT}$$

$$\text{Time constant } \tau = R \times C$$

$$\text{Time constant } \tau = \frac{L}{R}$$

$$f = \frac{1}{T}$$

END OF QUESTION AND ANSWER BOOK