VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2017

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER | | | | | | | | | Letter |

VCE VET INTEGRATED TECHNOLOGIES

Written examination

Thursday 16 November 2017

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	12	12	80
			Total 100

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

Materials supplied
- Question and answer book of 27 pages
- Detachable insert of miscellaneous formulas in the centrefold
- 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.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- 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.
- You may keep the detached insert.

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

SECTION A – Multiple-choice questions

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1

Work health and safety (WHS) practices mandate that safety glasses must be worn

A. at all times.

B. where machinery is being used.

C. only when using a machine that spins very fast.

D. only when there is significant risk of eye injury from things flying out from a machine.

Question 2

Which one of the following capacitance values is the largest?

A. 4 μF

B. 1000 nF

C. 2200 nF

D. 1 000 000 pF

Question 3

The characteristic impedance of a length of coaxial cable can be found by

A. reading the cable part number and referring to the manufacturer's specifications for the cable.

B. using an ohmmeter to measure the resistance of the cable between both ends of the inner conductor.

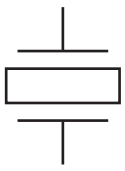
C. using an ohmmeter to measure the resistance of the cable at one end, between the inner conductor and the shield.

D. using an ohmmeter to measure the resistance of the cable at one end, between the inner conductor and the shield, with the other end short circuited.

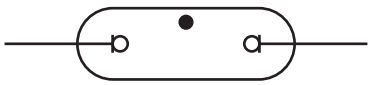
Question 4

Which one of the following symbols represents a capacitor in a circuit diagram?

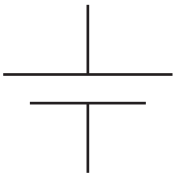
A.



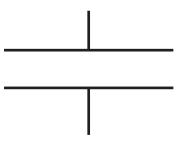
B.



C.



D.

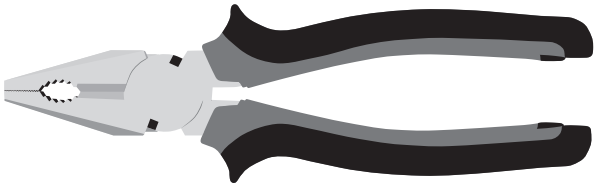


Question 5

The normal working temperature range for the tip of a temperature-controlled soldering iron is

A. 50 °C to 150 °C
B. 200 °C to 450 °C
C. 500 °C to 650 °C
D. 700 °C to 950 °C

Question 6



Source: Yanas/Shutterstock.com

What is the tool shown above?

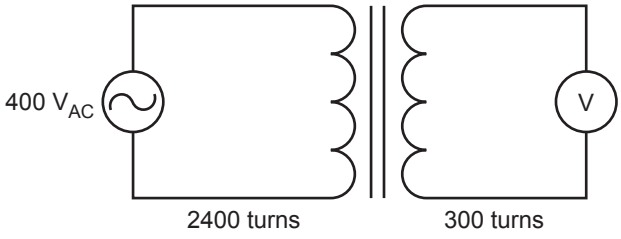
A. wire-stripping pliers
B. side-cutting pliers
C. combination pliers
D. long-nose pliers

Question 7

A function of a power transformer is to

A. step up or step down the AC voltage.
B. prevent any electric shocks.
C. provide a fixed current.
D. convert AC to DC.

Question 8



The voltage displayed on the voltmeter is

A. 30 V
B. 50 V
C. 400 V
D. 3200 V

Question 9

Why is lead-free solder often required on printed circuit boards (PCBs) instead of regular 60/40 solder?

A. Lead-free solder is safer.

B. Lead is an expensive metal.

C. Lead-free solder has better electrical properties.

D. Lead-free solder requires lower soldering temperatures.

Question 10

Which statement is most likely to apply when maintenance is required on a device connected to mains power?

A. The mains power can be maintained to hold RAM memory.

B. The mains power can be maintained to a device during maintenance, as long as care is taken.

C. The mains power should be turned off at the device and disconnected from the power supply.

D. The mains power should be turned off at the device, but the device can remain connected to the power supply.

Question 11

Bluetooth® is a wireless technology standard that is used to exchange data over short distances.

Bluetooth® utilises

A. HF RF.

B. UHF RF.

C. infra-red links.

D. medium-wave radio.

Question 12

Source: Juan_Gomez/Shutterstock.com

What are the output pin sockets labelled 1, 2 and 3 on the general purpose outlet (GPO) shown above?

	1	2	3
A.	neutral	active	earth
B.	earth	neutral	active
C.	active	earth	neutral
D.	active	neutral	earth

Question 13

The industry-preferred method of expressing 0.00088 A is

A. 0.88 kA

B. 880 mA

C. 88 mA

D. 880 μA

Question 14

What is the nominal output voltage of an LM7812 voltage regulator?

A. 1 A

B. 2 V

C. 12 V

D. 812 V

Question 15

The earth connection on the metal body of an electric power tool is required to

A. allow the tool to operate safely if the internal wires become loose.

B. provide a short circuit current path in the event of a fault.

C. make the tool safe if it is dropped to the ground.

D. assist with the current flow to the tool.

Question 16

What is the four-band colour code for a 12 R 1% tolerance resistor?

A. brown, red, black, gold

B. brown, red, brown, gold

C. brown, red, black, brown

D. brown, red, brown, brown

Question 17

The electricity supplied from a standard GPO is nominally

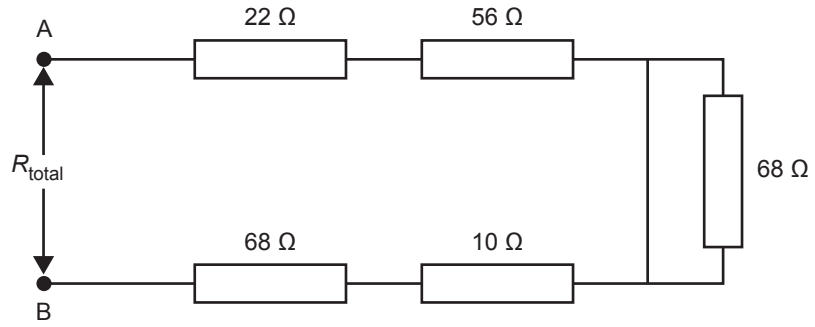
A. 230 V_{DC}

B. 110 V_{AC} 60 Hz

C. 230 V_{AC} 50 Hz

D. 250 V_{AC} 100 Hz

Question 18



What is the total resistance of the circuit between points A and B in the diagram shown above?

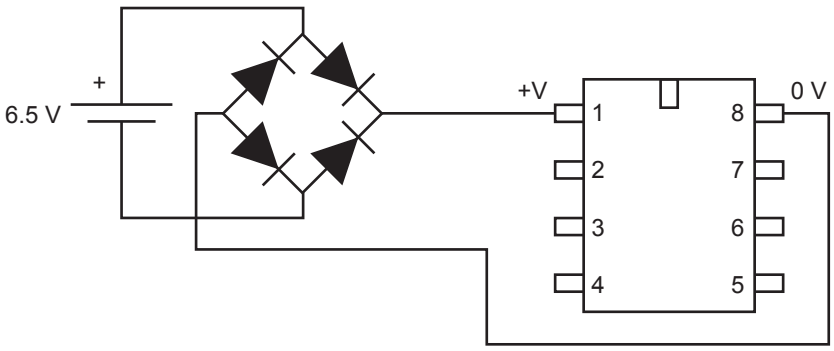
A. 39 Ω

B. 78 Ω

C. 156 Ω

D. 224 Ω

Question 19



A 6.5 V supply is connected to a microcontroller via a diode bridge, as shown in the diagram above.

The main purpose of the diode bridge is to

A. convert the AC input voltage to a DC voltage.

B. limit the current drawn by the microcontroller.

C. increase the voltage to the microcontroller pins.

D. prevent power from being connected with reverse polarity.

Question 20

A waveguide is used in RF communications.

A waveguide can be described as a

A. device to support coaxial cables.

B. transmission line for SHF signals with high data rates.

C. pipe or channel for the transmission of LF signals with high data rates.

D. device used by the National Broadband Network Company Limited (nbn co limited) to feed fibre-optic cables along ducts.

END OF SECTION A

CONTINUES OVER PAGE

SECTION B

Instructions for Section B

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

Formulas must be relevant to the calculations. Calculations must be shown.

All units must be specified in correct engineering notation in the answers.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 (5 marks)

Figure 1 below shows the audio output performance graph for a music device that is Bluetooth® enabled. The device's audio frequency output performance when connected through Bluetooth® is shown using a logarithmic scale on the graph.

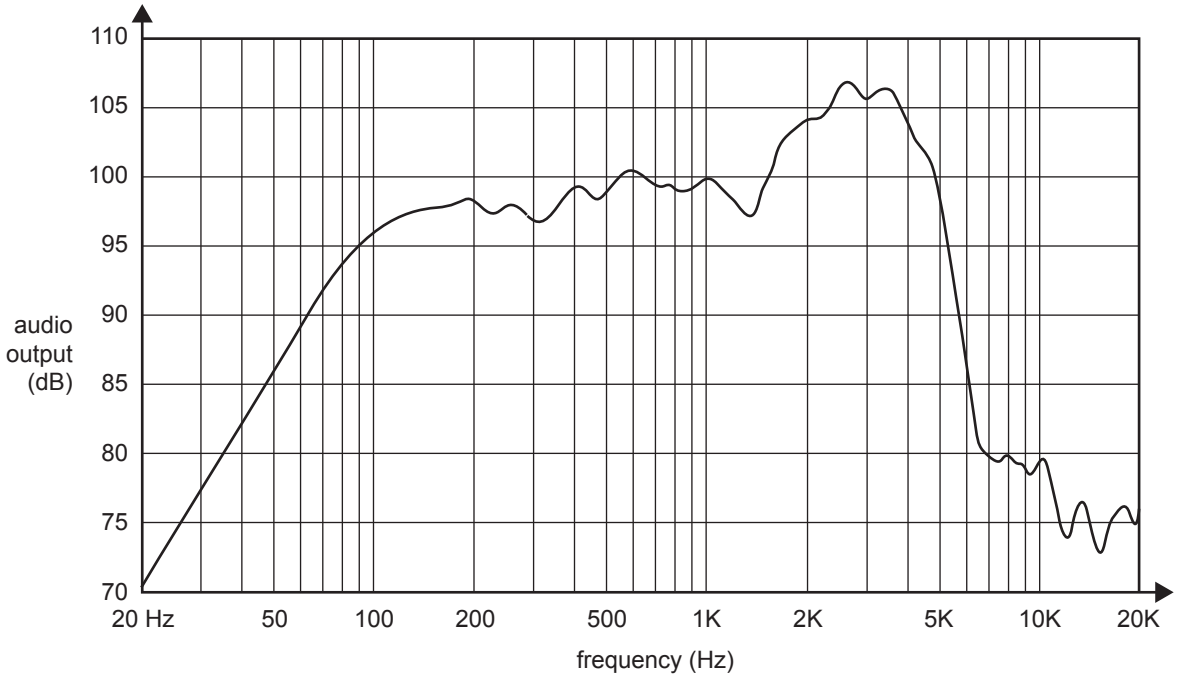


Figure 1

a. Why is the logarithmic scale used in the graph in Figure 1 best suited to representing the audio frequency output? 1 mark

_____

b. Refer to the graph in Figure 1. Find the specific frequency range for the best audio output performance at 95 dB or above for the device, and complete the table below. 2 marks

Lower frequency	Higher frequency

c. Describe the general performance level of the device between 100 Hz and 1000 Hz. 1 mark

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d. The higher audio output frequency performance is lower than expected.

Describe how this is shown on the graph. 1 mark

Question 2 (6 marks)

Figure 2 below is an oscilloscope's display showing the output waveform from an oscillator.

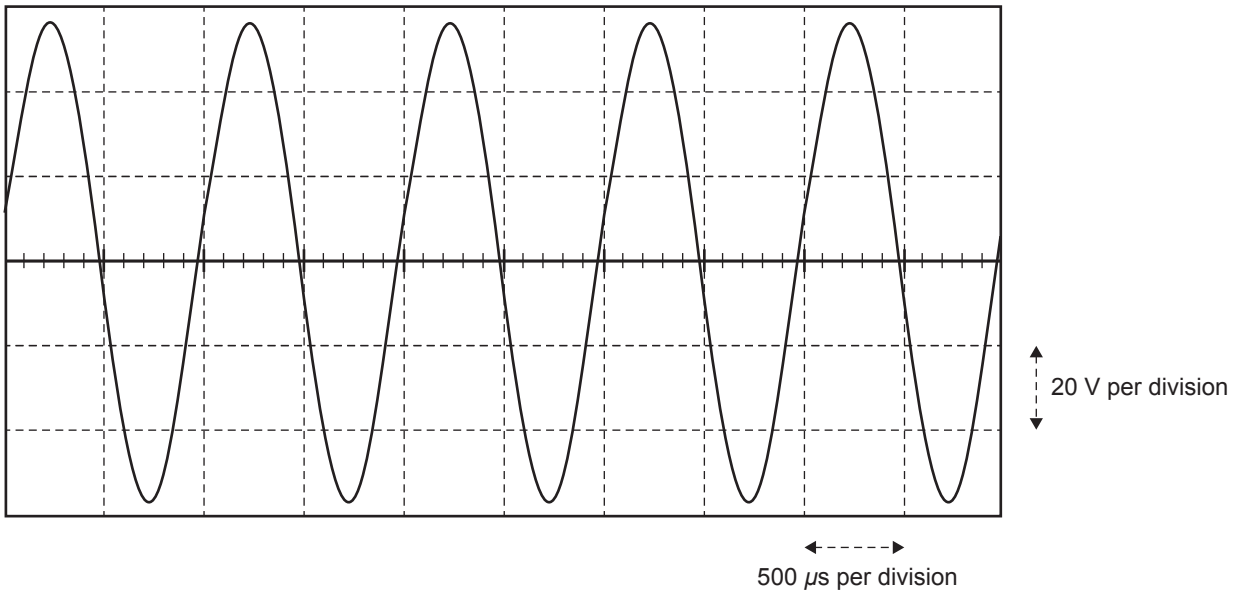


Figure 2

The oscilloscope's timebase is set to 500 μs per division and its vertical channel scale is set to 20 V per division.

a. **i.** Using the graph in Figure 2, find the following values. 2 marks

- the peak or maximum voltage of the waveform (V_{peak})

- the peak-to-peak voltage (V_{p-p})

ii. Calculate the RMS voltage (V_{RMS}). Show your working. 2 marks

b. What is the period of the waveform? 1 mark

c. What is the frequency of the waveform? 1 mark

CONTINUES OVER PAGE

Question 3 (12 marks)

Figure 3 below shows the schematic diagram of an oscillator circuit.

Figure 4 below shows incomplete printed circuit board (PCB) artwork for the oscillator, with six tracks missing from the artwork.

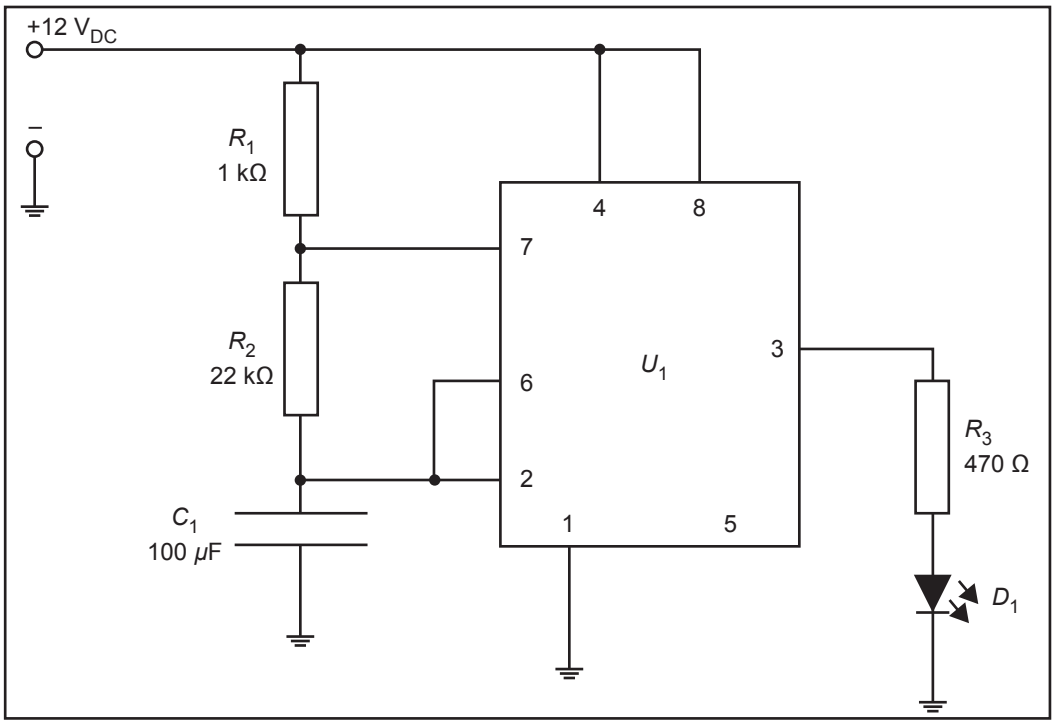


Figure 3

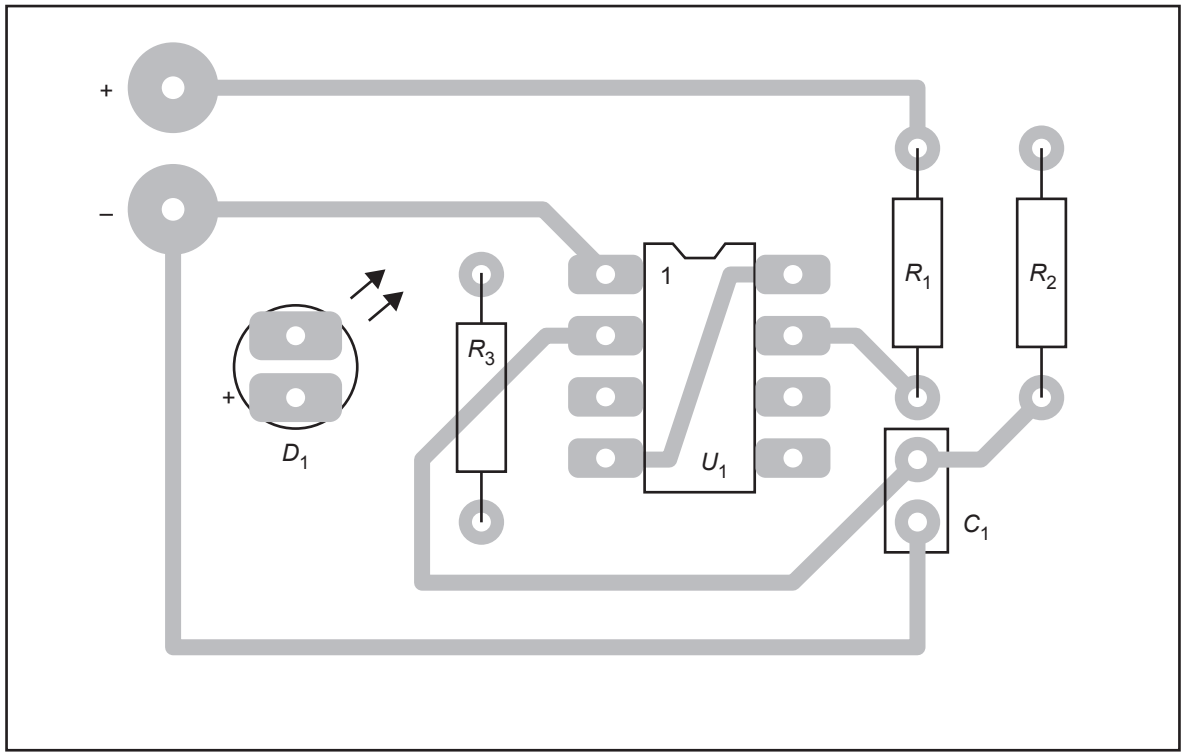


Figure 4

a. On Figure 4, draw all of the missing PCB track connections for the correct operation of the circuit. 6 marks

b. Series resistors R_1 and R_2 and capacitor C_1 in Figure 3 form a time-constant circuit.

Assuming pin 7, pin 6 and pin 2 have infinite resistance with reference to ground, what is the time constant for the circuit? Show your working. 2 marks

c. **i.** Name a software design package you have used to draw an electronic circuit as part of your design project. 1 mark

ii. Describe **three** main steps involved in designing and testing the oscillator circuit using the software package named in **part c.i.** 3 marks

Question 4 (6 marks)

Figure 5 below shows a microcontroller system that has been partially connected. Table 1 on page 15 shows the pin descriptions for each pin of the microcontroller.

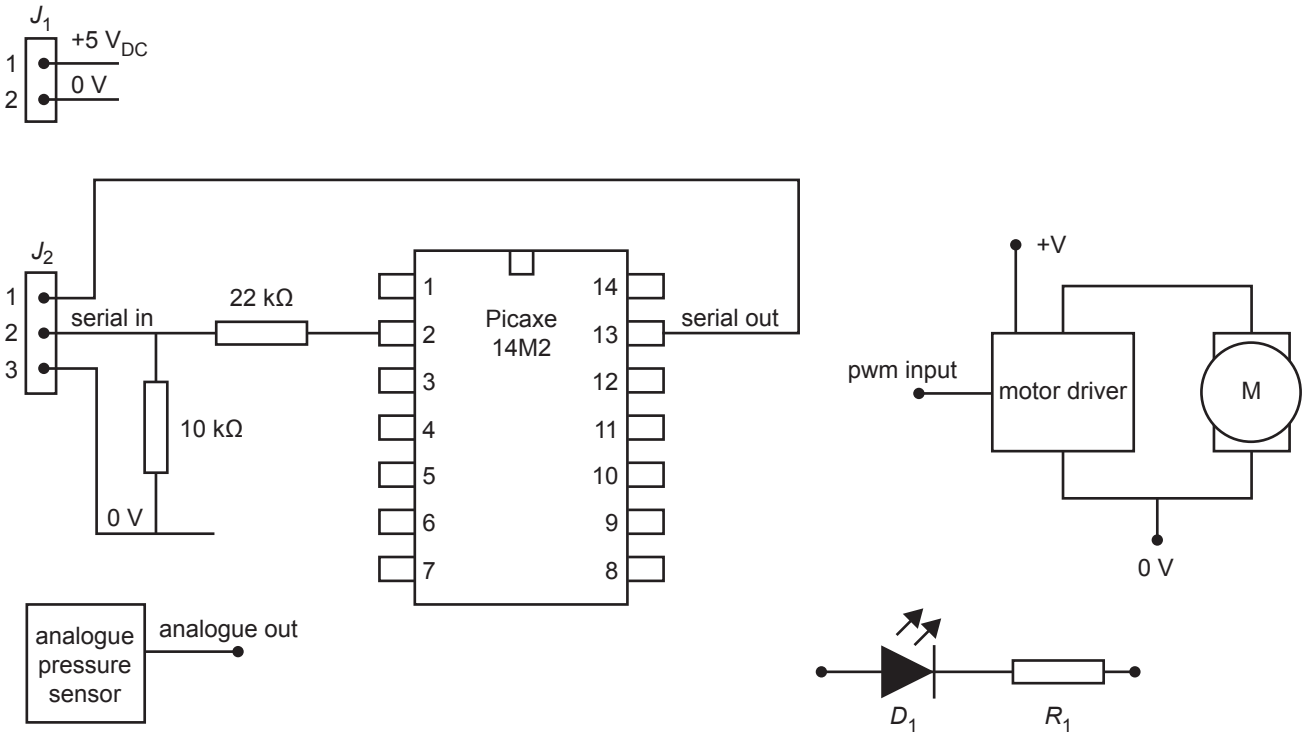


Figure 5

Table 1

Pin	I/O	Pin description
1		+V (5 V nominal)
2	C.5	(in) serial in
3	C.4	(touch/ADC/out/in)
4	C.3	(in)
5	C.2	(kb clk/hpwm A/pwm/out/in)
6	C.1	(kb data/hpwm B/out/in)
7	C.0	(hpwm C/pwm/touch/ADC/out/in)
8	B.5	(in/out/ADC/touch/hpwm D)
9	B.4	(in/out/ADC/touch/pwm/hi2c sda)
10	B.3	(in/out/ADC/touch/hi2c sda)
11	B.2	(in/out/ADC/touch/pwm/SRQ)
12	B.1	(in/out/ADC/touch/SRI/hserin)
13	B.0	serial out (out/hserout/DAC)
14		0 V

On Figure 5, draw the missing connections to and from the microcontroller, using your choice of pins from Table 1, to ensure the microcontroller will function. The required connections are:

- J_1 pins 1 and 2
- analogue pressure sensor
- pwm motor driver
- LED D_1, so that a logic '0' from the microcontroller turns the LED on.

Question 5 (5 marks)

Figure 6 below shows six components and two meters that are required to be connected into a circuit.

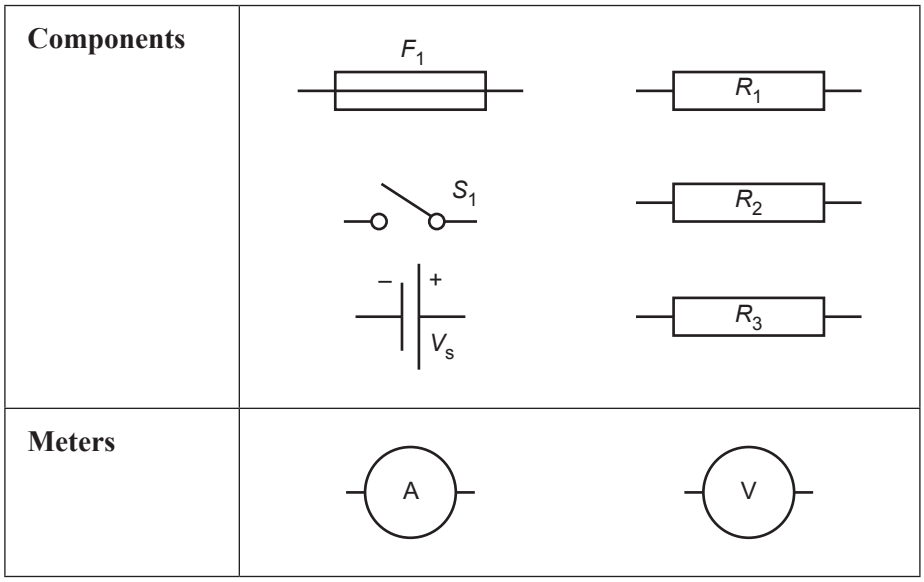


Figure 6

a. In the space provided below, draw a circuit using all of the components above connected in series. The voltmeter, V, is to measure the supply voltage and the ammeter, A, is to measure the current flowing in the circuit. The correct polarity on the voltmeter and the ammeter must be shown. 3 marks

b. If $R_1 = 56\ \Omega$, $R_2 = 39\ \Omega$, $R_3 = 10\ \Omega$ and $V_s = 50$ V, what would be the expected reading on the ammeter when the switch, S_1, is closed or 'on'? Show your working. 2 marks

Question 6 (6 marks)

Figure 7 below shows a 230 V_{AC} 50 Hz power supply that is connected to a motor. When 'on', the motor will run at full load, drawing a current of 15 A.

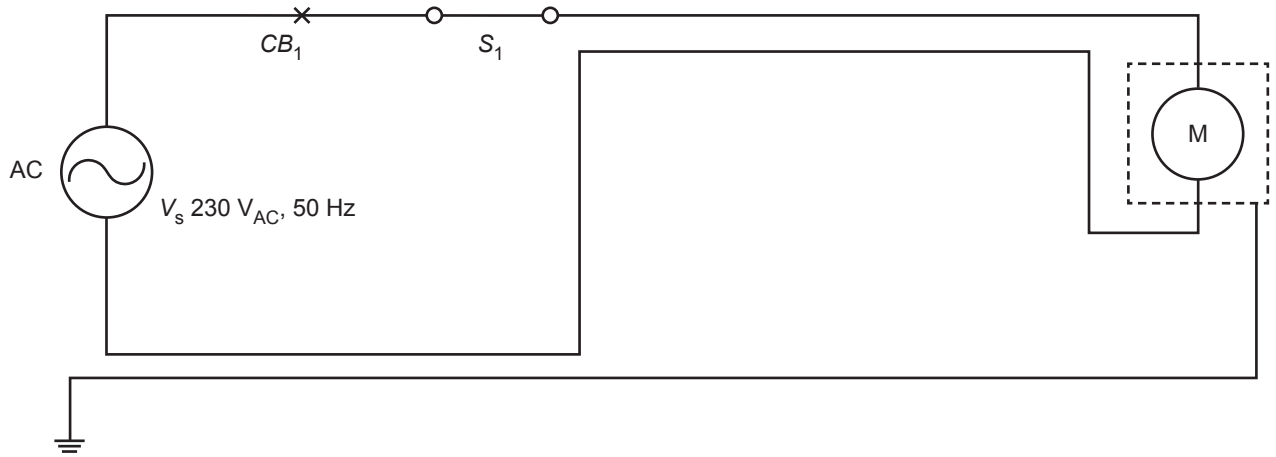


Figure 7

Assume that circuit breaker CB_1 and switch S_1 are closed, or 'on'.

a. Calculate the voltage across the motor if the voltage drop on the cable is 5% of the power supply voltage at a full load current. Show your working. 2 marks

b. Calculate the resistance of the cable that connects the motor to the power supply. Show your working. 2 marks

c. Suggest how the voltage drop could be reduced. 1 mark

d. Circuit breaker CB_1 is a thermal and electromagnetic device.

What function does CB_1 perform? 1 mark

Question 7 (5 marks)

Figure 8 below shows a 12 V lighting circuit.

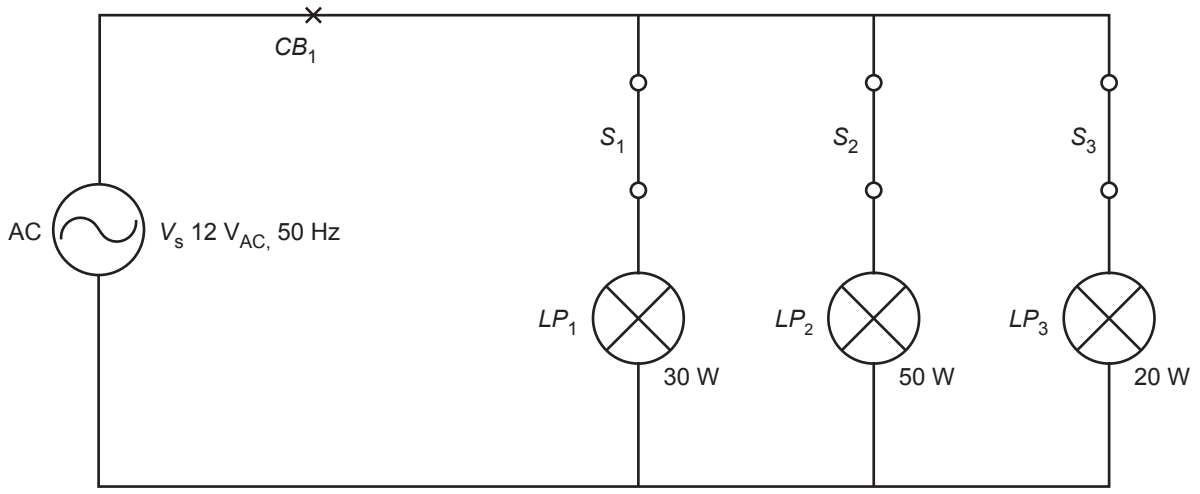


Figure 8

a. Assume that CB_1, S_1, S_2 and S_3 are closed.

i. How much power is now consumed by the lighting circuit? 1 mark

ii. Calculate the current flowing from the power supply. Show your working. 2 marks

b. State **two** outcomes that will occur if the 50 W incandescent lamp was replaced with 50 W of LED lighting. 2 marks

Question 8 (5 marks)

Refer to the circuit shown in Figure 9 below.

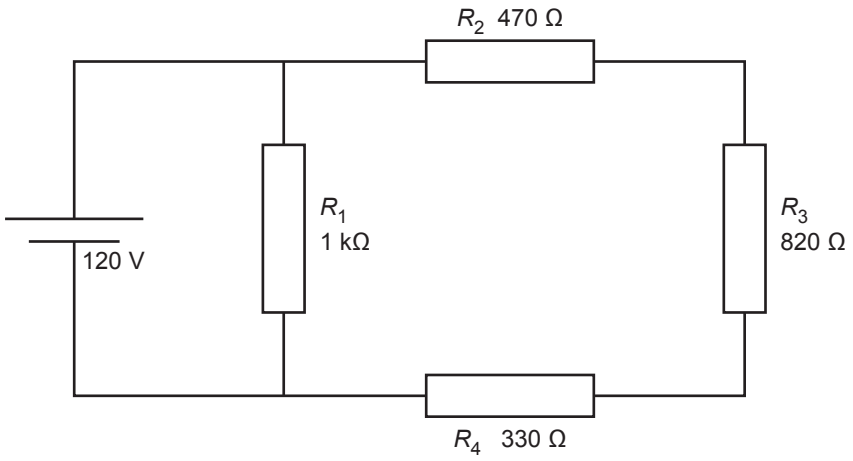


Figure 9

a. Find the total resistance of the circuit (R_{total}). Show your working. 3 marks

b. Find the voltage drop across resistor R_3. Show your working. 2 marks

CONTINUES OVER PAGE

Question 9 (9 marks)

Figure 10 below shows an embedded microcontroller connected to a liquid crystal display (LCD).

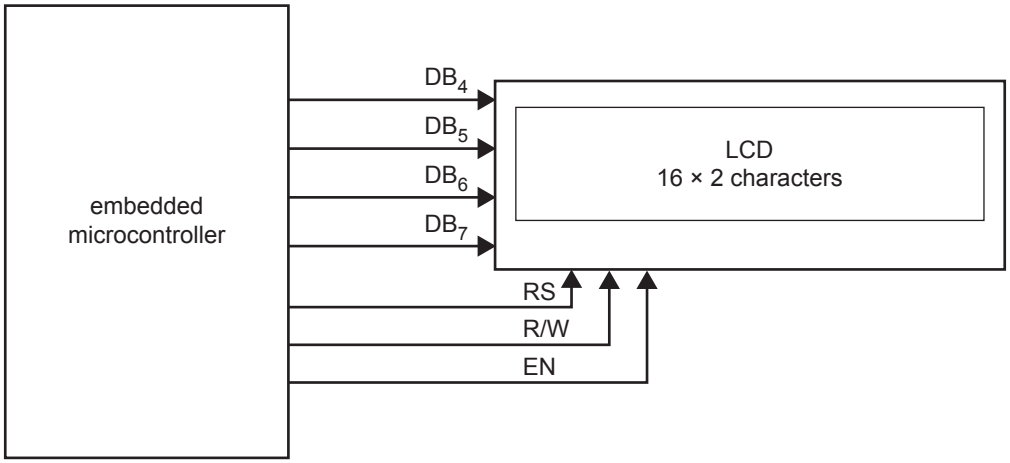


Figure 10

Table 2 below describes the LCD pin details.

Table 2

LCD pin details	
DB_4–DB_7	4-bit data lines to LCD
RS	register select '0' to address control register; register select '1' to address display data register
R/W	'1' = read data from LCD; '0' = write data to LCD
EN	enable; a pulse will latch data onto LCD

A byte of data is outputted from the microcontroller to the LCD's data register as follows:

Step 1 – Clear the R/W line to '0'.

Step 2 – Set the RS line to '1'.

Step 3 – Output the high-order 4 bits of the data onto the DB_4–DB_7 lines.

Step 4 – Pulse the EN line to latch the data into the LCD's data register.

Step 5 – Repeat the process for the low-order 4 bits.

Figure 11 shows a partly completed timing diagram displaying how data is sent from the microcontroller to the LCD and how the high-order 4 bits are latched onto the LCD.

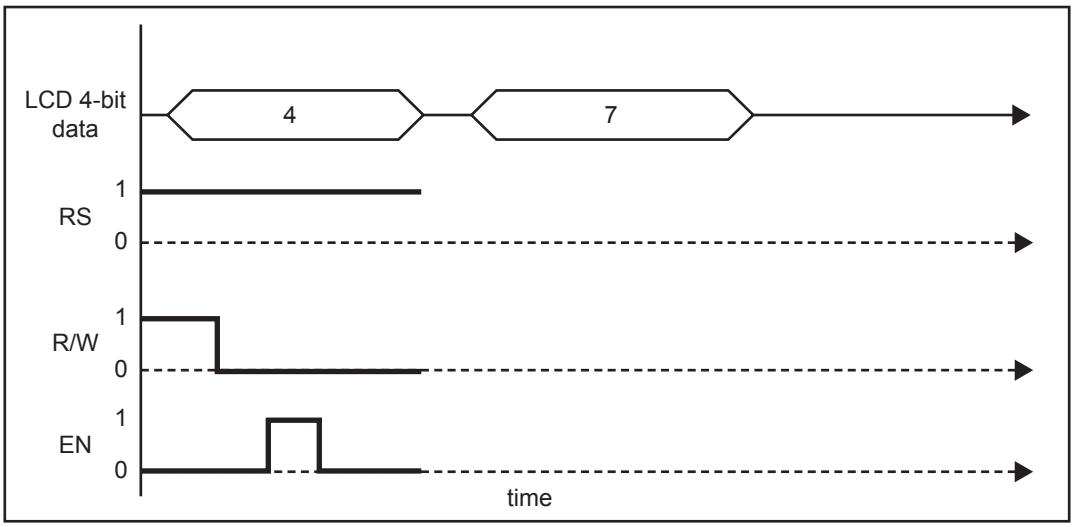


Figure 11

a. Refer to the partly completed timing diagram in Figure 11.

i. Complete the timing on Figure 11, showing how the byte 47H is written to the data register. Note: The most significant nybble (4) has already been sent to the LCD. 3 marks

ii. If the byte 47H is latched into the LCD data register correctly, what character will be displayed on the LCD? Refer to the ASCII code chart in the formula sheet to determine your answer. 1 mark

_____

b. The LCD display board is connected to some ports on the microcontroller.

Describe the function of ports on a microcontroller. 1 mark

_____

_____

c. Name **two** types of memory in a microcontroller system. 2 marks

_____

d. In a microcontroller system, what is the function of a real-time clock chip? 1 mark

_____

_____

e. What is the function of a CAN-bus in a vehicle? 1 mark

_____

_____

Question 10 (5 marks)

Figure 12 below shows a 4-bit voltage digital-to-analogue converter (DAC) with a 10 V_{DC} voltage reference driving a load in a control system.

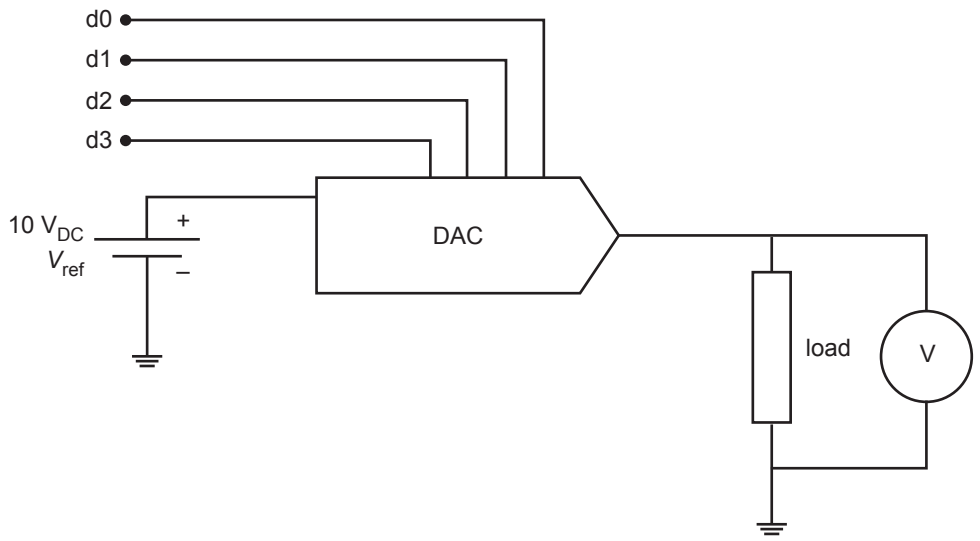


Figure 12

a. Name two electronic devices that use a DAC. 2 marks

1. _____

2. _____

b. If the digital logic input (d3 to d0) is 1011b, what voltage will be displayed on the voltmeter? Show your working. 2 marks

_____

_____

c. Determine the new resolution if the 4-bit DAC was replaced with a 12-bit DAC. 1 mark

_____

_____

Question 11 (6 marks)

A company needs to purchase a software package to be used in the design of technical diagrams for integrated technology purposes. The company is looking for a package that has some of the following features:

- scalable
- imports component objects
- relocatable toolbar
- exports different file formats
- PCB design function
- auto-route function
- simulation function

Select three features from the list above and describe the purpose of each.

1. _____

_____

_____

2. _____

_____

_____

3. _____

_____

_____

Question 12 (10 marks)

Figure 13 below shows the power supply for a small electronic circuit. Switch S_1 is 'on'.

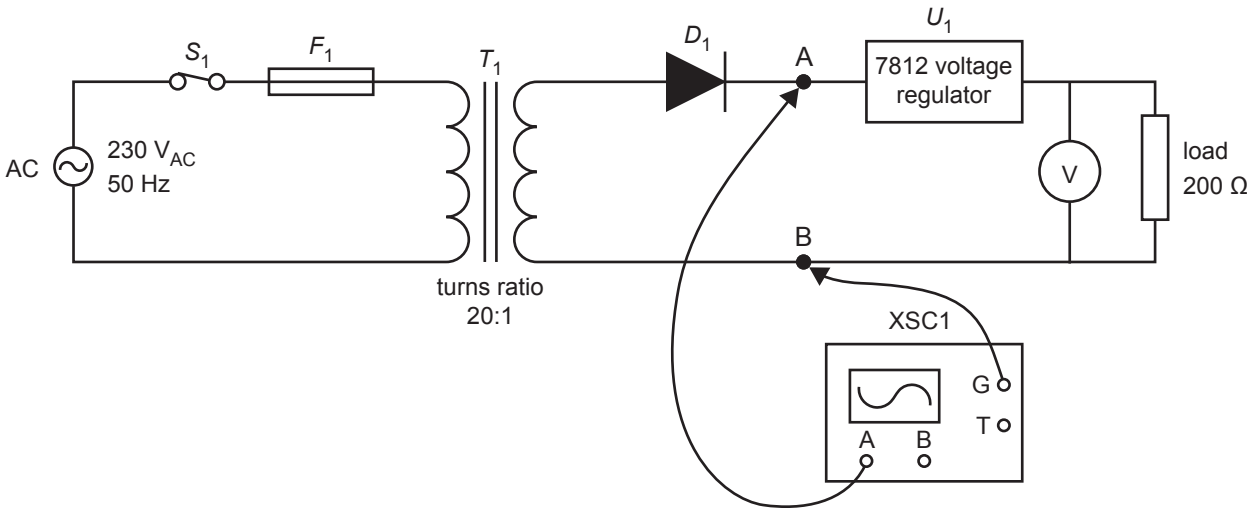
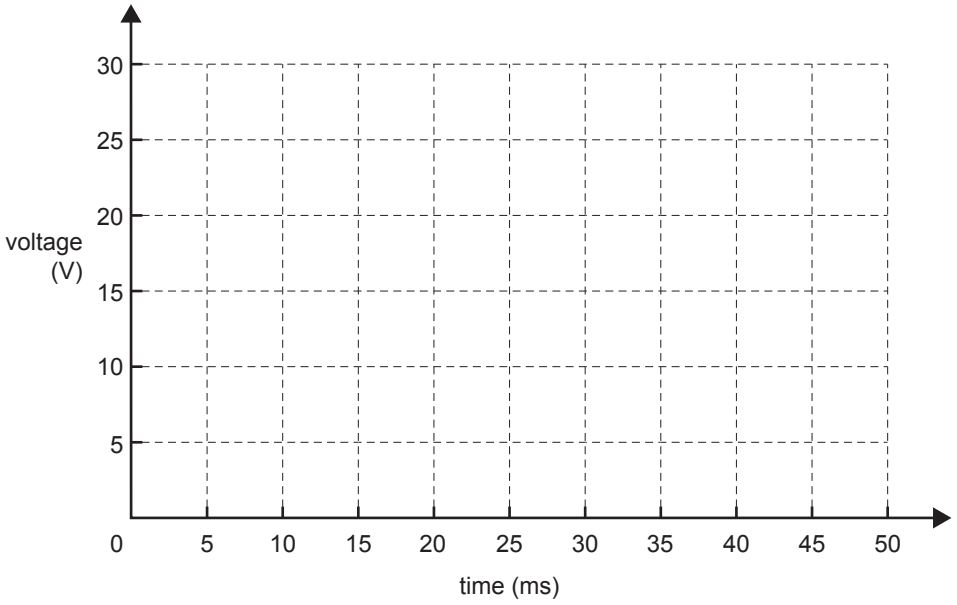


Figure 13

a. On the grid provided below, draw the expected output voltage waveform between points A and B for a period of 40 ms. 3 marks



b. What type of rectification is performed in this circuit? 1 mark

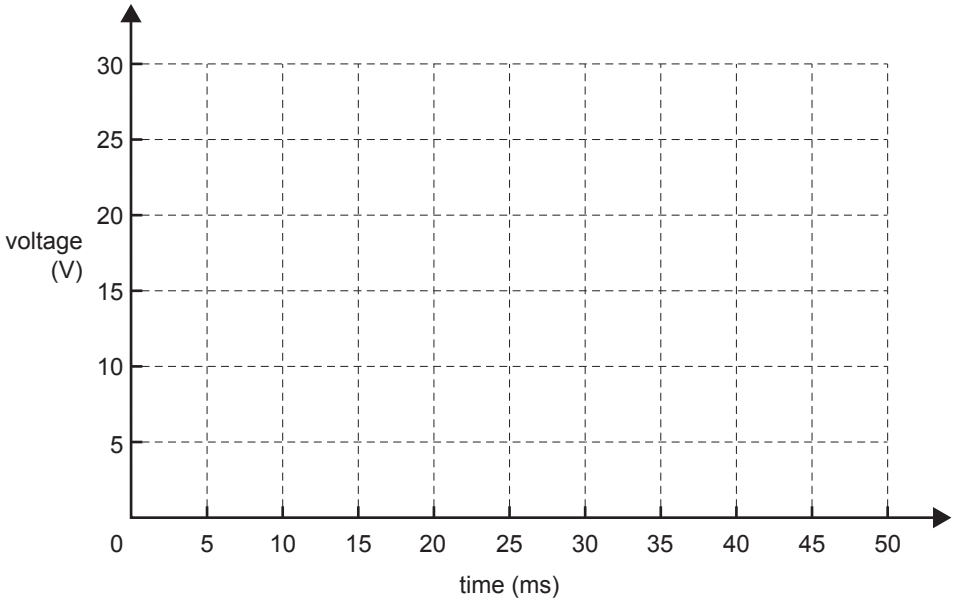
_____

c. What voltage could be read on the voltmeter? 1 mark

_____

d. A 1000 μF capacitor is now placed between points A and B.

i. On the grid provided below, draw the voltage output waveform now expected between points A and B for a period of 40 ms. 2 marks



ii. What voltage could now be read on the voltmeter? 1 mark

iii. Calculate the current flowing through fuse F_1 if the total power consumed by the load and the regulator circuit is 1.2 W. Show your working. 2 marks

END OF QUESTION AND ANSWER BOOK

VCE VET INTEGRATED TECHNOLOGIES

Written examination

FORMULA SHEET

Instructions

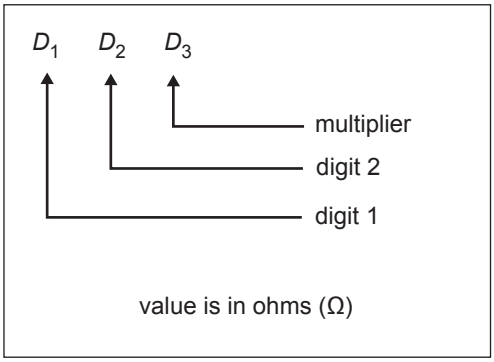
Please remove from the centre of this book during reading time.
This formula sheet is provided for your reference.

VCE VET Integrated Technologies formulas

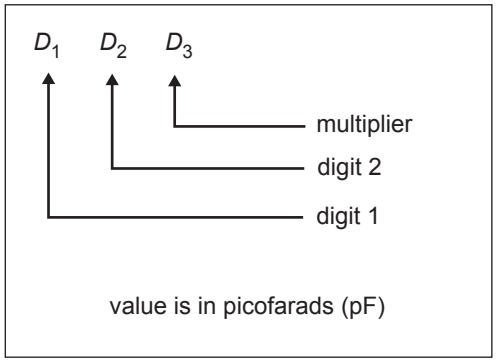
$R_T = R_1 + R_2 + R_3$	$f = \frac{1}{T}$
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	$\tau = C \times R$
$R_T = \frac{R_1 R_2}{R_1 + R_2}$	$A = \frac{\pi d^2}{4}$
$R = \frac{\rho l}{A}$	$C = \frac{\varepsilon A}{d}$
$V = I \times R$	$C_T = C_1 + C_2 + C_3$
$P = V \times I$	$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
$V_X = V_S\left(\frac{R_X}{R_T}\right)$	$Q = V \times C$
$V_{max} = V_{peak}$	$W = \frac{1}{2}CV^2$
$V_{step} = \frac{V_{max}}{2^n - 1}$	$W = P\,t$
turns ratio = $\frac{N_1}{N_2}$	1 ampere hour (Ah) = 1 A of amount drawn for one hour
$v = V_{max} \sin\theta$	$i = I_{max} \sin\theta$
$V_{av} = 0.637 \times V_{max}$	$V_{RMS} = 0.707 \times V_{max}$ $\quad V_{RMS} = \frac{V_{max}}{\sqrt{2}}$
$f = \frac{1}{t}$	$L_T = L_1 + L_2 + L_3$
$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$	$f_0 = \frac{1}{2\pi\sqrt{LC}}$ Hz (resonant frequency)

transformer ratios $\frac{V_S}{V_P} = \frac{N_S}{N_P} = \frac{I_P}{I_S}$	$\lambda = \frac{c}{f}$ m where λ is in metres, f is in Hertz and c is the speed of light (3×10^8 ms^{-1})
$\eta = \frac{\text{pin} - \text{losses}}{\text{pin}} \times 100$ (η = efficiency in %)	$\eta = \frac{\text{power out} \times 100}{\text{power in}}$ %
$\tau = \frac{L}{R}$	

Resistor codes



Capacitor codes

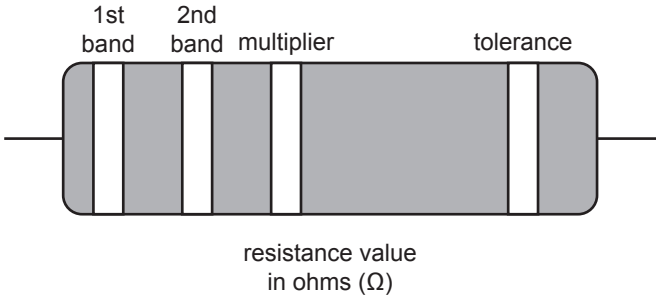


ASCII code chart (in hexadecimal)

Least significant nybble

Most significant nybble	**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

Resistor colour codes



Colour	Value	Multiplier	Tolerance
black	0	10^0	
brown	1	10^1	1%
red	2	10^2	2%
orange	3	10^3	
yellow	4	10^4	
green	5	10^5	0.5%
blue	6	10^6	0.25%
violet	7	10^7	0.1%
grey	8	10^8	0.05%
white	9	10^9	
gold		10^{-1}	5%
silver		10^{-2}	10%

END OF FORMULA SHEET