VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2021

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

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

VCE VET INTEGRATED TECHNOLOGIES

Written examination

Tuesday 16 November 2021

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	17	17	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

A damp sponge is used during the soldering process to

A. wet the solder.
B. remove the flux.
C. cool the soldering iron tip.
D. clean the soldering iron tip.

Question 2

A purely resistive circuit is fully disconnected from the power supply so its conductivity can be tested.
The most appropriate piece of test equipment to conduct this test is a

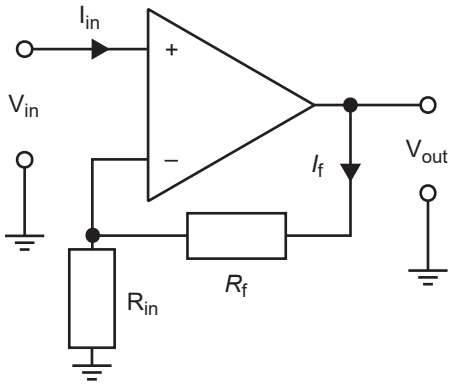
A. test lamp.
B. clamp current meter (tong meter).
C. digital multimeter (DMM).
D. cathode-ray oscilloscope (CRO).

Question 3

A capacitor with a capacitance of 0.000047 farads is best expressed as

A. 47 μF
B. 470 nF
C. 0.047 pF
D. 4700 μF

Question 4



The circuit shown above is

A. a digital inverter circuit.

B. an analogue-to-digital signal converter.

C. an analogue operational amplifier circuit.

D. a frequency modulation (FM) radio receiver.

Question 5

Source: Cristian Storto/Shutterstock.com

The switch shown above is

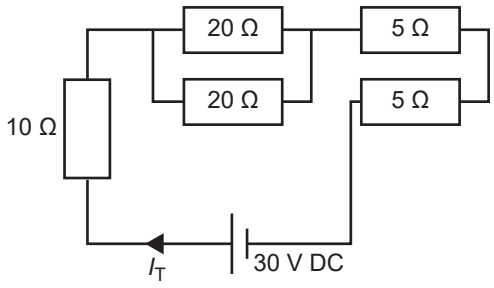
A. SPST.

B. SPDT.

C. DPDT.

D. DP NO PB.

Question 6



The total current drawn (I_T) by the circuit shown above is

A. 0.5 A

B. 1 A

C. 1.33 A

D. 10 A

Question 7

Source: Click Images/Shutterstock.com

The image above shows multigrip pliers.

Which one of the following gives the best reason to use multigrip pliers?

A. The width of the jaws can be constrained.

B. Multigrip pliers can also be used as an engineering hammer.

C. Multigrip pliers reduce slippage when tightening bolts, as open-ended spanners may slip.

D. Multigrip pliers can be used for a range of nuts, bolts and shaft sizes to hold, tighten and loosen them.

Question 8

A running electric motor produces a steady clicking sound.

The most likely cause of this noise is a

A. worn-out bearing.

B. misshapen main drive shaft.

C. poor electrical connection to the motor.

D. loose screw that has fallen into the motor stator.

Question 9

The best way to dispose of used machine oil is to

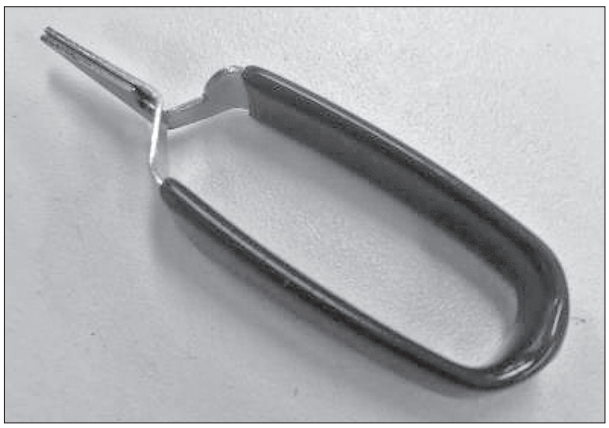
A. make a fire and burn the oil.

B. use the oil as fertiliser in a garden.

C. take the used oil to an accredited facility for recycling and pay for its disposal.

D. carefully and slowly tip the used oil into a sink and flush it away with lots of clean water.

Question 10



The clip tool shown above is attached to a specific component during the soldering of a printed circuit board (PCB).

Which one of the following gives the primary purpose of the clip tool?

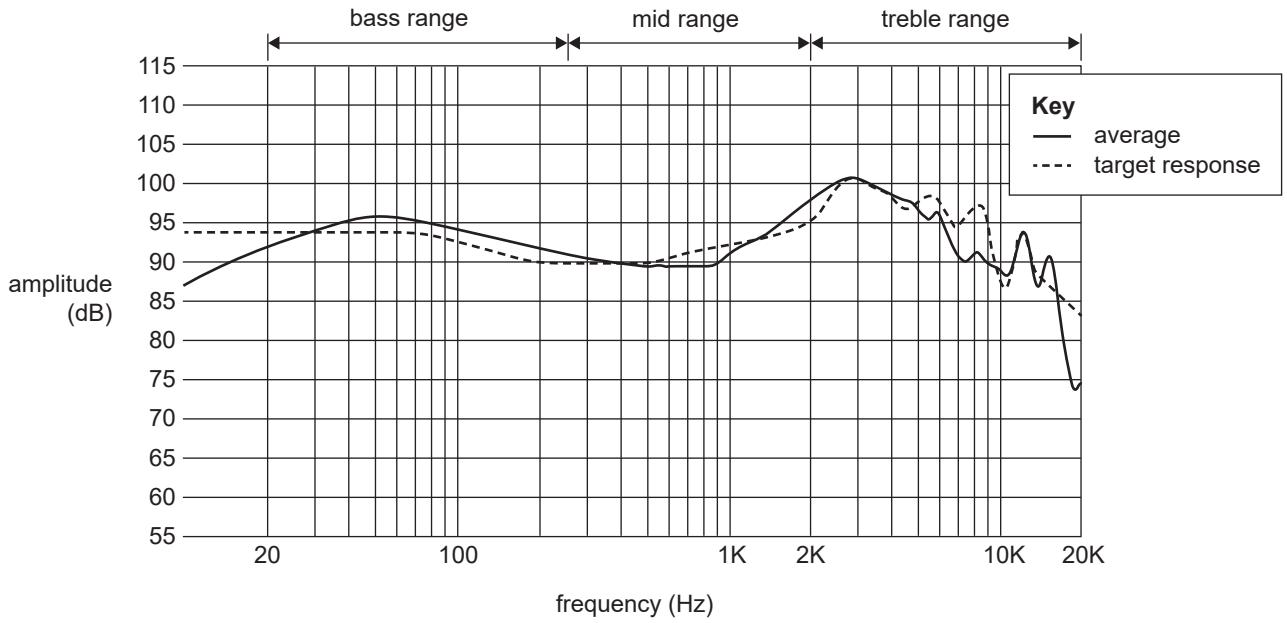
A. to trim the wires of the component

B. to provide a sink for the excess heat created when soldering

C. to be used as part of the circuit where an additional wire is connected to earth

D. to provide an electrically safe work environment, in case the component becomes live

Question 11



Source: adapted from RTINGS.com, <www.rtings.com/headphones/1-4/graph#560/4011/326>

Refer to the frequency response graph above.

Wireless earbuds produce an exceptional range of audible frequency tones.

At what frequency will an amplitude of 100 dB be achieved?

A. 50 Hz

B. 100 Hz

C. 2000 Hz

D. 3000 Hz

Question 12

The decimal equivalent of the 4-bit binary number 1011 is

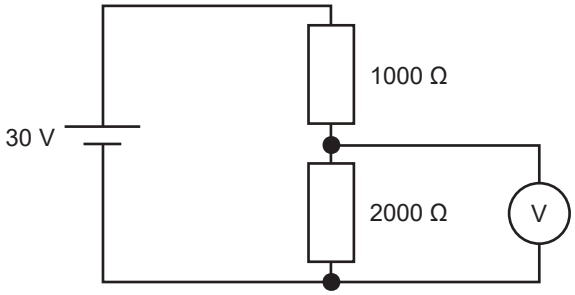
A. 8

B. 11

C. 23

D. 1011

Use the following information to answer Questions 13 and 14.



Question 13

The voltage displayed by the voltmeter, V, in the circuit shown above is

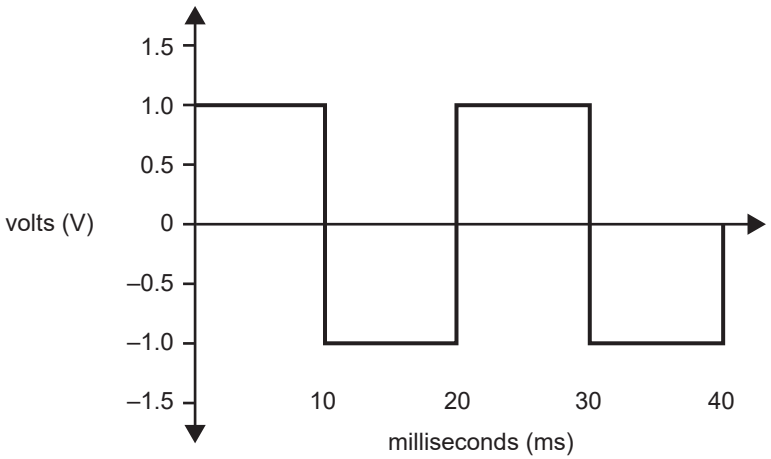
A. 10 V
B. 15 V
C. 20 V
D. 30 V

Question 14

The power dissipated by the circuit shown above is

A. 3 W
B. 300 mW
C. 30 mW
D. 10 mW

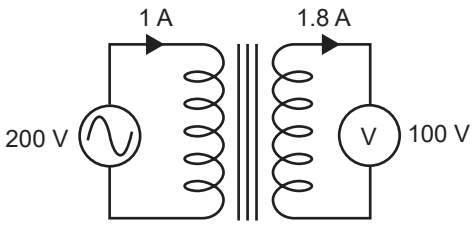
Question 15



The frequency of the signal waveform shown above is

A. 0 Hz
B. 10 Hz
C. 20 Hz
D. 50 Hz

Question 16



The efficiency of the step-down transformer shown above is

A. 1.8%

B. 90%

C. 95%

D. 100%

Question 17

Two-dimensional (2D) drawings need to be sent to a customer by email for approval.

Which one of the following file formats should be used for the drawings?

A. .pdf

B. .exe

C. .xlsx

D. .ptt

Question 18

Which one of the following tasks would be best performed using three-dimensional (3D) modelling software?

A. documenting the specific requirements of a project

B. creating a list of electronic components that need to be ordered

C. checking part designs to ensure they will fit together correctly

D. managing the timeline of a project to ensure goals and deadlines are met

Question 19

What is the name of the line type shown above, which is used in engineering drawings?

A. *z*-axis line

B. centre line

C. dimension line

D. hidden detail line

Question 20

The main purpose of a combination residual current circuit breaker with overcurrent (RCBO), which is used in home switchboards, is to

A. protect the home from short circuits only.

B. protect the electrical appliances in the home from damage.

C. keep the voltage supplied at the specified nominal level of 230 V.

D. provide protection from severe electric shock and excessive current being drawn.

END OF SECTION A
TURN OVER

SECTION B

Instructions for Section B

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

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

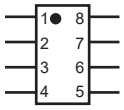
All units must be specified in correct engineering notation in the answers.

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

Question 1 (6 marks)

The table below shows the symbols for three common components.

Complete the table by naming each component and by providing a short description of its function or purpose.

Component symbol	Component name	Function or purpose of component
		
		
		

Question 2 (7 marks)

Figure 1 shows a circuit diagram.

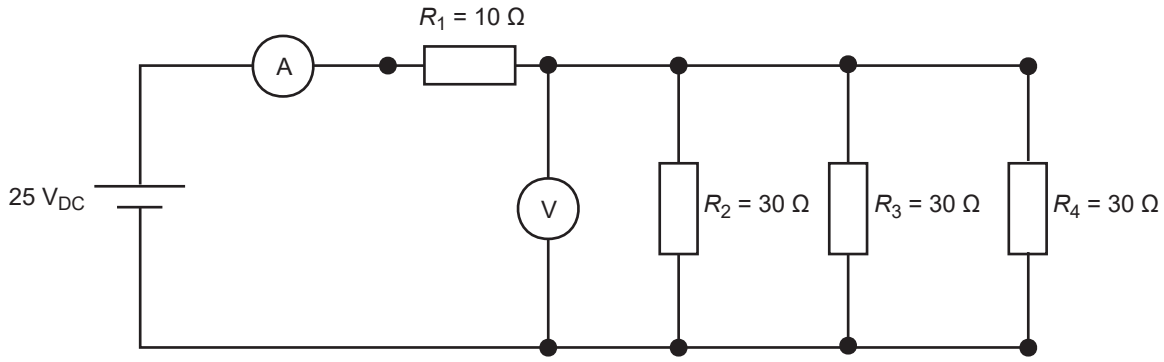


Figure 1

a. Calculate the total resistance of the circuit shown in Figure 1. Show your working and include the correct unit in the answer box provided. 3 marks

b. Determine the current that would be shown on the current meter, A, in Figure 1. Show your working and include the correct unit in the answer box provided. 2 marks

c. Determine the voltage that would be shown on the voltmeter, V, in Figure 1. Show your working and include the correct unit in the answer box provided. 2 marks

Question 3 (3 marks)

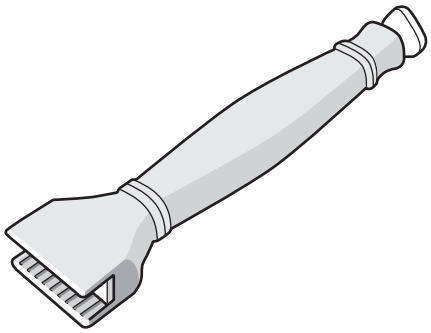


Figure 2

An integrated circuit (IC) insertion tool, as shown in Figure 2, is used to insert an IC into a printed circuit board (PCB). The IC insertion tool assists when working in tight spaces. It also keeps the IC legs aligned and provides electrostatic safe handling.

a. Describe how this tool would assist with installing ICs into a very densely populated PCB. 1 mark

b. Describe how this tool would provide electrostatic safe handling of the IC and why electrostatic safe handling is necessary. 2 marks

Question 4 (3 marks)

An electric circuit consists of multiple components, including resistors, capacitors, ICs and inductors.

a. The power to the circuit is turned off.

Describe, in detail, a method that can be used to isolate a resistor to accurately measure and check its resistance. 2 marks

b. Describe how a static DC resistance test across an electrolytic capacitor could indicate if the capacitor is damaged. 1 mark

Question 5 (5 marks)

A student has designed a fan blower that can blow either cool or hot air. The fan motor can run by itself; however, to avoid overheating the heating element, the fan motor must always be on when the heating element is on. The specifications are given and the required components of the circuit are shown in Figure 3.

Specifications

- The circuit is powered by 240 V_{AC} from the mains.
- The air is blown by the fan motor.
- The fan motor is turned on and off by switch S_1.
- The heating element is switched on and off by switch S_2.
- The fan motor must be on whenever the heating element is on.

Complete the wiring for the circuit in Figure 3 by drawing in the required connections (lines) to perform the required functions.

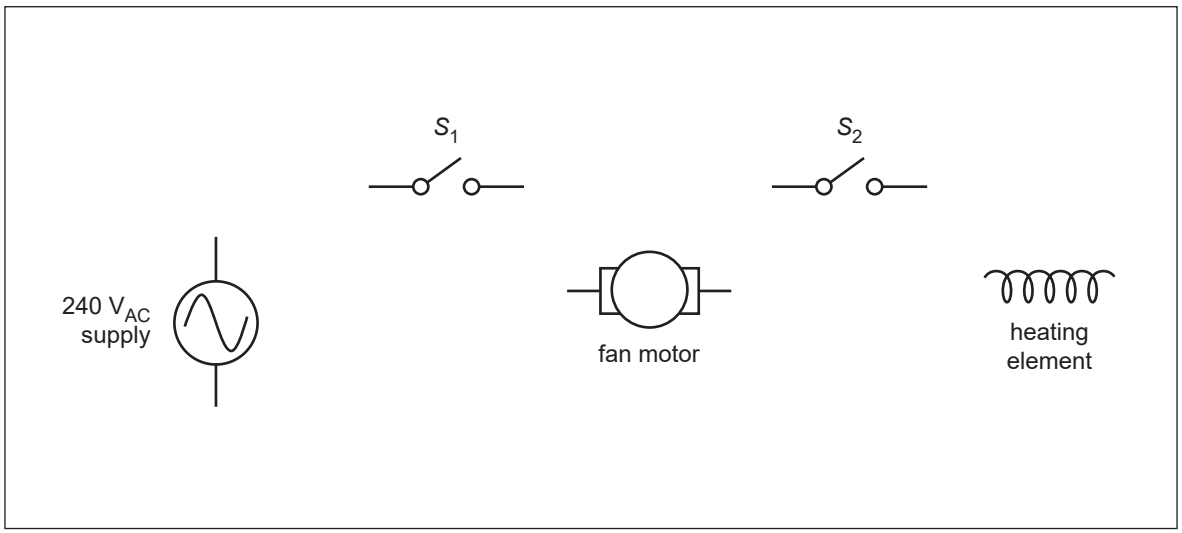


Figure 3

Question 6 (4 marks)

An aluminium box is to be fabricated to house a small integrated technologies project. The process requires marking out sheet aluminium, then drilling it and cutting it out, and then finally bending it into shape.

Two significant steps in the fabrication stage are given in the table below.

Complete the table by naming the specific tool and/or equipment for each step in the fabrication stage and by describing the use of this tool and/or equipment.

Fabrication stage	Name of tool and/or equipment and description of its use
marking out	
drilling and cutting out	

Question 7 (2 marks)

Computer software is now usually supplied as a download, whereas in the past it was supplied on discs.

Provide two advantages of computer software being supplied as a download only.

1. _____

_____

2. _____

_____

Question 8 (2 marks)

It is recommended that computers be shut down or restarted at least once daily.

Provide two reasons why a computer should be shut down or restarted daily.

1. _____

_____

2. _____

_____

Question 9 (3 marks)

A title block is included on all engineering drawings.

List three different pieces of information that are usually included in a title block.

1. _____

_____

2. _____

_____

3. _____

_____

Question 10 (3 marks)

Figure 4 is a drawing of a mechanical link component that will be fabricated from 12 gauge (2.05 mm) flat aluminium sheet.

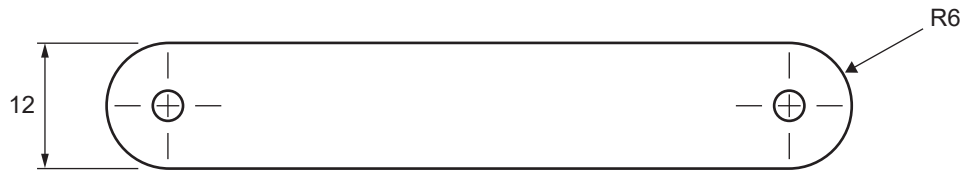


Figure 4

a. What units of measurement would be used for the dimensions of the mechanical link shown above? 1 mark

_____

b. What are the two missing dimensions that must be included to ensure the component is fabricated correctly? 2 marks

1. _____

2. _____

Question 11 (1 mark)
Computer software can be used to produce engineering drawings.

Name **one** software program that is used to produce engineering drawings.

_____

Question 12 (6 marks)
PCB design software usually includes an auto-routing function.

a. Describe the role of the auto-routing function in PCB design software. 2 marks

_____

_____

_____

_____

b. Provide two reasons why a user would want to use the auto-routing function in PCB design software. 2 marks

1. _____

_____

2. _____

_____

c. Occasionally a user will choose **not** to use the auto-routing function.

Provide two reasons why the auto-routing function may be turned off during the PCB design process. 2 marks

1. _____

_____

2. _____

_____

Question 13 (5 marks)

Figure 5 shows a schematic diagram for a five-second courtesy light circuit. When the switch is pressed, a light-emitting diode (LED) lights up a keyhole for five seconds – enough time to insert and turn a key.

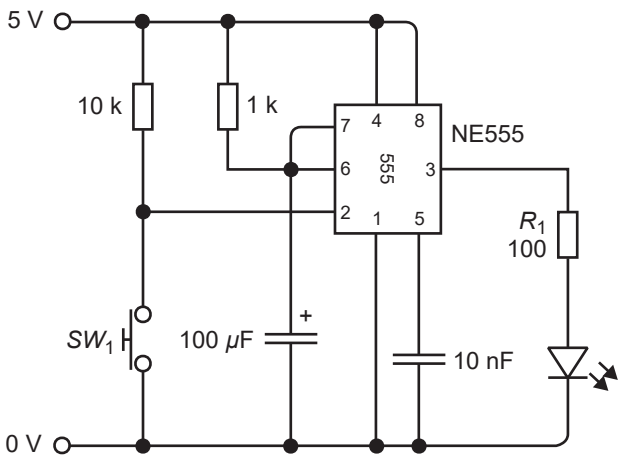


Figure 5

Figure 6 shows the matching but incomplete PCB artwork for the courtesy light.

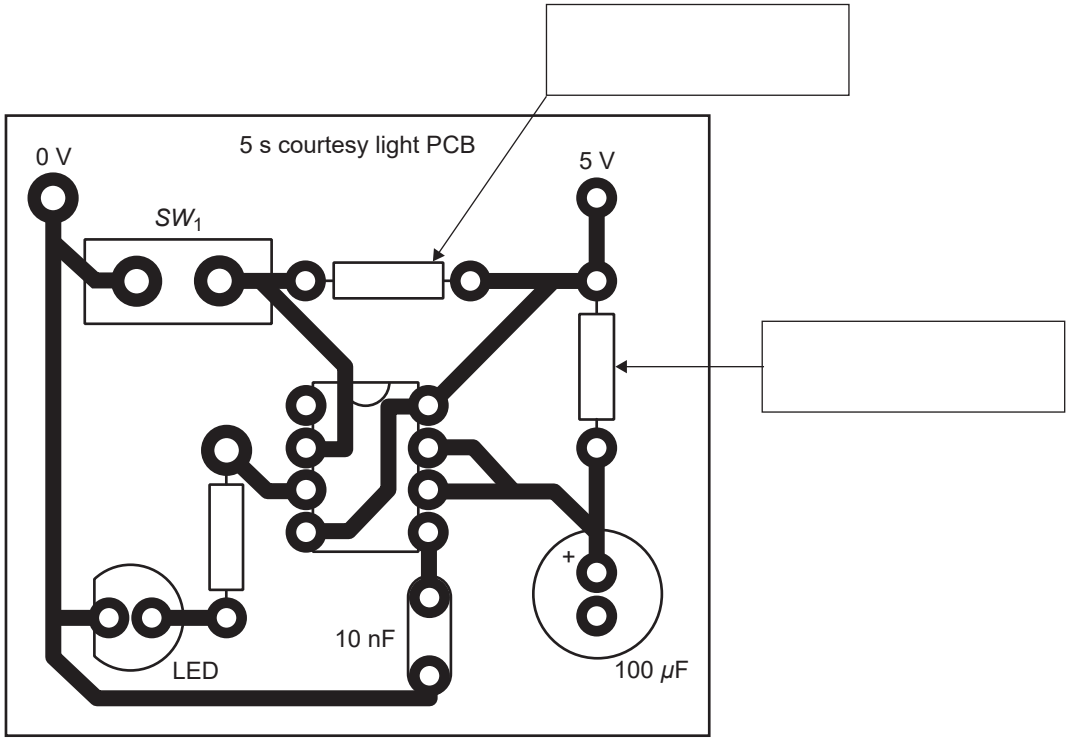


Figure 6

For ease of understanding, the PCB artwork is shown as viewed from the component side.

On the PCB artwork for the courtesy light in Figure 6, complete the following.

a. In the boxes provided, label the two resistor values. 2 marks

b. Label the LED cathode with a ‘k’. 1 mark

c. Draw in the two missing copper tracks to complete the PCB artwork. 2 marks

Question 14 (8 marks)

A correctly functioning electric circuit is shown in Figure 7.

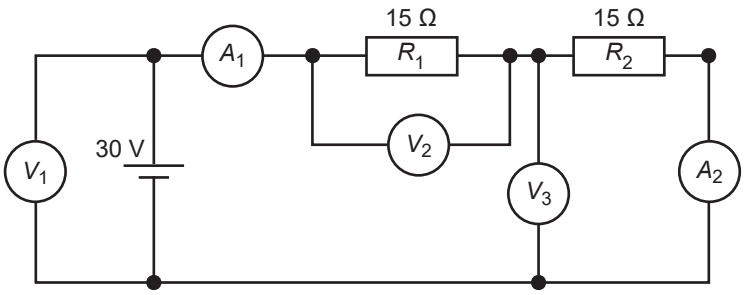


Figure 7

a. **i.** Complete the table below with the readings that would be displayed for voltmeters V_1, V_2 and V_3 in Figure 7. 3 marks

Voltmeter	Voltage determined
V_1	V
V_2	V
V_3	V

ii. Complete the table below with the readings that would be displayed for ammeters A_1 and A_2 in Figure 7. 1 mark

Ammeter	Current determined
A_1	A
A_2	A

DO NOT WRITE IN THIS AREA

b. A fault occurred in the circuit shown in Figure 7. The new meter readings are shown in the tables below.

Voltmeter	Voltage
V_1	30 V
V_2	30 V
V_3	0 V

Ammeter	Current
A_1	2 A
A_2	2 A

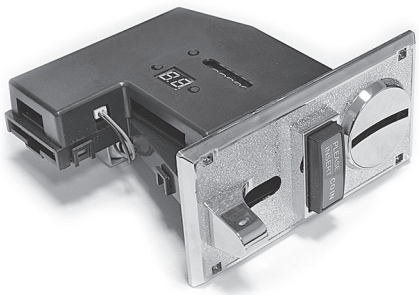
i. Given the new meter readings, identify the single faulty component. 1 mark

ii. Determine the type of fault that has occurred in the component identified in **part b.i.** and explain how you determined it was this type of fault. 3 marks

Use the following information to answer Questions 15–17.

Figure 8 shows a coin acceptor module found in many vending machines. The coin acceptor module produces different digital pulses when coins of different values are inserted. These digital pulses are sent via the coin data wire to a microprocessor that reads the pulses and tallies the amount of money that has been inserted.

Figure 9 shows a simplified schematic diagram of the coin acceptor module and the associated external wiring required for it to function.



Source: MZinchenko/Shutterstock.com

Figure 8

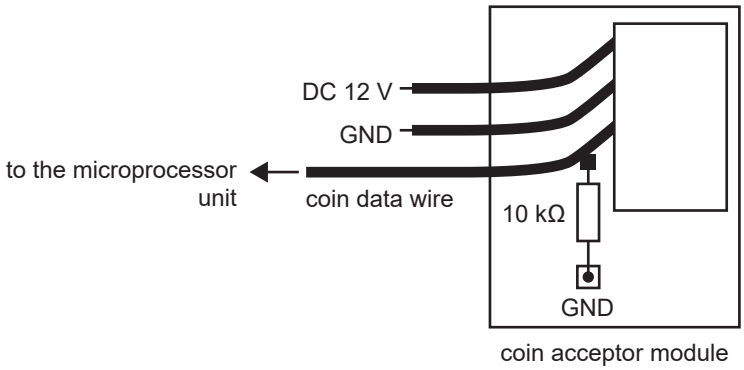


Figure 9

It is recommended that shielded multi-strand wire be used for the wiring between the coin acceptor module shown in Figure 9 and the microprocessor unit.

Question 15 (12 marks)

a. **i.** What is shielded wire? Describe the purpose of the shielding. 2 marks

ii. Provide **one** example of a specific type of wire that is shielded. 1 mark

b. Provide two benefits of using shielded multi-strand wire in a vending machine. 2 marks

1.

2.

c. From what material is conducting wire usually made? 1 mark

_____

d. Some insulation needs to be stripped from the multi-strand wire using a tool when joining and connecting the wires.

i. Name a tool commonly used to strip insulation from wires. 1 mark

_____

ii. Describe in detail the process of using the tool named in **part d.i.** to successfully strip some insulation from the wires without damaging the conducting wires. 2 marks

_____

_____

_____

_____

e. Shown in Figure 9, within the coin acceptor module, is a 10 kΩ resistor connected to the coin data wire.

What is the function of this resistor? 1 mark

_____

DO NOT WRITE IN THIS AREA

The digital pulses shown in Figure 10 and Figure 11 are produced by the coin acceptor module when $1 and $2 coins are separately inserted into the module. These pulses are transferred to the microprocessor, where the money tally is maintained.

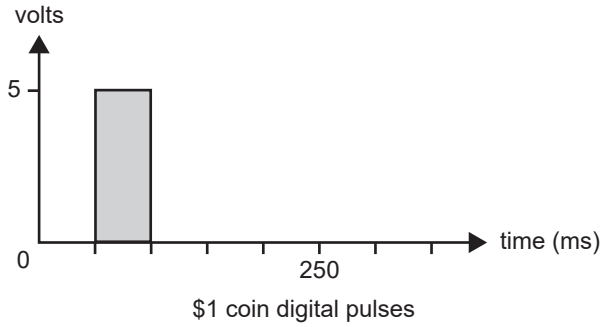


Figure 10

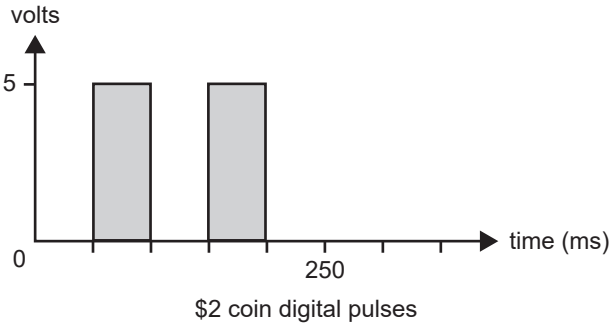


Figure 11

f. What is the duration of the generated digital pulses shown in Figure 10 and Figure 11, measured in milliseconds? 1 mark

ms

g. Name **one** appropriate diagnostic tool that could be used to view these digital pulses produced by the coin acceptor module. 1 mark

Question 16 (5 marks)

The microprocessor IC shown in Figure 12 is used to read the digital pulse data created by the coin acceptor module shown in Figure 9 on page 22.

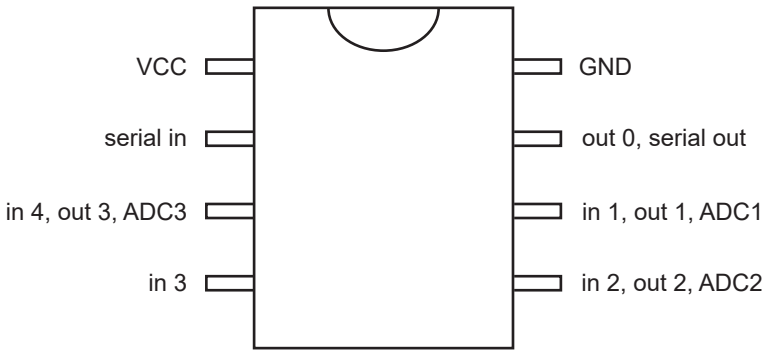


Figure 12

a. On Figure 12, number the pinout of the microprocessor IC for pins 1 to 8. 2 marks

b. On Figure 12, draw a circle on one pin of the microprocessor IC that could be used to receive the pulses. 1 mark

c. What is the purpose of the pin identified as 'VCC' on the microprocessor IC and what would it be connected to? 2 marks

Question 17 (5 marks)

The flow chart in Figure 13 shows how the microprocessor reads the digital pulse data and adds them together to create a variable called ‘money’.

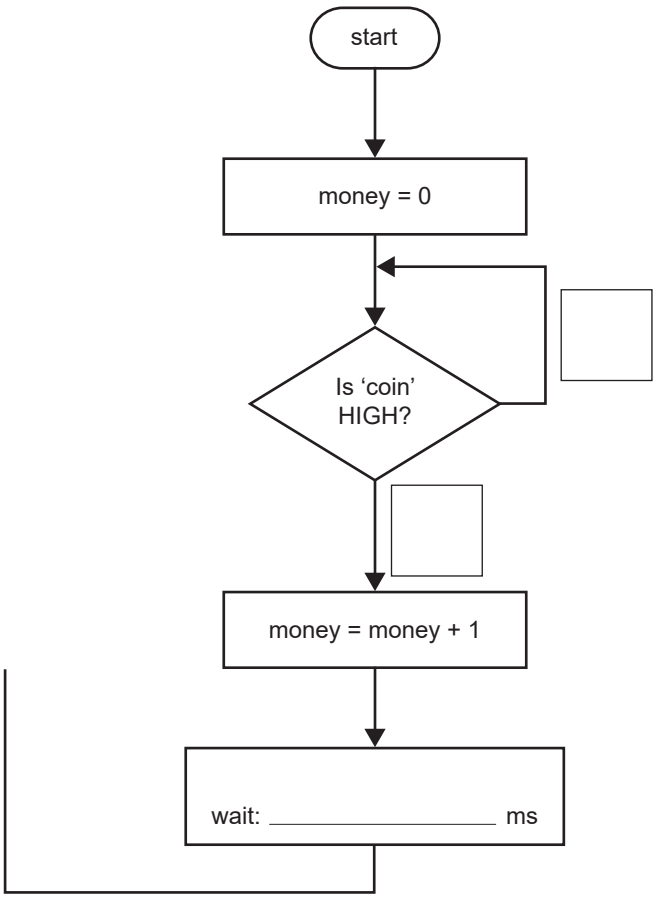
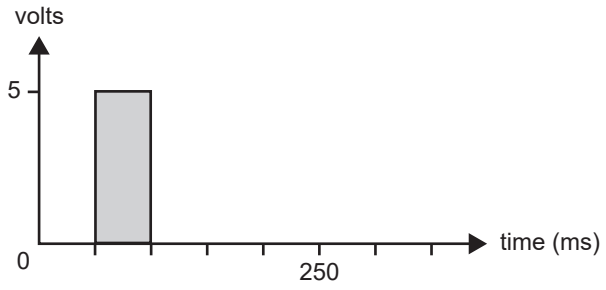


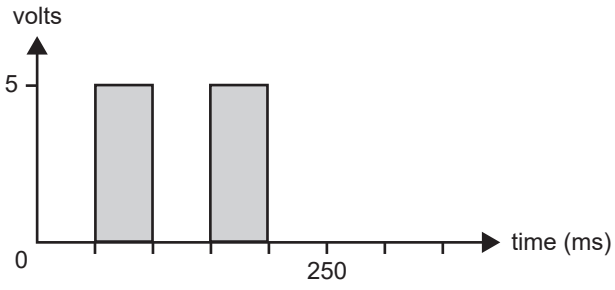
Figure 13

a. On the flow chart in Figure 13, write ‘Y’ for ‘yes’ or ‘N’ for ‘no’ in the squares for the decision boxes. 2 marks

In the final function box, the wait time, in milliseconds, has not been specified. The digital pulses shown in Figure 10 and Figure 11 on page 24 are repeated below as a reference.



$1 coin digital pulses



$2 coin digital pulses

b. Determine a suitable time for the 'wait' command, in milliseconds, and write the time in the 'wait' function box on the flow chart in Figure 13. 1 mark

c. An incomplete program loop line extends from the 'wait' function box on the flow chart in Figure 13.

On the flow chart in Figure 13, draw a line to show how the program loop should be connected back to the flow chart and place an arrow at its return point. 2 marks

END OF QUESTION AND ANSWER BOOK

VCE VET INTEGRATED TECHNOLOGIES

Written examination

FORMULA SHEET

Instructions

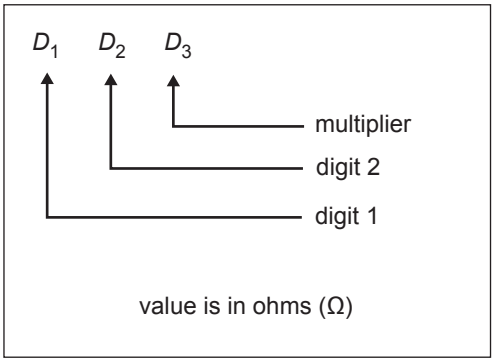
Please remove from the centre of this book during reading time.
This formula sheet is provided for your reference.

VCE VET Integrated Technologies formulas

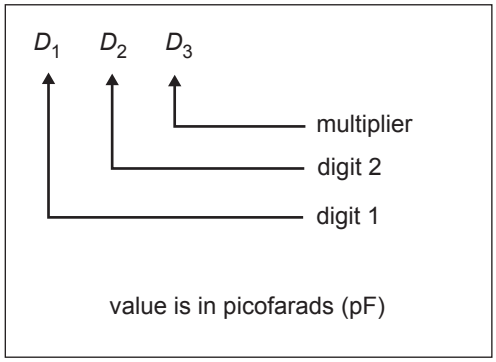
$R_T = R_1 + R_2 + R_3$	$f = \frac{1}{T}$
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$	$\tau = C \times R$
$R_T = \frac{R_1 R_2}{R_1 + R_2}$	$A = \frac{\pi d^2}{4}$
$R = \frac{\rho l}{A}$	$C = \frac{\varepsilon A}{d}$
$V = I \times R$	$C_T = C_1 + C_2 + C_3$
$P = V \times I$	$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$
$V_X = V_S\left(\frac{R_X}{R_T}\right)$	$Q = V \times C$
$V_{max} = V_{peak}$	$W = \frac{1}{2}CV^2$
$V_{step} = \frac{V_{max}}{2^n - 1}$	$W = P\,t$
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

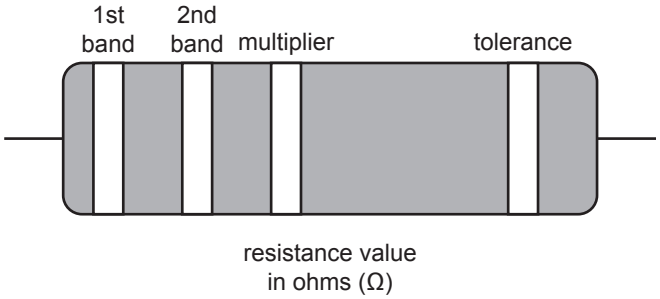


ASCII code chart (in hexadecimal)

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