**Victorian Certificate of Education
2020**

Letter

STUDENT NUMBER

VCE VET INTEGRATED TECHNOLOGIES
Written examination

Wednesday 11 November 2020

Reading time: 11.45 am to 12.00 noon (15 minutes)
Writing time: 12.00 noon to 1.30 pm (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	10	10	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 26 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

<div style="border:1px solid">

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.
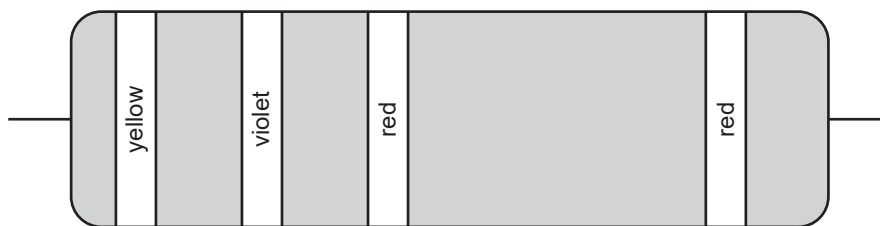
</div>

Question 1

Many devices utilise a USB connection.

The acronym USB stands for

A.   Universal Serial Bus.

B.   Unified Spectrum Band.

C.   Unidirectional Serial Bus.

D.   Uninterrupted Serial Broadcast.
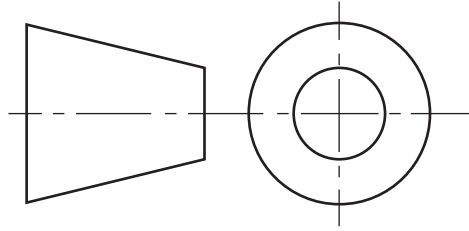
Question 2

An image of a resistor is shown below.

The nominal resistance value of the four-band resistor shown above is

A.   47 kΩ, 2%

B.   470 Ω, 2%

C.   4k7 Ω, 2%

D.   4700 Ω, 5%

Question 3

A standard function in three-dimensional (3D) modelling software is to

A.   format text for documents.

B.   edit images to correct for lighting.

C.   perform repetitive mathematical calculations.

D.   document the form and the dimensions of a component.

Question 4

On an engineering drawing, what does the symbol shown above indicate?

A. first-angle projection

B. second-angle projection

C. third-angle projection

D. fourth-angle projection

Question 5

A 3D printable file sent to a 3D printer would have which one of the following file extensions?

A. .docx

B. .jpg

C. .exe

D. .stl

Question 6

When removing a USB memory stick from a computer, it is recommended that users use the software function(s) that allows them to safely remove hardware and eject media.

Why should this recommendation be followed?

A. to check that the transferred files have no malicious software included

B. to switch off electrical power to the USB device and make it electrically safe

C. to check storage capacity has not been exceeded and report available storage to the user

D. to ensure that no background processes related to the USB memory stick are running and to prevent data corruption
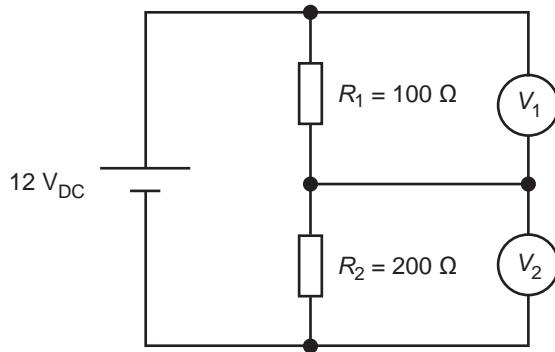
Question 7

The benefit of using cloud storage for integrated technologies circuit designs and diagrams instead of local storage is that

A. cloud storage offers much greater security.

B. backing up large files to cloud storage is much faster.

C. cloud storage uses much less internet data when saving large files.

D. cloud storage allows access to saved files from a range of different locations.

Question 8

The circuit shown below has two resistors, R_1 and R_2, and two voltmeters, V_1 and V_2, that are connected to a 12 V_{DC} supply.

What voltage would be displayed on V_1 and V_2?

	V_1	V_2
A.	4 V	8 V
B.	8 V	4 V
C.	6 V	6 V
D.	10 V	2 V

Question 9

A wire-stripping tool is shown below.

Source: Lovely Bird/Shutterstock.com

The main advantage of using a wire-stripping tool, such as the one shown above, is that
A.   it grips the wire, cuts and removes the insulation, and is capable of handling different wire gauges.
B.   it strips and bends the wire ends over, ready for fitting into a terminal block.
C.   it tins the wire in preparation for joining two wires together.
D.   in one action it strips the insulation and cuts the wire.

Question 10

What is the purpose of electrical 'testing and tagging'?

A.   to ensure the best and cheapest electrical equipment is sourced, ensuring value for money

B.   to inspect and test electrical equipment, and certify that it is safe for general use

C.   to attach a permanent identification tag to electrical equipment in case it is stolen

D.   to create a current database record for all electrical equipment in a workplace
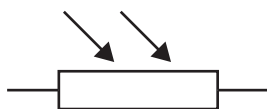
Question 11

A power extension lead that is being used is found to be damaged. After turning off the power and inspecting the lead, it is noted that the outer insulation is damaged.

The procedure that should be followed in this situation is to

A.   stop using the damaged lead immediately and attach an 'out of service' tag to the lead.

B.   repair the lead immediately with electrical insulation tape so that the job can be completed without delay.

C.   switch the power back on and complete the job, then send the lead to be repaired once the job has been completed.

D.   place a block of wood over the damaged section of the lead so no further damage can occur and complete the job without delay.
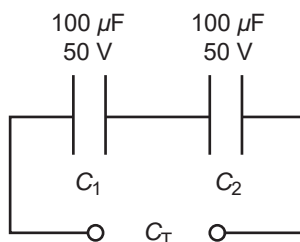
Question 12

The symbol shown below represents a circuit component.

Which one of the following components is represented by this symbol?

A.   LCD

B.   LDR

C.   LRS

D.   LTD

Question 13

What is the combined capacitance (C_T) and voltage rating for the circuit shown above?

A.   200 μF, 100 V

B.   100 μF, 50 V

C.   50 μF, 50 V

D.   50 μF, 100 V

Question 14

The image below shows a ceramic disc capacitor labelled '104'.

Source: huntingSHARK/Shutterstock.com

What is the capacitance value of this capacitor?

A. 0.1 μF

B. 10 μF

C. 100 μF

D. 104 μF

Question 15

The image below shows a drill bit.

Source: ajt/Shutterstock.com

This type of drill bit would be used when drilling into

A. wood.

B. plastic.

C. masonry.

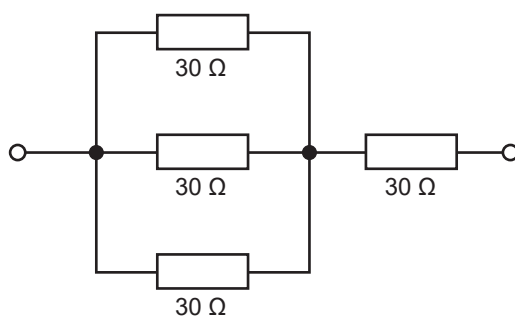D. aluminium.

Question 16

The National Broadband Network (nbn[TM]) is delivered across Australia using the nbn[TM]'s Multi Technology Mix (MTM). One type of technology in the MTM is HFC.

HFC stands for

A. hybrid fast cable.

B. hybrid fibre coaxial.

C. high-speed fibre cable.

D. high-speed fast configuration.

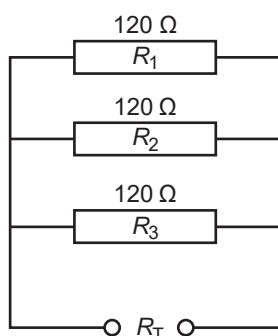**Question 17**

The diagram below shows a network of resistors.

What is the total resistance of this network of resistors?

A.   30 Ω

B.   40 Ω

C.   60 Ω

D.   120 Ω

Question 18

Three 120 Ω resistors are connected in parallel, as shown below.

The three resistors are to be replaced with a single resistor.

Which one of the following resistors from the E12 standard resistor series values would be the most suitable single replacement resistor?

A.   27 Ω

B.   33 Ω

C.   39 Ω

D.   47 Ω

Question 19

The image below shows an engineering drawing of a screw with a hex slot head.
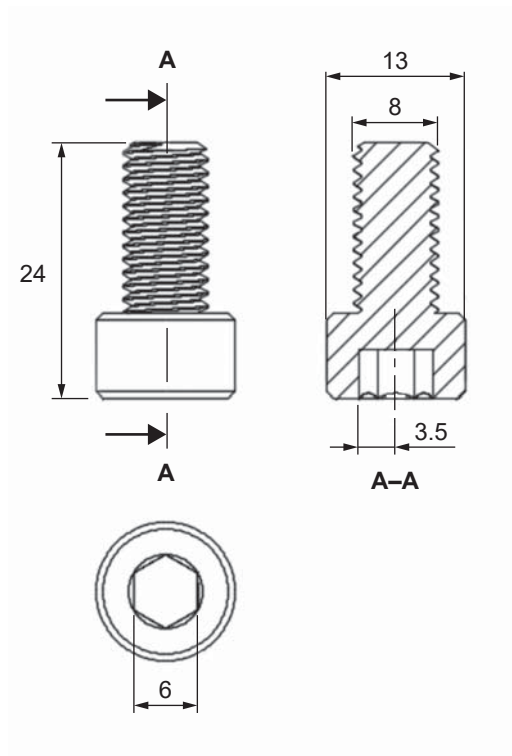
What size of hex key would be appropriate for tightening the screw?

A.   3.5 mm

B.   6.0 mm

C.   8.0 mm

D.   13.0 mm

Question 20

Why is flux required when joining two metals by soldering, brazing or welding?

A.   Flux works as a chemical cleaner and a flowing agent.

B.   Flux provides mechanical adhesion as it is brown and sticky.

C.   Flux is not required at all if the metals are coated with a layer of clean oil.

D.   Flux is associated with magnetism in metals so it is used to hold the two metals closer.

END OF SECTION A

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 (4 marks)

To protect our environment and recover more precious resources, the Victorian Government banned all e-waste from landfill with effect from 1 July 2019. Sustainability Victoria describes e-waste as 'any item with a plug, battery or power cord that is no longer working or wanted'. E-waste must be taken to a recycling collection point for correct disposal.

a.   What does the first 'e' in 'e-waste' stand for?   1 mark
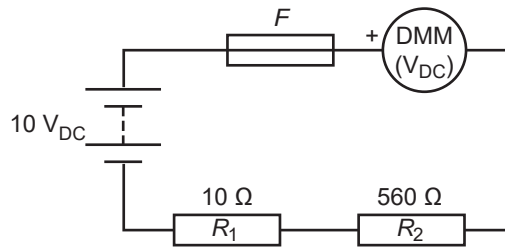
_____

b.   The table below lists the three categories of e-waste, according to Sustainability Victoria.

For each category of e-waste, give one example of a device that would include a component from that category of e-waste.   3 marks

Category of e-waste	Device
plug	
battery	
power cord	

Question 2 (14 marks)

Figure 1 shows a circuit diagram.

Figure 1

a. What does the symbol for component *F* in Figure 1 represent? 1 mark

_____

The display on the digital multimeter (DMM) shows 9.98 V_{DC} on the 20 V_{DC} setting.

b. Does the reading on the DMM display above indicate that the meter is faulty or is this an accurate reading for the circuit in Figure 1? Provide a reason for your answer. 2 marks
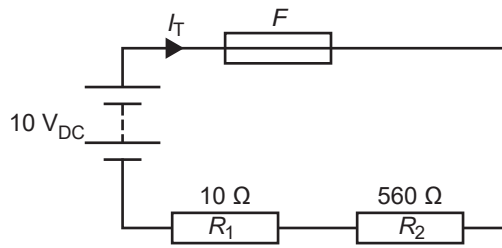
_____

_____

The DMM is removed from the circuit. The new circuit configuration is shown in Figure 2.

Figure 2

c. Determine the current, I_T, that would be drawn by the circuit in Figure 2 and express your
final answer in milliamperes. Show your working.   3 marks

| | mA |

d. Find the voltage across R_1 in the circuit in Figure 2. Express your answer in millivolts. Show
your working.   2 marks

| | mV |

e. On the circuit diagram in Figure 3, draw the connections for the leads that would read the voltage across R_1. Indicate with (+) the correct polarity on the DMM.   1 mark
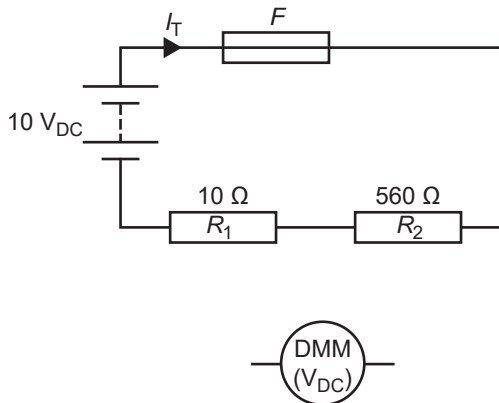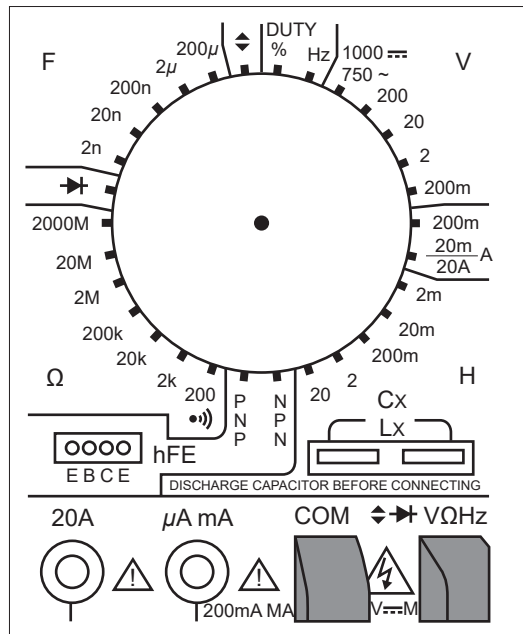

Figure 3

f. What setting on the dial of the DMM would give the greatest measurement accuracy for the DC voltage across R_1? Indicate the dial setting by drawing an arrow on the image of the DMM shown below.   1 mark

g. If the DMM is accidentally connected in reverse polarity, what additional information would be displayed on the DMM?   1 mark

h. Some models of DMMs provide an auto-ranging display.

Explain the term 'auto-ranging display', giving an example of its diagnostic benefits.   3 marks

_____

_____

_____

_____

Question 3 (11 marks)

High-performance cordless power tools often use DC brushless motors.

a. Apart from these motors having no brushes or a commutator, what are two characteristics that make brushless motors superior to other types of motors used in cordless power tools? **2 marks**

1. _____

_____

2. _____

_____

The product information provided on the battery of a cordless power tool is shown below.

BRAND NAME Product code: XXXXX

18.0 V
90 Wh Li-ion (5.0 Ah)
Serial number: XXXXX
Manufacturer name and website

Li-ion

Made in Australia

b. For each piece of information or symbol given in the table below, provide its full name and a technical description. The first row has been completed as an example. **4 marks**

Information or symbol	Full name	Technical description
Li-ion	*lithium-ion battery*	*Lithium-ion is a rechargeable battery technology used in cordless power tools.*
18.0 V ⎓		
5.0 Ah		
♲		
⊠		

c. Other than the lithium-ion battery, name **one** type of rechargeable battery technology used in cordless power tools.   1 mark

_____

d. Rechargeable lithium-ion batteries have far less memory effect than some other, older types of rechargeable batteries.

Provide a detailed description of what battery memory effect is and how it affects a battery.   2 marks

_____

_____

_____

e. A small number of cordless power tool manufacturers use supercapacitors rather than batteries to store electrical energy. Car manufacturers are trialling hybrids of supercapacitors combined with conventional battery technology.

Provide two advantages of using supercapacitor technology instead of more conventional battery technology, such as lithium-ion technology.   2 marks

1. _____

2. _____

Question 4 (14 marks)

Figure 4 shows a circuit that includes a 24 V_{DC} power supply, a milliamp meter, a voltmeter, a switch, resistor networks and component *F*.
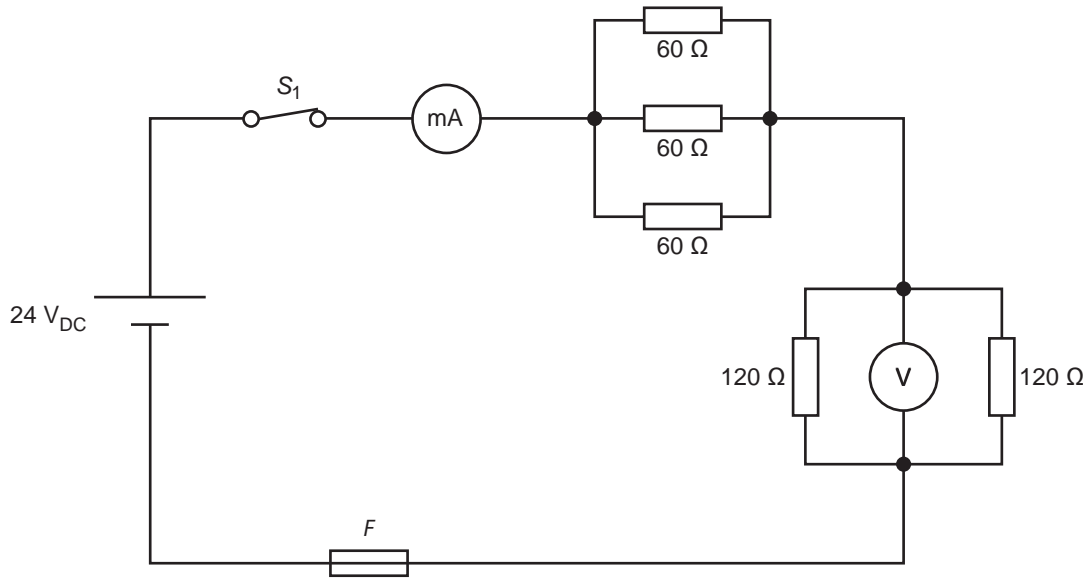
Figure 4

a. In what state is S_1 in Figure 4?   1 mark

_____

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

_____

_____

_____

c. Calculate the current displayed by the milliamp meter, mA. Show your working and express your answer in milliamperes.   3 marks

_____

_____

_____

| |
| mA |
| |

d. Calculate the voltage displayed by the voltmeter, V. Show your working and include the correct unit in the answer box provided.   3 marks

_____

_____

_____

| |
| |
| |

e. Calculate the power dissipated by the circuit. Show your working and include the correct unit in the answer box provided.   2 marks

_____

_____

_____

| |
| |
| |

f. What current rating should component *F* have in the circuit? Write your answer in the answer box provided and give a reason for your answer.   2 marks
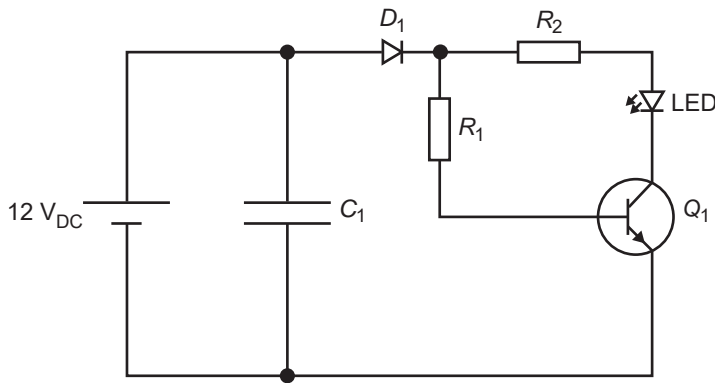
| |
| |
| |

_____

_____

Question 5 (9 marks)

Figure 5 shows a schematic circuit diagram for a small electronic circuit.
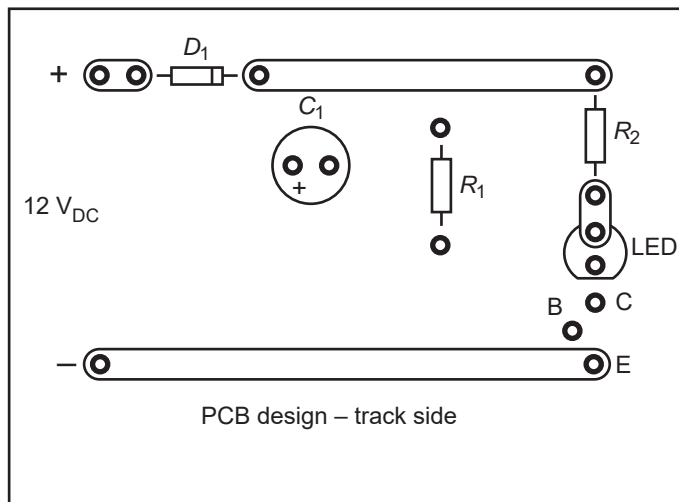

Figure 5

a. A partially completed printed circuit board (PCB) for the circuit in Figure 5 is shown below. It is labelled 'PCB design – track side'.

Draw the missing PCB track connections that are required to complete the PCB layout artwork below.   5 marks

PCB design – track side

b. What is the function of R_2 in the circuit?   2 marks

_____

_____

c. What is the function of the capacitor, C_1, in the circuit?   2 marks

_____

_____

Question 6 (9 marks)

Different techniques can be used to prototype circuits. One common technique is to use a circuit patch board commonly known as a 'breadboard'. Another common technique is to use a Veroboard.

a. What is the main purpose of prototyping a circuit and why is prototyping undertaken? 2 marks

_____

_____

b. In the table below, provide one advantage and one disadvantage for both the breadboard and Veroboard prototyping techniques. 4 marks

Prototyping technique	Advantage	Disadvantage
breadboard		
Veroboard		

DO NOT WRITE IN THIS AREA

c. The main steps in the process of circuit design and development are given in the table below, in no particular order.

Label the steps in the correct order by writing the numbers 1 to 7 in the column 'Step number'. The number '1' represents the first step and the number '7' represents the last step.   3 marks

Process	Step number
Design the PCB layout on a computer.	
Simulate the circuit on a computer.	
Output the final circuit PCB design to a CNC router.	
Mock up the circuit on a breadboard.	
Mock up and fabricate the circuit on a Veroboard.	
Solder the components into the fully designed PCB.	
Propagate the components into the fully designed PCB.	

Question 7 (12 marks)

Many Australian homes are connected to the National Broadband Network (nbn^TM) via an FTTN connection. Figure 6 represents a typical nbn^TM FTTN home connection.
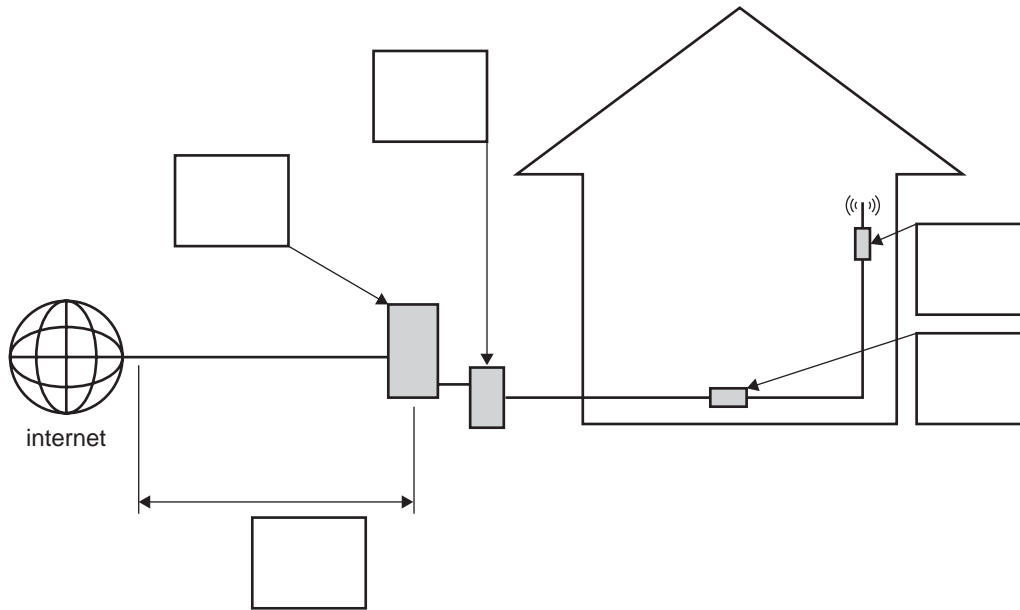
Figure 6

a. What does FTTN stand for? 1 mark

_____

b. A number of nbn™ retail providers have also incorporated a 4G data SIM card into the household modem/router gateway device.

What does 4G stand for and what is 4G? 2 marks

_____

_____

c. Explain why some modem/router gateway devices are permanently hardwired to the nbn^TM and have a 4G data SIM card. In your answer, describe how data speed is affected when the modem/router is operating on 4G. 3 marks

_____

_____

_____

d. The table below shows nbn^{TM} network items labelled A to E. These network items would be used in a typical nbn^{TM} FTTN home connection, as shown in Figure 6.
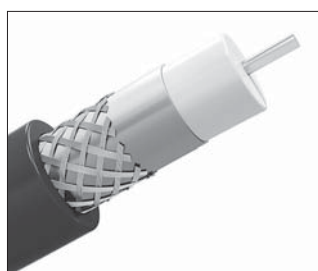
nbn^{TM} network items

Letter	Network item
A	modem/router
B	street pit
C	street node
D	optical fibre
E	wall socket

On Figure 6, indicate the correct location of these network items in a typical nbn^{TM} FTTN home connection by writing the appropriate letter, A to E, in the boxes provided.   3 marks

e.

Source: dny3d/Shutterstock.com

Figure 7

Name the type of cable shown in Figure 7 above.   1 mark

_____

f. The nbn^{TM} network item labelled A in the table shown in **part d.** is commonly called a home network modem. Referring to this network item as a modem is technically incorrect.

Explain why 'modem' is not the correct term.   2 marks

_____

_____

_____

Question 8 (2 marks)

Figure 8 shows an electronic design engineer working on her laptop. She has set up her laptop in the staff lounge for the morning.

Source: marvent/Shutterstock.com

Figure 8

Identify a specific occupational health and safety (OH&S) or work health and safety (WHS) user hazard and provide a related control measure for the hazard.
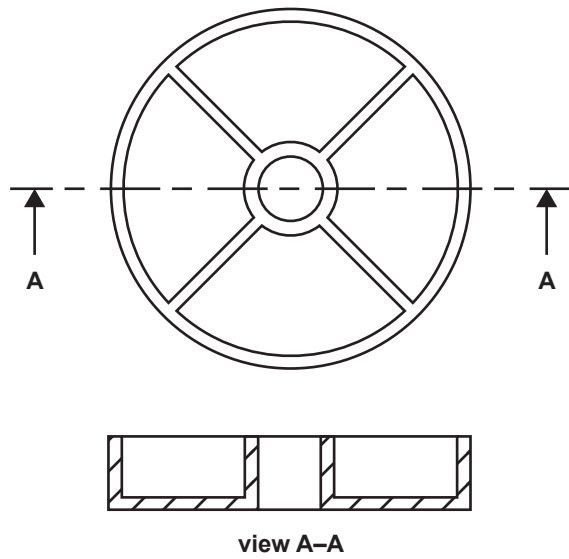
User hazard _____

Control measure _____

Question 9 (2 marks)

The drawing in Figure 9 shows two different views of a model train wheel.


view A–A

Figure 9

a.   Name the type of drawing labelled 'view A–A' in Figure 9.   1 mark

_____

b.   What is an identifying feature of the type of drawing labelled 'view A–A' in Figure 9?   1 mark

_____

Question 10 (3 marks)

A digital thermostat device needs to continually monitor the ambient temperature of a room, turning on the heater if the temperature falls below 20 °C and turning off the heater if the temperature rises above 20 °C.

The flow chart in Figure 10 shows the operation of the thermostat temperature control.
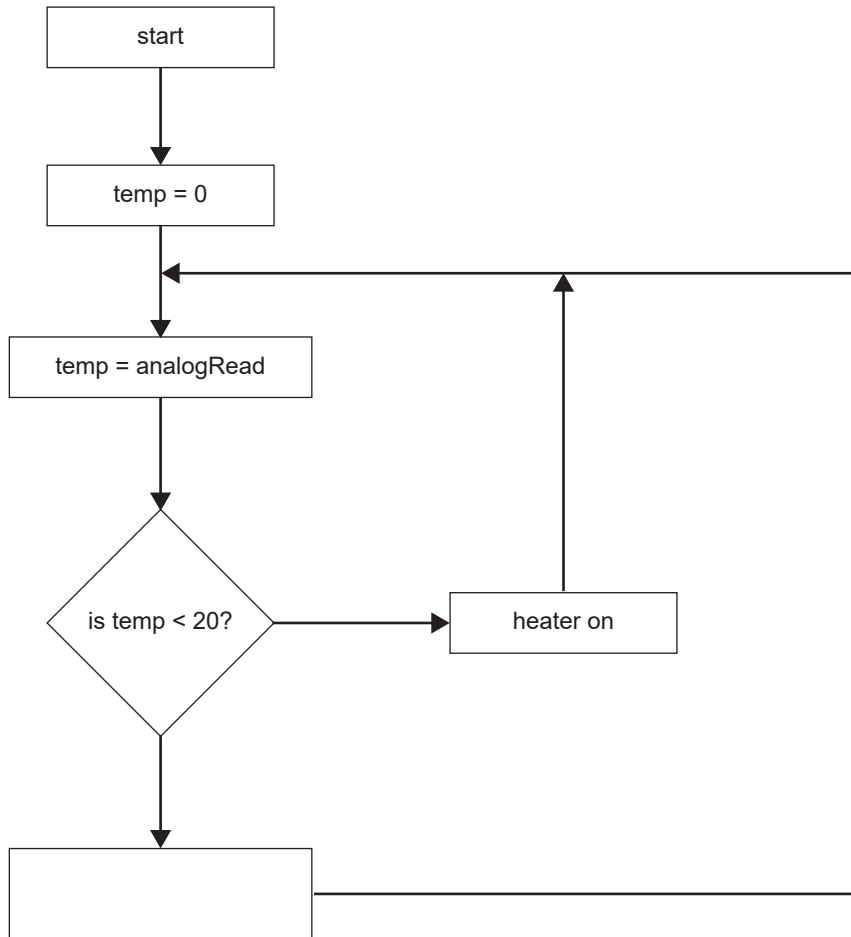
Figure 10

a. On Figure 10, label each output arrow from the **decision box** as either YES or NO.   2 marks

b. The last function box in Figure 10 is blank.

Write the function that should occur in the blank box in Figure 10.   1 mark

END OF QUESTION AND ANSWER BOOK

VCE VET INTEGRATED TECHNOLOGIES

Written examination

FORMULA SHEET

Instructions

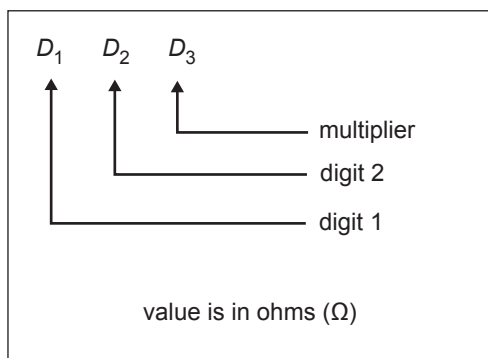Please remove from the centre of this book during reading time.

This formula sheet is provided for your reference.
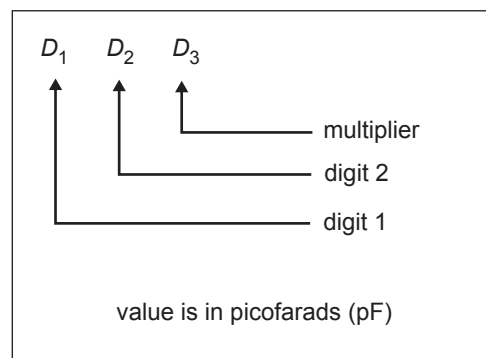
VCE VET Integrated Technologies formulas

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

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

Resistor codes

value is in ohms (Ω)

Capacitor codes

value is in picofarads (pF)

ASCII code chart (in hexadecimal)

Least 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	!	"	#	$	%	&	'	(	)	*	+	,	-	.	/
Most significant nybble	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

TURN OVER

Resistor colour codes

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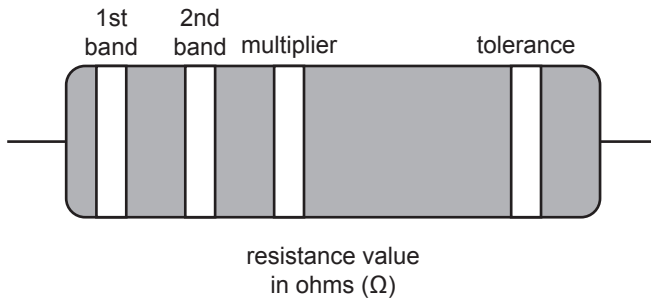
Colour	Value	Multiplier	Tolerance
black	0	10^0	
brown	1	10^1	1%
red	2	10^2	2%
orange	3	10^3	
yellow	4	10^4	
green	5	10^5	0.5%
blue	6	10^6	0.25%
violet	7	10^7	0.1%
grey	8	10^8	0.05%
white	9	10^9	
gold		10^{-1}	5%
silver		10^{-2}	10%

END OF FORMULA SHEET