VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2011

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

VCE VET ELECTROTECHNOLOGY

Written examination

Tuesday 15 November 2011

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	10	10	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 22 pages including a formula sheet on page 22.
- 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

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.

Question 1

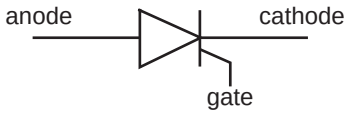


Figure 1

The device represented by the symbol in Figure 1 is a

A. rectifier diode.
B. bipolar transistor.
C. light-emitting diode.
D. silicon controlled rectifier.

Question 2

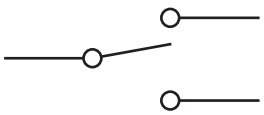


Figure 2

The circuit symbol shown in Figure 2 represents which type of switch?

A. PBNO
B. SPDT
C. SPST
D. DPDT

Question 3

When handling static sensitive components, the most suitable method for protecting them from electrostatic discharge (ESD) is to

A. sit on a metal chair.
B. wear an ESD protection wrist strap.
C. touch the metal case of a computer.
D. hold the component with metal pliers.

Question 4

A Residual Current Device (RCD) trips a circuit breaker by detecting current

A. in the earth wire.
B. in the neutral wire.
C. overload in the circuit.
D. imbalance between the active and neutral conductors.

Question 5

Which of the following items of safety equipment are the most suitable to use when soldering electronic circuits?

A. safety glasses, leather gloves, earplugs
B. safety glasses, heat sink pliers, desoldering braid
C. fume extractor, tip-wiping sponge, long-nose pliers
D. safety glasses, fume extractor, soldering-iron holder

Question 6

Which of the following battery types is a primary cell?

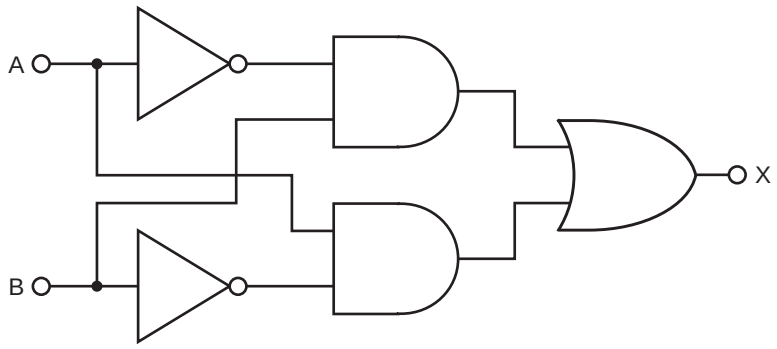
A. alkaline
B. Ni-Cad
C. lead acid
D. lithium ion

Question 7

How many nickel metal hydride cells, connected in series, would be required to form a 12 V battery?

A. 6
B. 8
C. 10
D. 12

Question 8



A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

Figure 3

Which type of logic gate is represented by the circuit and the truth table shown in Figure 3?

A. OR
B. AND
C. XOR
D. NOT

Question 9

The first three bands of a four band resistor are: brown, green, red.
The resistance value is

A. 1 K5
B. 25 K
C. 150 R
D. 250 R

Question 10

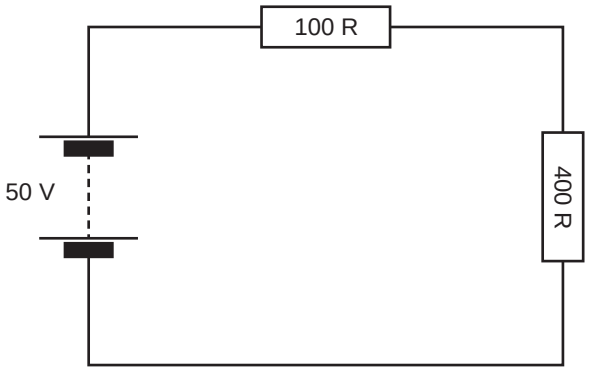


Figure 4

What is the voltage across the 400 R resistor in Figure 4?

A. 10 V
B. 20 V
C. 30 V
D. 40 V

Question 11

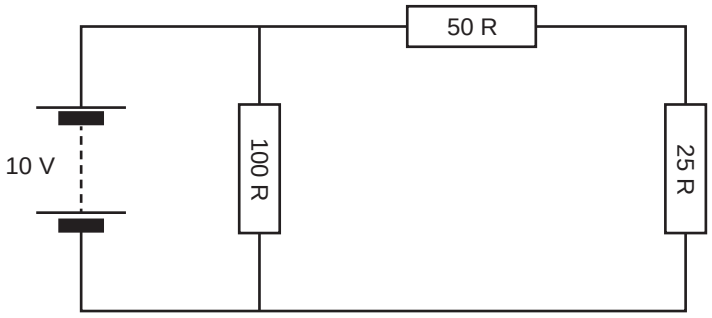


Figure 5

What is the power dissipated by the 100 ohm resistor in Figure 5?

A. 1 W
B. 2 W
C. 10 W
D. 1000 W

Question 12

Figure 6

The loudspeaker of a subwoofer audio system shown in Figure 6

A. is known as a tweeter.
B. outputs sound waves at 500 Hz and above.
C. converts high-frequency electrical signals to sound waves.
D. converts very low-frequency electrical signals to sound waves.

Question 13

A transformer is able to step up or step down an AC input voltage by

A. mutual induction.
B. selecting the correct core material.
C. increasing and decreasing eddy currents.
D. changing the diameter of the wire used in the primary or secondary windings.

Question 14

Which type of device could be used to convert temperature into a digital format?

A. ADC
B. DAC
C. counter
D. shift register

Question 15

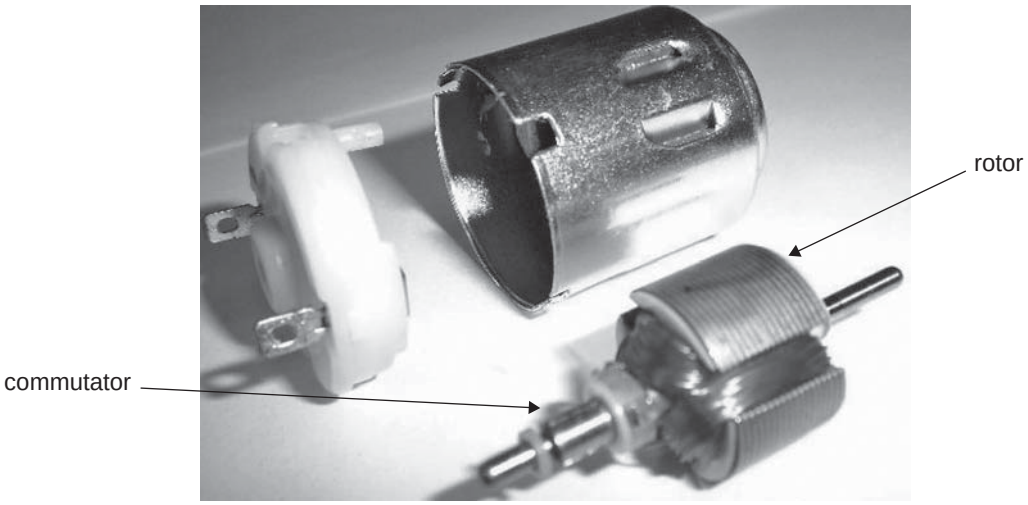


Figure 7

Figure 7 shows a disassembled DC permanent magnet motor.
The commutator of the motor

A. increases bearing life due to its segmentation.
B. reduces brush wear by limiting rotor coil current.
C. reduces the flux density of the fixed permanent magnets.
D. provides a current path through the rotor coils, creating a magnetic field.

Question 16

The binary number **0101 1010** is represented by the hexadecimal number

A. 22H
B. 38H
C. 5AH
D. 8CH

Question 17

Your personal computer's (PC) operating system uses virtual memory.
Virtual memory uses

A. cache memory.
B. an area on the hard disk drive.
C. SRAM memory inside the computer's CPU.
D. part of the computer's main dynamic RAM.

Question 18

A SATA hard disk drive is installed in a PC in preference to other types due to

A. a simple cable connection.
B. a built-in cache memory on the drive.
C. no additional DC power connections being required.
D. the system BIOS not requiring to see the SATA drive.

Question 19

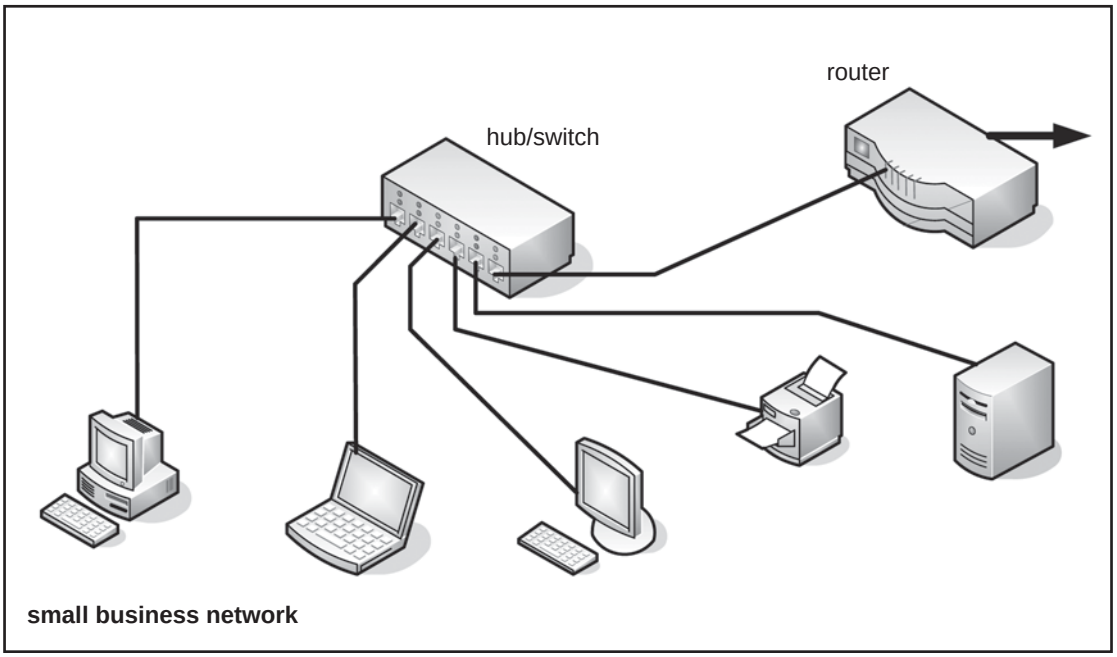


Figure 8

The computer network topology shown in Figure 8 is

A. bus topology.
B. star topology.
C. daisy-chain topology.
D. small business topology.

Question 20

All current PCs and laptops are fitted with USB 2.0 ports.
Which one of the statements below is correct regarding USB?

A. USB devices are 'hot swappable'.
B. USB 2.0 can support up to 64 devices.
C. USB printers get their power from the USB port.
D. The USB port provides a data connection to the peripheral devices via a UTP CAT 5 cable.

END OF SECTION A
TURN OVER

SECTION B

Instructions for Section B

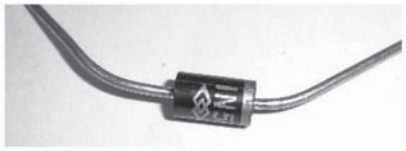
Answer **all** questions in the spaces provided.
State all formulas and calculations.
All units must be specified in the answers.

Question 1

Complete the table below with the corresponding component photo **(A.–H.)** and the circuit symbol **(i.–viii.)**.

Component

A.

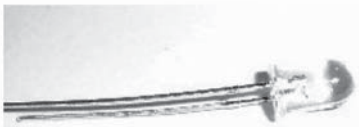


B.

C.

D.

E.



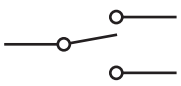
F.

G.

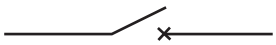
H.

Symbol

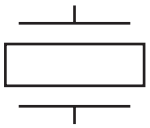
i.



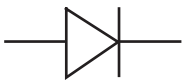
ii.



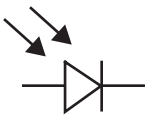
iii.



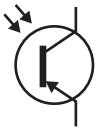
iv.



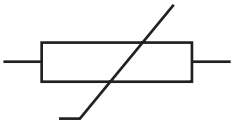
v.



vi.



vii.



viii.

Component	Photo	Symbol
phototransistor		
rectifier diode		
crystal		
circuit breaker		

8 marks

Question 2

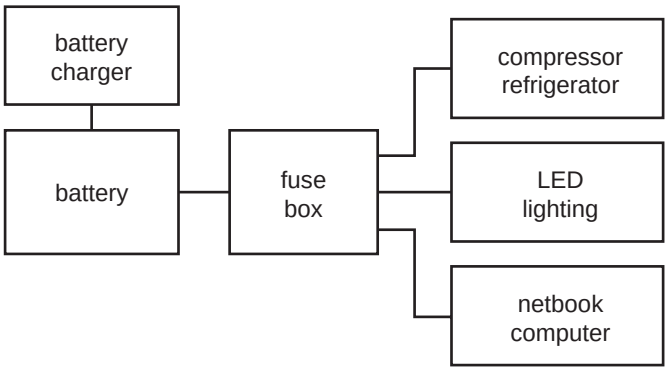


Figure 1

You are designing a 12 V power system suitable for camping. You require sufficient battery capacity to meet your power requirements for one day (24 hours) if the battery is unable to be charged.

Figure 1 shows a block diagram of your proposed system.

Table 1 shows the percentage of available battery capacity before recharging is required for three different types of lead-acid batteries.

Table 1

Lead-acid battery type	Available battery capacity
starter battery	20%
marine battery	50%
deep-cycle battery	80%

a. The power consumption for each device, plus the average daily usage, is listed in the table below. The current drawn by the appliances and their required battery capacity, in ampere-hours, can be calculated.

Fill in the gaps on the table below.

Device	Power (W)	Average daily usage (hr)	Current drawn (amps)	Required battery capacity (A–H)
netbook computer	30 W	2	2.5 A	5 A–H
LED lights	12 W	4		4 A–H
refrigerator	60 W	6	5 A	

2 marks

b. You decide to add some electrical appliances and your daily battery consumption is now 50 ampere-hours. You then purchase an additional lead-acid marine battery (refer to Table 1).

What capacity battery will you require?

_____

1 mark

c. Refer to the block diagram in Figure 1.

i. What is the purpose of the fuse box?

ii. What would be the risk of locating the fuse box away from the battery and near the appliances?

1 + 1 = 2 marks

d. Describe two safety precautions that should be taken when working with lead-acid batteries.

2 marks

Question 3

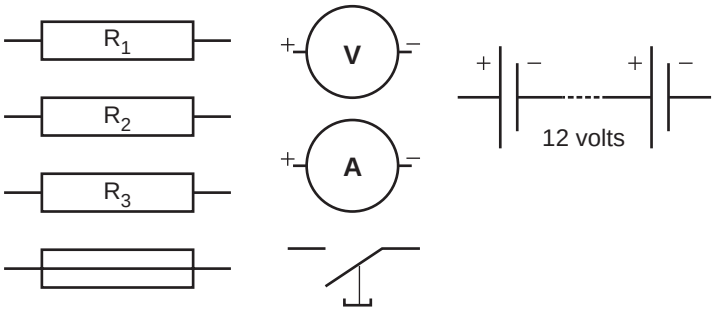


Figure 2

a. Using the components shown in Figure 2, draw in the space provided below a **circuit** configured as follows: 12 V (positive of the battery), connects via the fuse and the switch to series resistors R_1 and R_2, with R_3 in parallel with R_2. The ammeter is required to measure the total current flowing in the circuit, while the voltmeter measures the voltage drop across R_3. **Ensure meter polarity is shown**.

4 marks

b. Calculate the readings on the ammeter and voltmeter if R_1 = 270 R, R_2 = 560 R and R_3 = 560 R.

ammeter _____

voltmeter _____

4 marks

c. If R_3 becomes an open circuit, what will the ammeter reading be?

_____

2 marks

Question 4

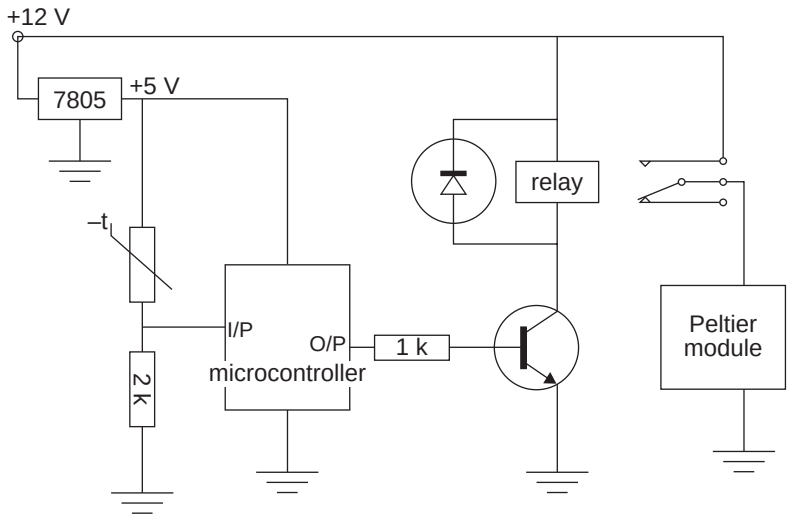


Figure 3

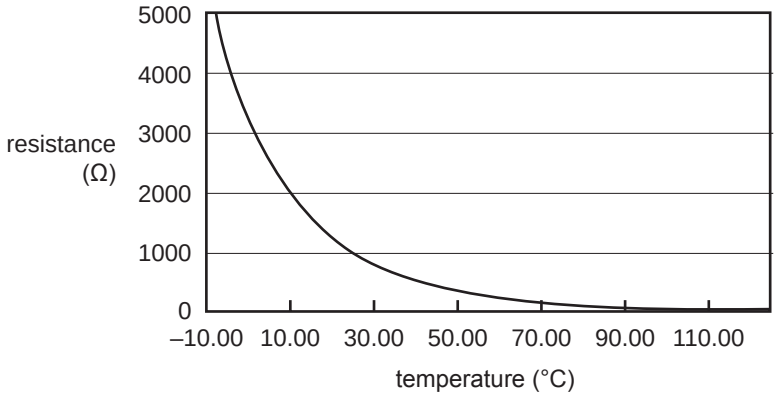


Figure 4

The circuit in Figure 3 shows a thermostat for a drink cooler. The drink cooler uses a Peltier module to provide the cooling required. The thermostat uses a Negative Temperature Coefficient (NTC) thermistor to monitor the temperature in the cooler. The microcontroller is programmed to switch the Peltier module ON when the temperature is above the required temperature. The microcontroller will switch OFF the Peltier module when the required temperature is reached. Figure 4 shows a graph of the thermistor resistance versus temperature.

a. What is the function of the component labelled 7805?

1 mark

b. What effect does a rise in the temperature have on the resistance of the thermistor?

1 mark

c. Calculate the voltage at the input pin (I/P) of the microcontroller when the cooler temperature is 10°C.

3 marks

d. You decide to modify the circuit so that an LED lights up to indicate when the Peltier module is switched ON. On the circuit diagram in Figure 3, draw a modification that would enable this to happen. Use the correct circuit symbol for an LED.

3 marks

Question 5

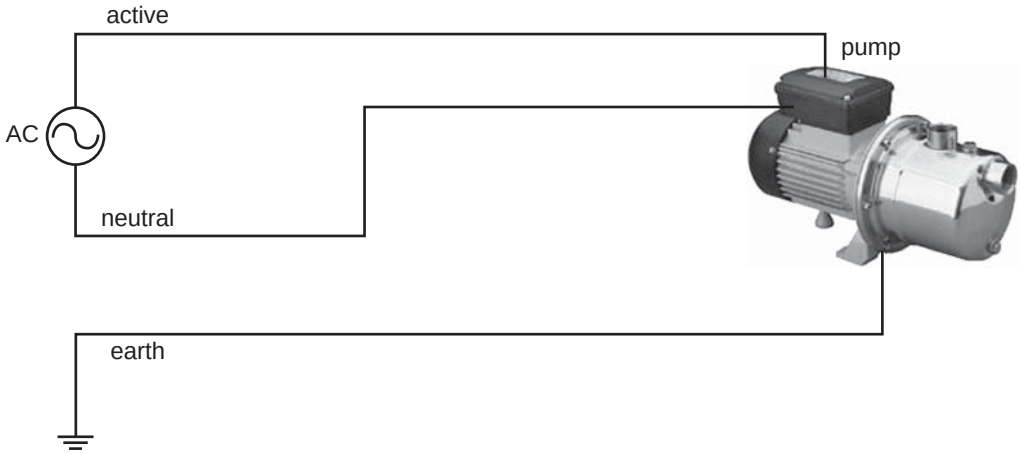


Figure 5

A 230 V water pump has been installed 400 metres from the mains switchboard. When the pump is switched ON it fails to run, but draws 20 amps of current during the starting process. The measured voltage at the pump is 210 V. At the switchboard 230 V is measured.

a. What is the resistance of the cable?

2 marks

b. How much power is dissipated by the cable?

2 marks

c. Describe two possible causes for the power loss in the cable.

2 marks

d. What action must be taken to ensure the pump operates?

1 mark

e. Name two properties of the cable that affect the cable resistance.

2 marks

Question 6

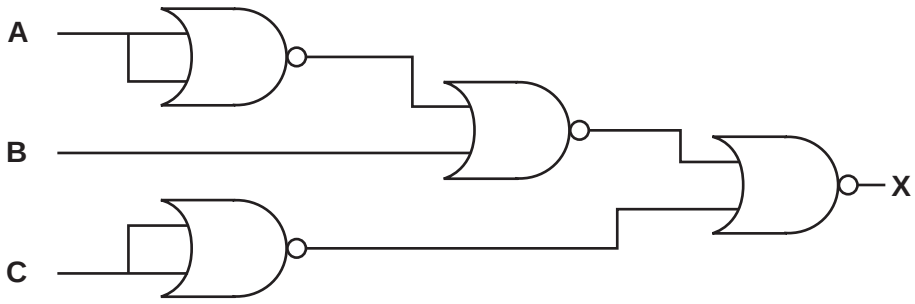


Figure 6

a. Find the logic function for the logic circuit in Figure 6.

X = _____

4 marks

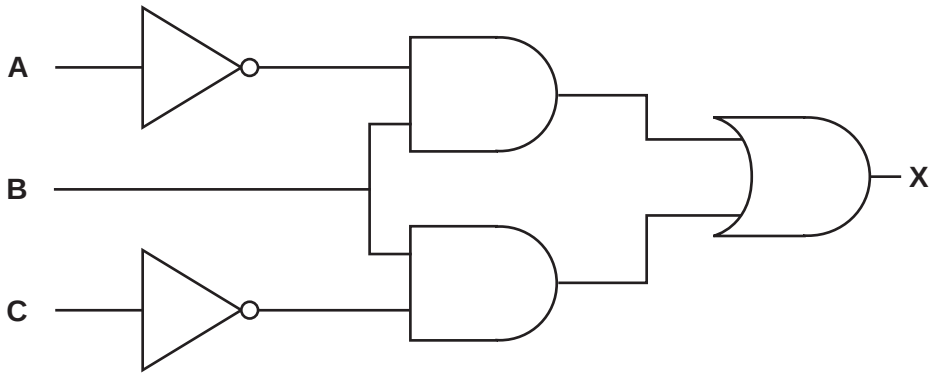


Figure 7

b. Complete the truth table of the logic circuit in Figure 7.

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	
0	1	1	
1	0	0	
1	0	1	0
1	1	0	
1	1	1	0

4 marks

Question 7

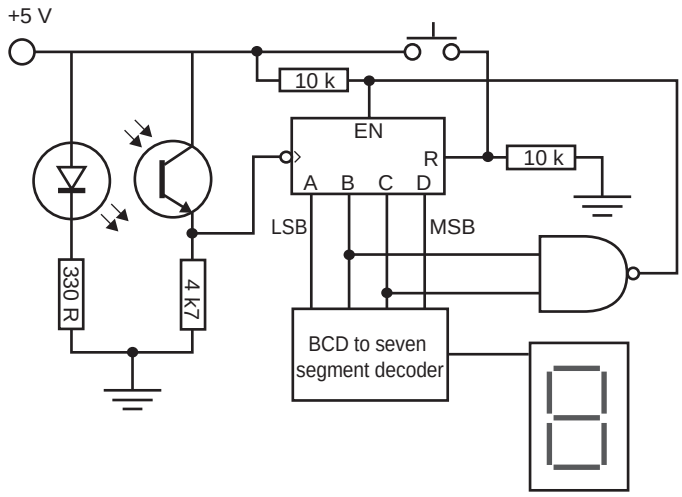


Figure 8

Table 2

Enable (EN)	Reset (R)	Clock	D (MSB)	C	B	A (LSB)
low	low	×	×	×	×	×
high	high	×	0	0	0	0
high	low	pulse 1	0	0	0	1
high	low	pulse 2	0	0	1	0
high	low	pulse 3	0	0	1	1
high	low	pulse 4	0	1	0	0
high	low	pulse 5	0	1	0	1
high	low	pulse 6	0	1	1	0
low	low	pulse 7	0	1	1	0
low	low	pulse 8	0	1	1	0
low	low	pulse 9	0	1	1	0

The circuit in Figure 8 is a lap counter for a toy racing-car set. The laps are counted by the slot car, moving between the LED and the phototransistor, breaking the beam and causing the counter to increase by one. The binary output of the counter is decoded and used to display the lap number on the seven-segment display. When the required lap number is reached, the NAND gate causes the 'enable' input of the counter to go low and the counter is disabled. The lap counter will remain on that number until the reset button is pushed. Table 2 is the truth table for the counter.

a. What logic level will appear at the clock input of the counter when the phototransistor is switched ON?

_____

1 mark

b. What is the purpose of the 10 k resistor connected to the reset input (R) of the counter?

_____

_____

1 mark

c. Refer to Table 2. How many laps will be counted before the binary counter is disabled?

_____

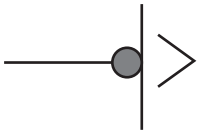
1 mark

d. Which two outputs of the binary counter would need to be connected to the NAND gate in order to stop the binary counter after nine laps?

_____

1 mark

e. The following symbol appears at the clock input to the counter.



i. What does the dot indicate?

_____

ii. What does the arrow indicate?

_____

1 + 1 = 2 marks

Question 8

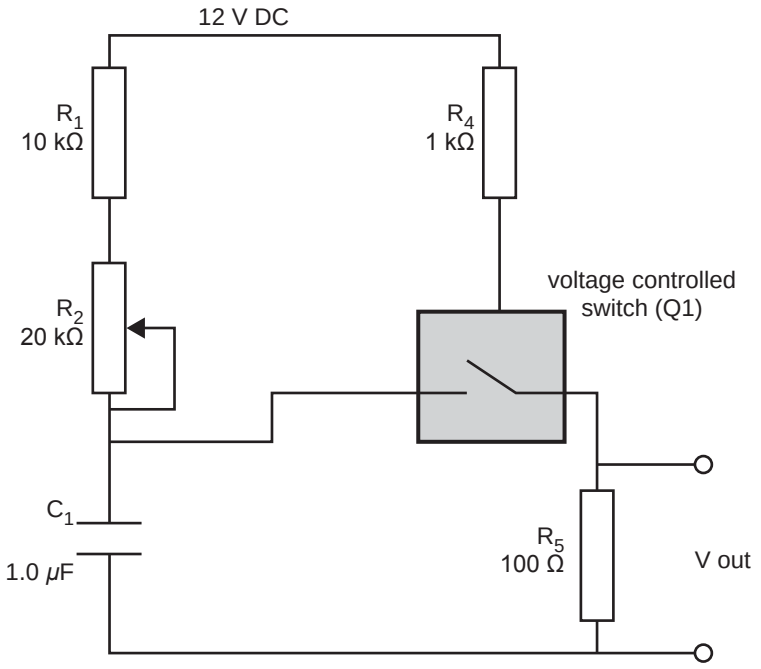


Figure 9

Figure 9 shows part of a control circuit for a variable DC power supply. Resistor R_1, variable resistor R_2, and capacitor C_1 form a timing circuit that charges and discharges depending on the operation of the voltage controlled switch Q1.

The switch Q1 closes when the capacitor C_1 charges to one time constant, 63% of the total charge, and opens when the capacitor discharges to almost 0 volts.

a. If the variable resistor is set to its midrange

i. how long will it take for the capacitor to charge to 1 time constant

_____

ii. what voltage will be across the capacitor after 1 time constant?

_____

2 + 2 = 4 marks

b. When the voltage controlled switch closes, how long will it take for the capacitor C_1 to discharge?

_____

2 marks

Question 9

You are about to commence soldering through hole components onto a Printed Circuit Board (PCB) using a temperature controlled soldering station.

a. Name two things on the soldering station you would check before switching on the power.

i. _____

ii. _____

2 marks

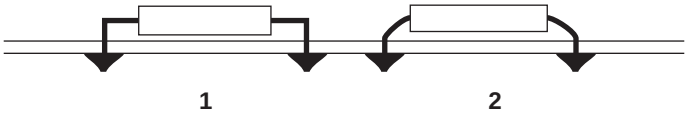


Figure 10

b. State which of the two resistors shown in Figure 10 is correctly mounted onto the PCB and give the reason for your choice.

selection _____

reason _____

_____

2 marks

c. One of the risks associated with soldering is the lead in the solder.
Suggest two possible control measures that would either eliminate or minimise the risk.

_____

_____

_____

2 marks

d. When soldering an Integrated Circuit (IC) to a PCB, state one possible risk to the IC and suggest how the risk could be controlled effectively.

risk _____

control _____

_____

2 marks

e. What is the purpose of the resin, in resin core solder?

_____

_____

1 mark

Question 10

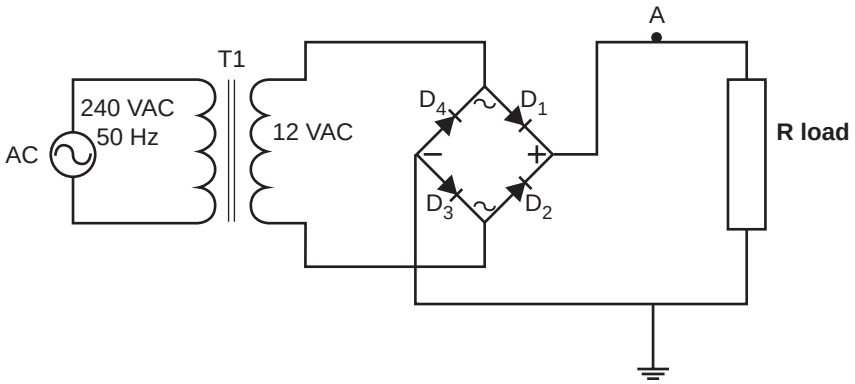


Figure 11

Refer to Figure 11.

a. What is the function of T1 in this circuit?

1 mark

b. What type of core material might be used in the mains transformer T1?

1 mark

c. What is the turns ratio for the transformer T1?

2 marks

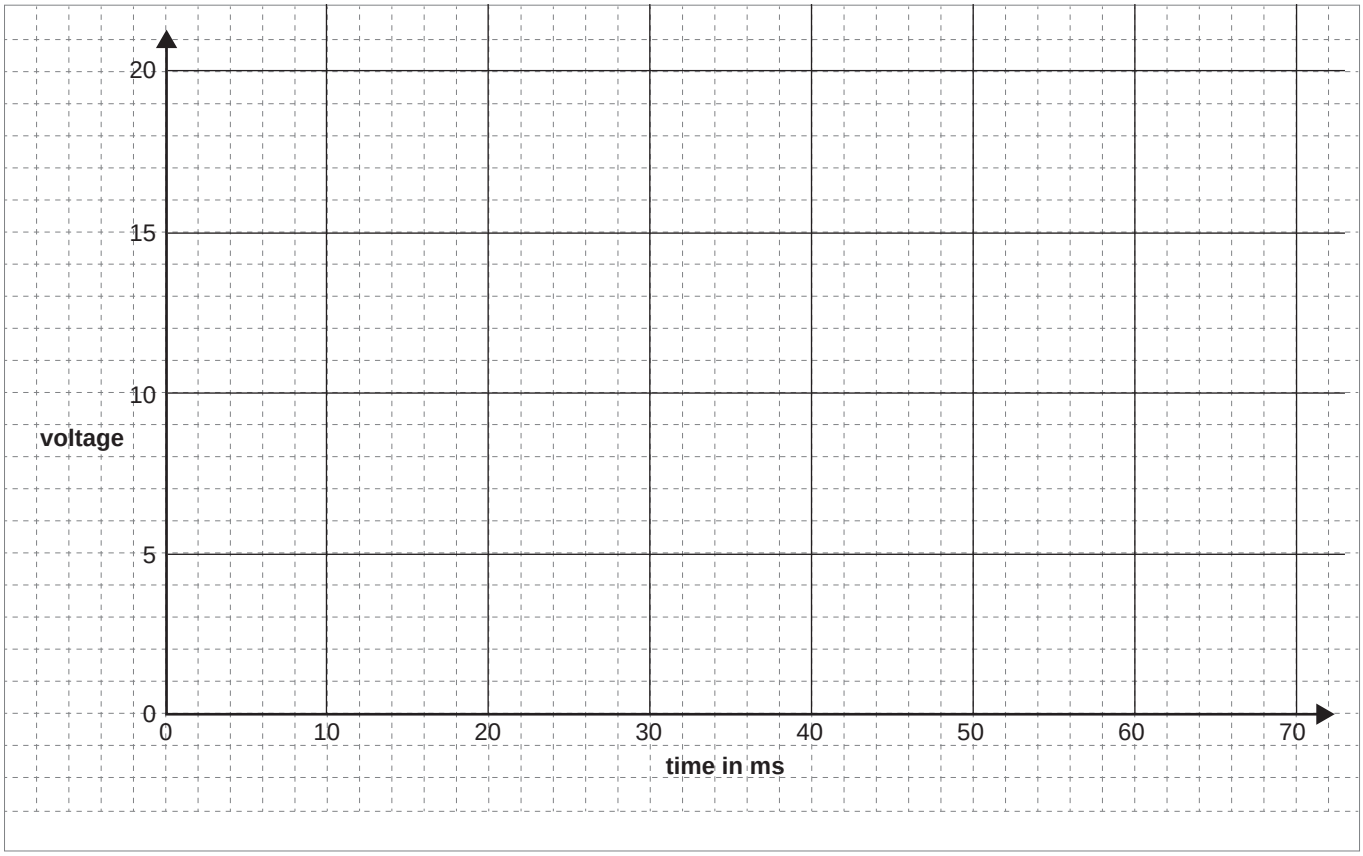
d. What is the function of diodes D_1–D_4 in this circuit?

1 mark

e. The diodes have a forward voltage of 0.6 V.
What is the peak voltage at point A, with reference to ground?

2 marks

f. In the space below, draw the voltage waveform at point A.

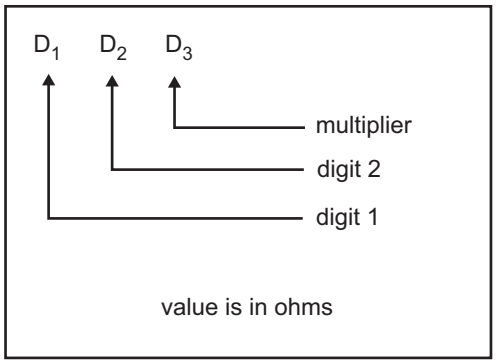


2 marks

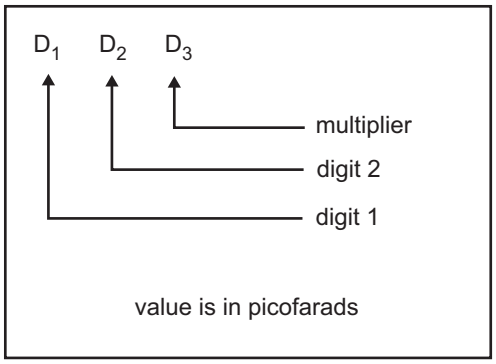
END OF SECTION B
TURN OVER

Formula sheet

resistor code



capacitor code



$$R_T = R_1 + R_2 + R_3$$

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

$$V = I \times R$$

$$P = V \times I$$

$$V_X = V_S\left(\frac{R_X}{R_T}\right)$$

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

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

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

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

$$V_{STEP} = \frac{V_{max}}{2^n - 1}$$

$$\tau = C \times R$$

Resistor colour code

0 black
1 brown
2 red
3 orange
4 yellow
5 green
6 blue
7 violet
8 grey
9 white

END OF QUESTION AND ANSWER BOOK


State Government
Victoria