VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2013

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

VCE VET INTEGRATED TECHNOLOGIES

Written examination

Monday 11 November 2013

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 and 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

A photovoltaic solar panel produces electrical energy due to

A. irradiation.
B. solar heating.
C. the panel's magnetic field.
D. a chemical reaction in the panel.

Question 2

The coal-fired power station at Loy Yang, in the Latrobe Valley, generates electricity by rotating a magnetic field.

The amount of electromotive force (EMF) that is produced by the generator is controlled by varying the

A. speed of the generator.
B. frequency of the generator.
C. strength of the rotating magnetic field.
D. amount of coal that is supplied to the furnace.

Question 3

Which battery is classified as a primary cell?

A. carbon-zinc
B. lithium-ion
C. nickel-cadmium
D. nickel-metal hydride

Question 4

A material safety data sheet (MSDS)

A. describes the safe use of equipment.
B. provides data on the safe storage of a substance.
C. is used to record chemical spills in the workplace.
D. is required only if a materials-handling accident has occurred.

Question 5

A Cat5 cable that is terminated with RJ45 connectors can be used in a computing environment to

A. provide a firewire connection to a digital camera.
B. connect two PCs together as a peer-to-peer network.
C. provide HDMI audio and video to an LCD television.
D. connect to the PC com port, providing serial RS232 communications to industrial equipment.

Question 6

A voltmeter can be connected in parallel with a load because it

A. has no resistance.
B. has low input resistance.
C. has high input resistance.
D. measures the current through the load.

Question 7

The device that is often referred to as a 'megger' is

A. a multimeter.
B. a clamp meter.
C. an insulation tester.
D. a time-domain reflectometer.

Question 8

In a 12 V DC power supply, the output is electrically isolated from the mains input by a

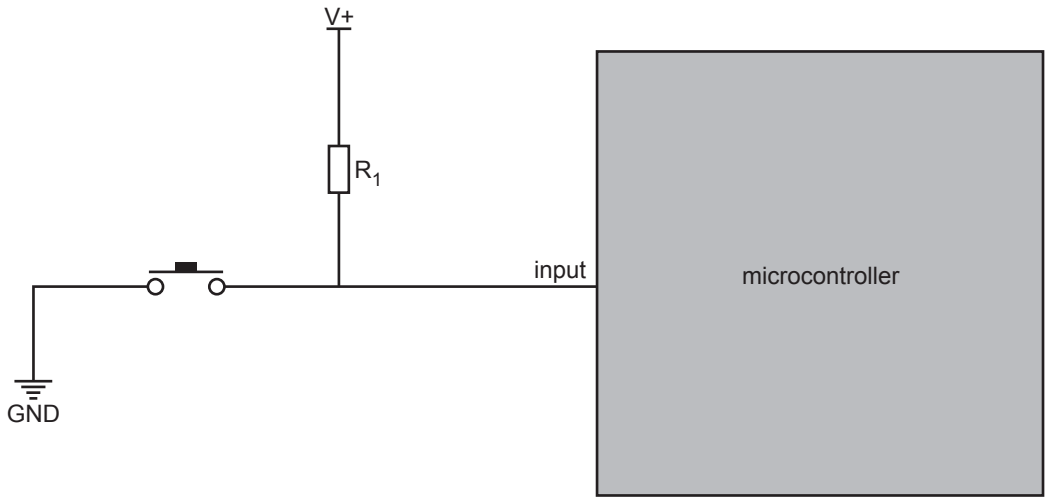
A. rectifier.
B. capacitor.
C. regulator.
D. transformer.

Question 9

Which one of the following is **not** a type of transducer?

A. a capacitor
B. a light globe
C. a speaker
D. a light-emitting diode

Question 10



In the diagram above, R_1 is known as a

A. pull-up resistor.
B. switching resistor.
C. pull-down resistor.
D. current-limiting resistor.

Question 11

A thyristor is often used to

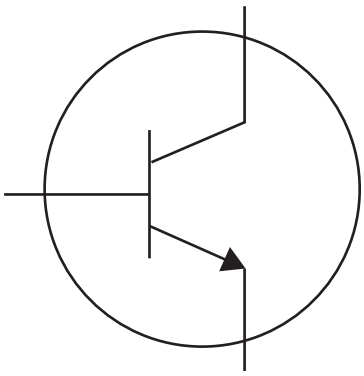
A. measure position.
B. sense hydrogen in the air.
C. control power in an AC circuit.
D. regulate current flow in a thermal resistor.

Question 12

What is the cell voltage of a standard nickel-cadmium cell?

A. 1.0 V
B. 1.2 V
C. 1.5 V
D. 3.6 V

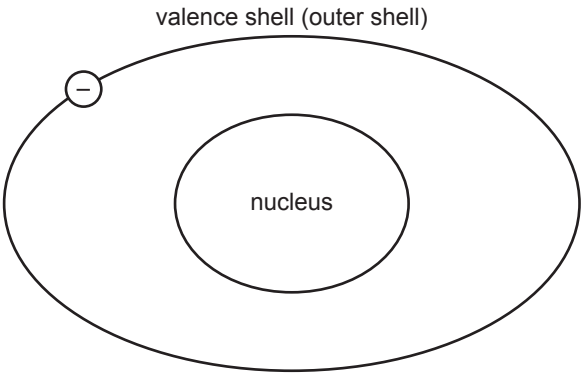
Question 13



The electronic symbol that is shown above is a

A. triac.
B. thyristor.
C. rectifier diode.
D. bipolar junction transistor.

Question 14



The diagram above shows the atomic structure of

A. an insulator.
B. a conductor.
C. a carbon atom.
D. a semiconductor.

Question 15

Which one of the following best describes Energy Safe Victoria (ESV)?

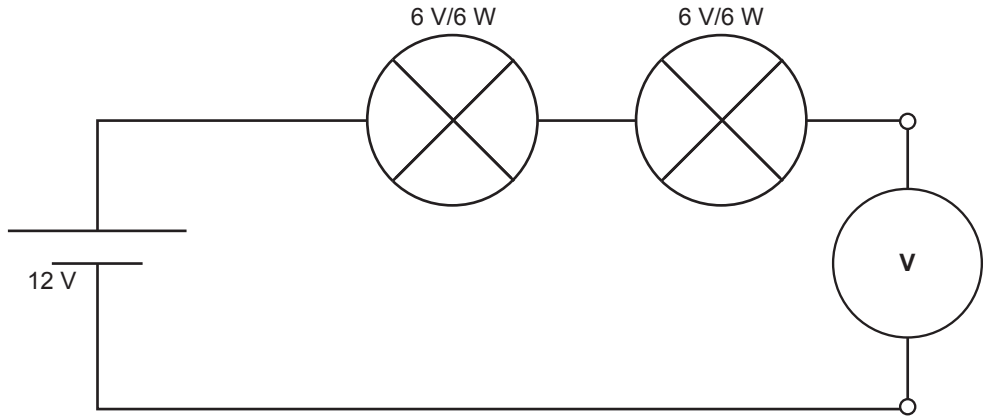
A. responsible for the maintenance of power distribution in Victoria

B. a registered training organisation (RTO) that trains electricians and gasfitters

C. an independent technical regulator that is responsible for electricity, gas and pipeline safety in Victoria

D. an industry training advisory body (ITAB) that provides the Victorian Government with up-to-date industry training advice

Question 16



What is the reading on the DC voltmeter in the circuit above?

A. 1 A

B. 0 V

C. 6 V

D. 12 V

Question 17

To avoid injury when using a pedestal drill, you should

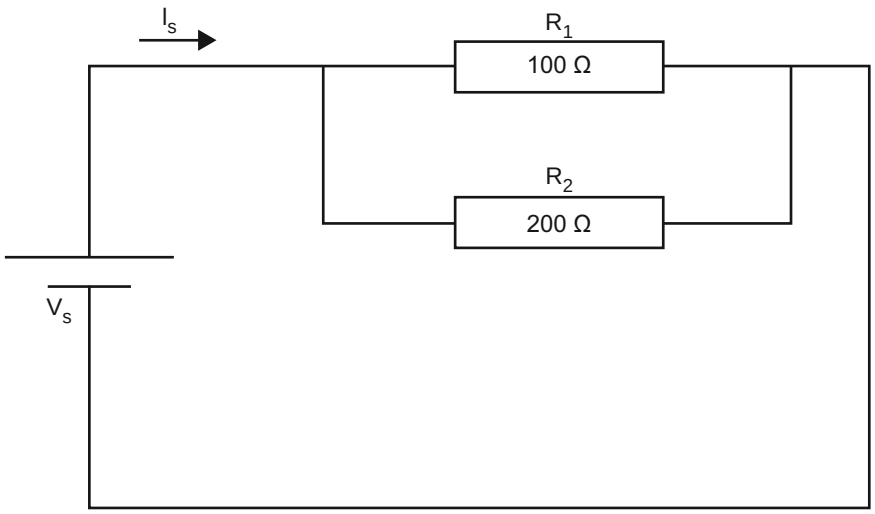
A. wear gloves.

B. hold the job with your hands.

C. use a vice clamp to secure the job.

D. use compressed air to remove the drill swarf.

Question 18



In the circuit above, what is the relationship between the current that is flowing through R_1 and the current that is flowing through R_2?

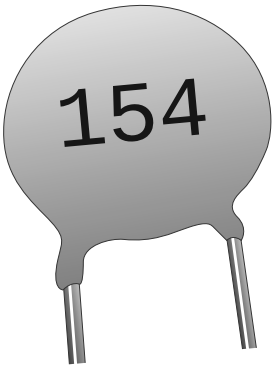
A. The current through R_1 is equal to the current through R_2.

B. The current through R_1 is double the current through R_2.

C. The current through R_2 is double the current through R_1.

D. There is not enough information to decide.

Question 19



Courtesy of Wayne Storr, www.electronics-tutorials.ws

What is the capacitance value of the ceramic capacitor that is shown in the image above?

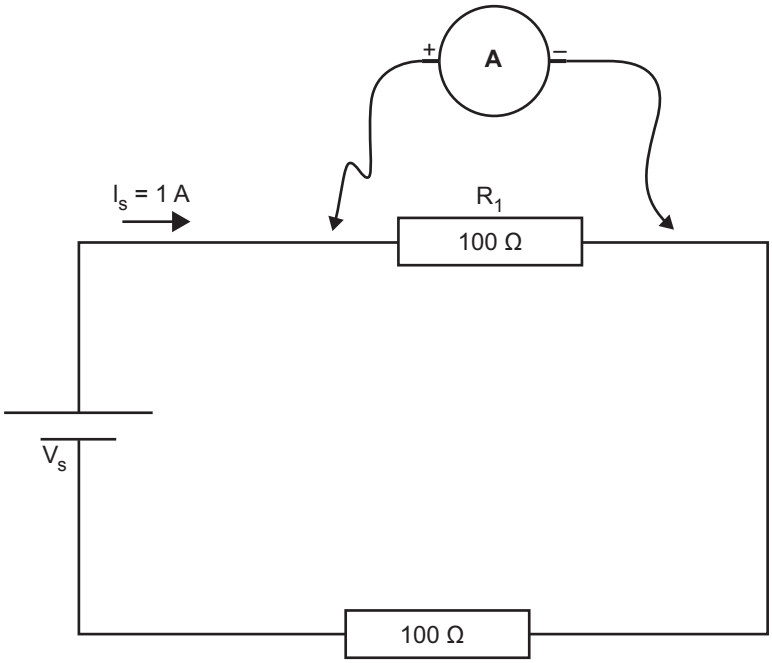
A. 15 nF

B. 150 nF

C. 154 nF

D. 154 μF

Question 20



In the circuit above, the ammeter is to be connected to each side of resistor R_1. The ammeter range is selected to 10 A.

When connected, what will the reading on the ammeter be?

A. 0 A

B. 0.5 A

C. 1 A

D. 2 A

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 notations in the answers.

Question 1 (8 marks)
In the electrotechnology industry, the use of correct engineering notations is important.
In the space provided in Table 1, convert each value into engineering notations (mA, kΩ, etc.).
Note: In engineering notations, whole numbers are from 1–999.

Table 1

Value	Engineering notation	Value	Engineering notation
0.0556 A		0.115 mV	
22 000 nF		52 764 μV	
47 000 Ω		2000 KV	
6 800 000 Ω		0.075 W	

Question 2 (4 marks)

Figure 1

Figure 1 shows two resistors that are connected. Each resistor has a tolerance of 5%.

a. Calculate the total circuit resistance between **A** and **B**. 3 marks

b. Calculate the total resistance between **A** and **B** if both resistors are at their minimum values. 1 mark

Question 3 (10 marks)

Figure 2 shows the components that are required to make a series circuit.

a. On Figure 2 below, draw the connections that are required to form a series circuit, where the current flows from the positive terminal of the power supply, through the 20 R resistor, through the ammeter, through the 28 R resistor and back to the negative terminal of the supply. Indicate how the voltmeter would be connected to measure the voltage across the 28 R resistor.

Note: Polarity for both the ammeter and voltmeter must be shown. 6 marks

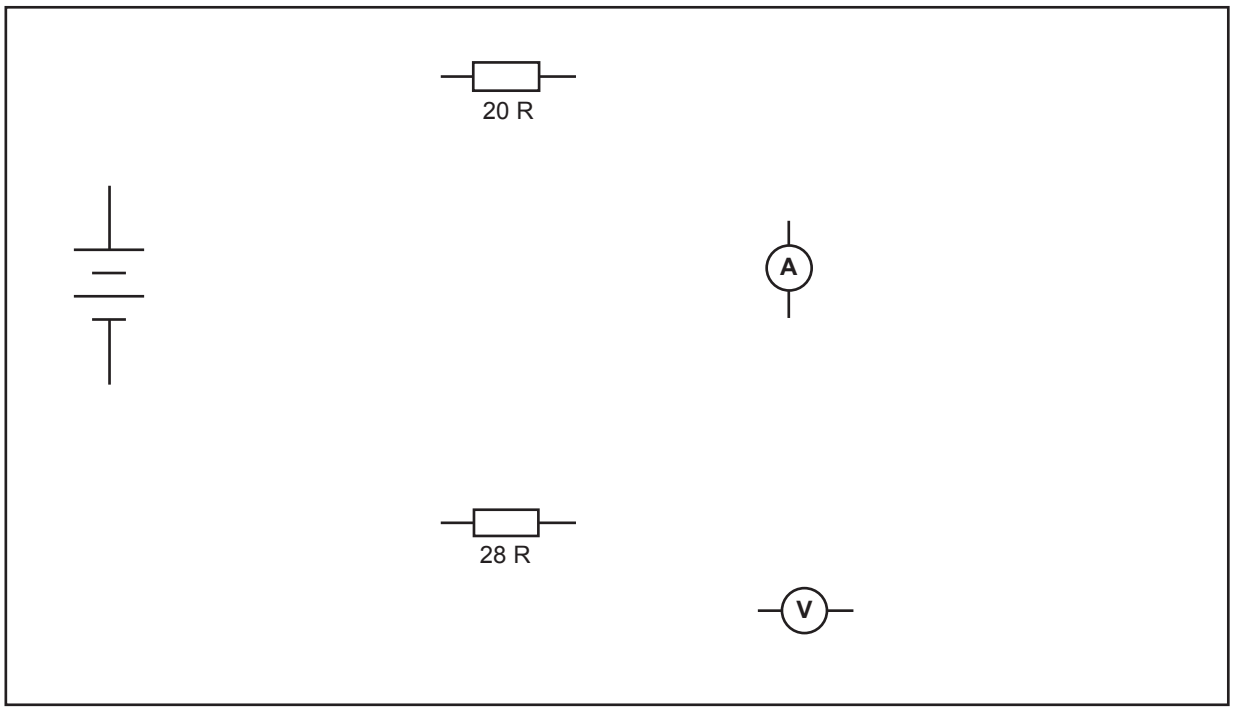


Figure 2

b. Using your completed circuit in Figure 2, if the voltmeter measures 7 V

i. find the current that is drawn from the supply 2 marks

ii. find the supply voltage. 2 marks

Question 4 (6 marks)

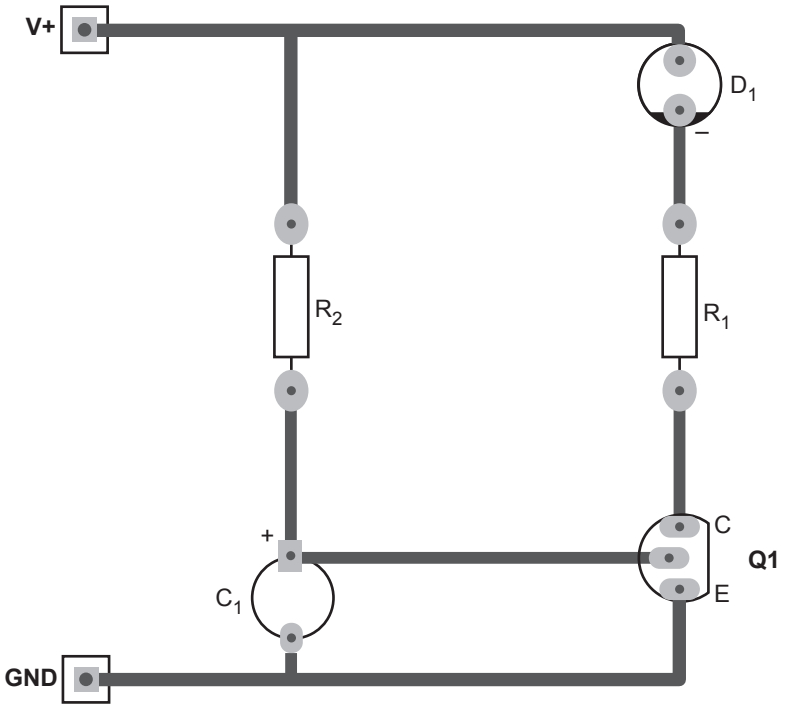


Figure 3

Figure 3 shows a Printed Circuit Board (PCB) layout for a small electronic circuit. The partially completed schematic diagram for the circuit is shown in Figure 4.

In Figure 4 below, complete the diagram by drawing the **six** missing connections.

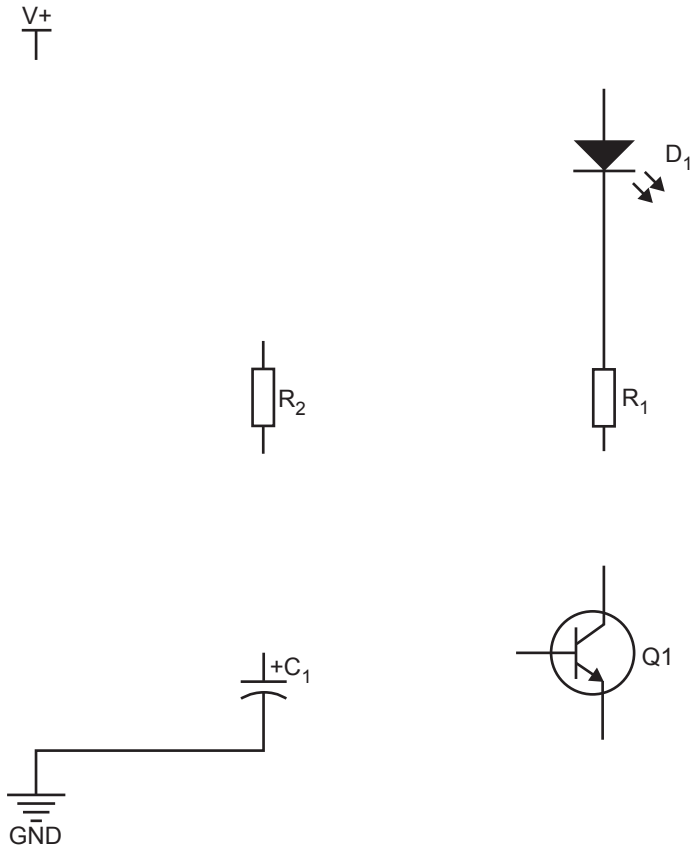


Figure 4

Question 5 (9 marks)

The circuit at Figure 5 shows a light-dependent resistor (LDR), R_1, connected to an amplifier with a voltage gain of 10. Figure 6 shows the luminance versus resistance graph of the LDR.

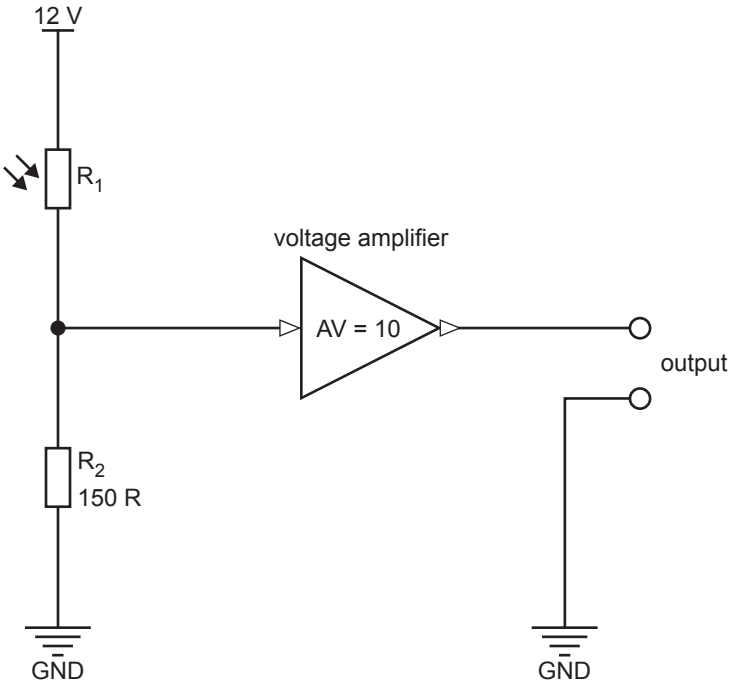


Figure 5

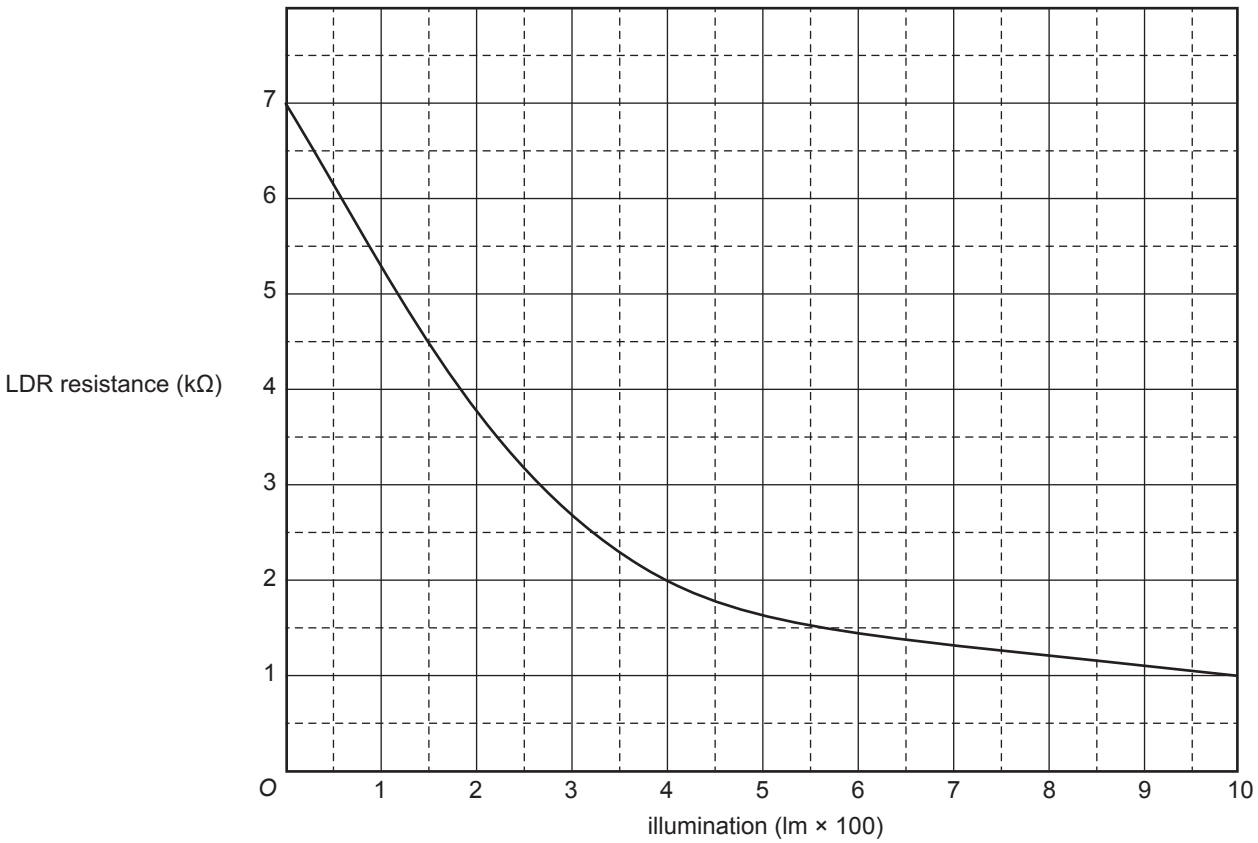


Figure 6

a. If the light intensity that is falling on the LDR increases, what effect will this have on the output of the amplifier? 2 marks

_____

_____

b. Using the graph in Figure 6, determine the input voltage to the amplifier if the light intensity that is falling on the LDR is equal to 400 lm. 3 marks

c. If the measured output of the amplifier is 10.9 V, determine the light intensity that is falling on the LDR. 4 marks

Question 6 (10 marks)
Refer to the circuit diagram at Figure 7.

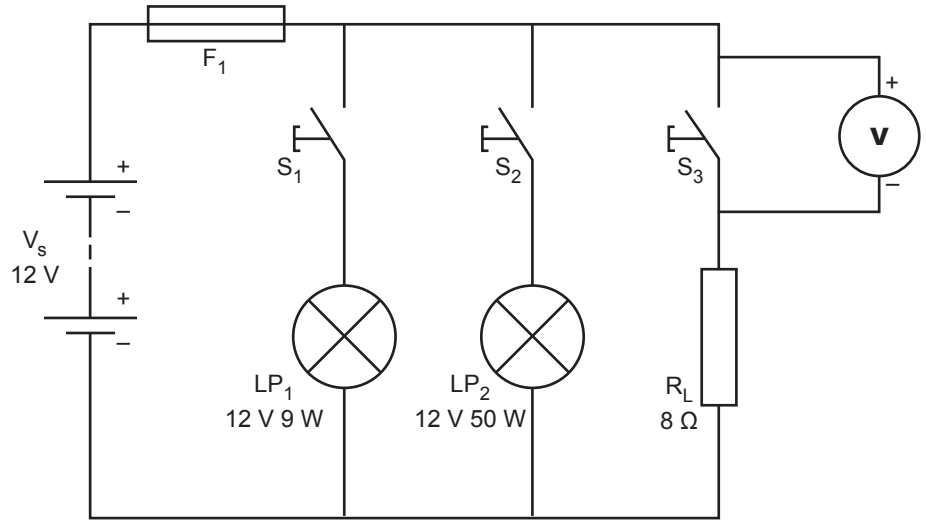


Figure 7

a. What is the voltage drop across switch S_3 when it is closed? 1 mark

b. With S_3 closed, how much power is dissipated by R_L? 2 marks

c. With S_2 closed, how much current is flowing through LP_2? 2 marks

d. With S_1, S_2 and S_3 closed, what is the total power that is consumed by the circuit? 2 marks

e. What fuse size is required to provide protection when the circuit is fully loaded? 3 marks

Question 7 (8 marks)
Refer to the circuit diagram at Figure 8.

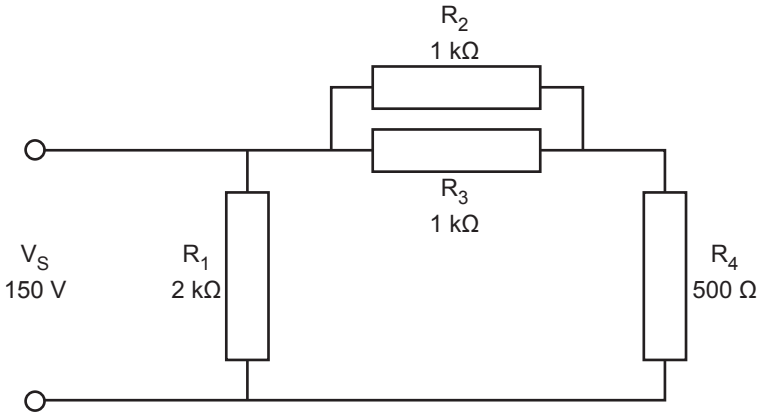


Figure 8

a. Find the total resistance of the circuit. 2 marks

b. Find the total current that is flowing from the supply. 2 marks

c. Find the voltage drop across R_2. 2 marks

d. Find the current that is flowing through R_3. 2 marks

Question 8 (9 marks)

A ceiling fan controller often uses capacitors to vary the speed of a fan's motor. Figure 9 shows capacitors that are connected to a fan's motor. Table 2 details the connection for each switch position.

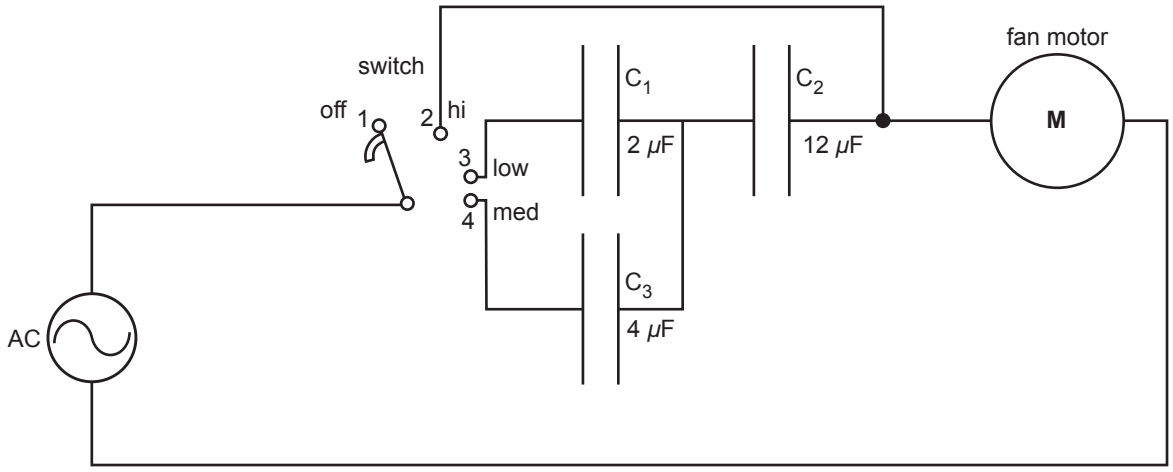


Figure 9

Table 2

Switch position	Motor connection
1	off position – no connection
2	high (hi) – direct connection to motor
3	low – capacitors C_1 and C_2 connected
4	medium (med) – capacitors C_1, C_2 and C_3 connected Note: Switch contacts 3 and 4 are connected together when 'med' is selected.

a. Calculate the capacitance in the circuit when the switch is on 'low' (position 3). 2 marks

b. Calculate the capacitance in the circuit when the switch is on 'med' (position 4).
Note: Switch contacts 3 and 4 are connected together at position 4. 3 marks

c. Electrolytic capacitors are often used in electrical circuits. This type of capacitor often has polarity.

What type of capacitor would be used in this circuit – polarised or non-polarised? Explain your selection. 2 marks

_____

_____

_____

d. Electrolytic capacitors often have voltage ratings.

Why is this an important factor when selecting a capacitor for a specific circuit? 2 marks

_____

_____

_____

_____

Question 9 (6 marks)

As part of your Integrated Technologies project, you are required to drill holes into an aluminium plate (483 mm × 100 mm × 2.5 mm). The plate has been marked out and centre-punched, and is ready for drilling. Drill bit sizes of 5 mm to 12 mm are available, as well as a drawing showing hole sizes. You will use a pedestal drill in your workshop to carry out this task.

Prior to drilling, you are required to fill out a Job Safety Analysis (JSA) worksheet identifying the activities that you are to perform, the hazards that are associated with the task, risk control measures and who is responsible for implementing the control measures.

The activities to be performed are already listed in Table 3 on page 19.

Complete the table by recording hazards, risk control measures and who is responsible for each control measure.

Table 3

Activity	**Hazard** Against each task, list a hazard that could cause injury when the task is performed.	**Risk control measure** List the control measure that is required to eliminate or minimise the risk of injury arising from the identified hazard.	**Who is responsible** List the person who is responsible (me, supervisor [sup] or employer [boss]) for implementing the control measure that is identified.
visual inspection of workshop			
inspect and check pedestal drill for correct operation and documentation			
method of securing job			
drill bit selection			
drilling holes in the aluminium plate			
clean up			

Question 10 (10 marks)

You have purchased a second-hand 2/4 channel car amplifier (amp) from a reputable seller at a recent swap meet. Unfortunately, you have no details but manage to find specifications (specs) for the amp online. Your intention is to install the amp in the boot of your 1973 Falcon GT Hardtop. Figure 10 is a snapshot of the specs.

Specifications	
Power source	14.4 VDC (11.1 V to 15 V allowable)
Grounding system	negative
Current consumption	32 A (at continuous power into 4 Ω speakers)
Average current drawn	10 A (4 Ω four channels)
	15 A (4 Ω two channels)
Fuse	25 A × 2
Maximum power output	760 W (190 W × 4)
Continuous power output	60 W × 4 (@ 14.4 V, 4 Ω, 20 Hz to 20 kHz <= 1% THD + N)
	180 W × 2 (@ 14.4 V, 4 Ω bridge, 1 kHz <= 1% THD + N)
	85 W × 4 (@ 14.4 V, 2 Ω, 1 kHz <= 1% THD + N)
Load impedance	4 Ω (2 Ω to 8 Ω allowable)

Figure 10

Reading further into the specs, you can use the 'average current drawn' 10 A (four channels) to work out the power cable requirements for the amp. You have plenty of 0.9 mm insulated tinned copper wire and want to use it for the power cable.

Figure 11 shows the DC input connection from the battery to the amp. Note that the negative terminal of the amplifier is connected to the metal body of the vehicle (chassis ground). The negative return path to the battery is by the car's metal body.

Figure 12 shows the locations of the battery and amplifier in the vehicle.

Figure 11

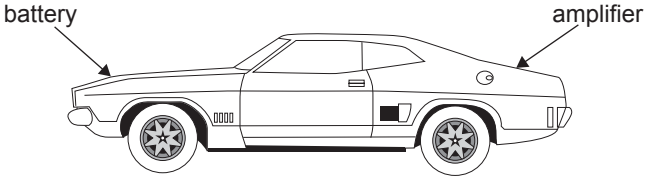


Figure 12

a. Name **two** factors that affect the resistance of a cable. 2 marks

b. Referring to Figure 11, what is the average power consumption of the amplifier? 2 marks

c. What is the effective load resistance of the amplifier's power circuit in Figure 11? 2 marks

d. With the battery in the engine bay and amplifier in the boot, you need 7 m of the 0.9 mm insulated tinned copper wire for the positive lead (red), plus 1 m of 0.9 mm cable (black) for the negative connection to the chassis. This tinned copper wire has a resistance of 27 mΩ per metre. Assume the chassis resistance is 0 Ω.

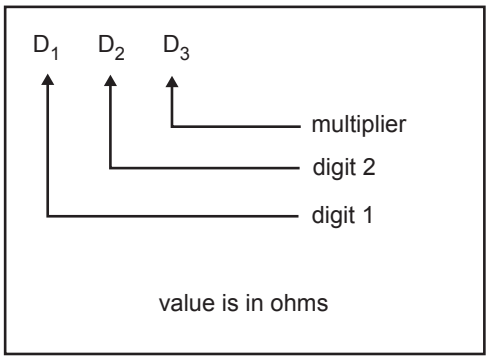
i. Taking into account the cable resistance, what is the voltage that is applied to the amplifier? 3 marks

ii. Referring to the specs at Figure 10, will the amplifier operate correctly? Explain your answer. 1 mark

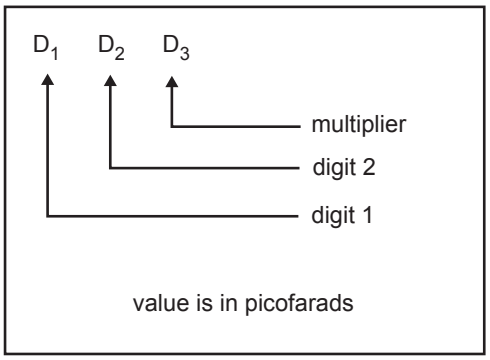
END OF SECTION B
TURN OVER

Formula sheet

resistor code



capacitor code



$$R_T = R_1 + R_2 + R_3$$

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

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

$$R = \frac{\rho \iota}{A}$$

$$V = I \times R$$

$$P = V \times I$$

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

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

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

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

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

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

$$\tau = C \times R$$

$$C = \frac{\varepsilon A}{d}$$

$$C_T = C_1 + C_2 + C_3$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

$$Q = V \times C$$

$$W = \frac{1}{2}CV^2$$

$$W = P\,t$$

Resistor colour code

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

$$\text{efficiency \%} = \frac{output}{input} \times 100$$

END OF QUESTION AND ANSWER BOOK