2011 VCE VET Electrotechnology GA 2: Examination

SPECIFIC INFORMATION

Section A – Multiple-choice questions

The table below indicates the percentage of students who chose each option. The correct answer is indicated by shading.

Question	% A	% B	% C	% D	% No Answer	Comments
1	49	19	13	17	3	Many students chose the diode (option A) as it is very common component.
2	4	70	20	6	0	
3	0	94	1	5	0	
4	12	3	29	57	0	
5	0	4	8	88	0	
6	70	9	17	4	0	
7	19	30	47	4	0	
8	21	11	61	7	0	
9	77	3	17	3	0	
10	18	12	4	66	0	
11	39	10	35	15	1	
12	3	9	29	59	0	
13	28	2	29	41	0	A transformer has both primary and secondary windings. Option D contained both these key words but did not contain the correct reason.
14	61	31	3	4	1	
15	4	11	14	71	0	
16	12	16	62	10	1	
17	17	18	20	43	1	Students' understanding of memory types needs to be improved.
18	18	42	27	12	1	Students' understanding of different memory and storage devices needs to be improved.
19	19	41	7	32	0	
20	35	11	9	46	0	

Section B

Question 1

Marks	0	1	2	3	4	5	6	7	8	Average
%	1	1	8	12	12	19	22	15	9	5.1

Component	Photo	Symbol
phototransistor	D	vi.
rectifier diode	A	iv.
crystal	G	iii.
circuit breaker	C	ii.

Students were required to match the circuit pictures for the given components to the corresponding circuit symbols. It was evident that identifying pictures and corresponding circuit symbols is an area of strength for students. Students should continue to focus on identifying the pictures and symbols of all commonly used components in Electrotechnology as this is a fundamental concept.

Question 2a.

Marks	0	1	2	Average
%	42	11	47	1.1

Device	Power (W)	Average daily useage (hr)	Current drawn (amps)	Required battery capacity (A–H)
netbook computer	30W	2	2.5A	5 A–H
LED lights	12W	4	**1A**	4 A–H
fridge	60W	6	5A	**30 A–H**

Many students were able to understand the sample given on line 1 and extend the method to lines 2 and 3.

Question 2b.

Marks	0	1	Average
%	72	28	0.3

A marine battery can only be discharged to 50% of capacity; therefore, a capacity of 100 A–H is required.

Some students struggled to follow the additional situation stated in the question. This is a practical situation that may arise in real life.

Question 2c.

Marks	0	1	2	Average
%	58	37	5	0.5

2ci.
The fuse box protects the wiring and the battery against short circuit or overload.

2cii.
The fuse box should be located as close as practicable to the battery to avoid increased risk of a short circuit between the fuse box and battery.

Some students assumed that the short circuit was in the battery and not in the load. The fuse protects the battery from draining out if the loads cause a short circuit, with the most probable reason for short circuit being the wrong circuit connection.

Question 2d.

Marks	0	1	2	Average
%	21	30	49	1.3

Correct safety precautions when working with lead-acid batteries include (two of):

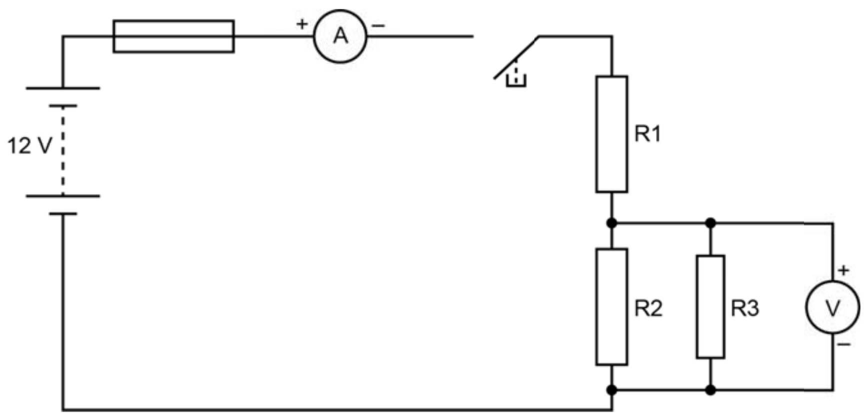
- ensure proper ventilation
- no naked flames
- protective glasses and clothing when working with a wet cell
- keep wet cells upright and avoid excessive vibration
- check for leaks
- take care when using spanners/screwdrivers near terminals (risk of short circuit)
- take care when lifting or manual handling.

This was an area of strength displayed by students. Responses showed that they are well aware of the safety precautions to be followed in the use of lead-acid batteries.

Question 3
Calculations required in parts b. and c. were not done correctly by the majority of students. Students should be able to compare calculated values to expected values in order to make judgments.

Question 3a.

Marks	0	1	2	3	4	Average
%	22	12	11	31	23	2.2



Some students used the meter connection or polarity incorrectly.

Students need to understand the proper connection of meters to take current or voltage measurements. This is a very important basic skill required of an electronics technician.

Question 3b.

Marks	0	1	2	3	4	Average
%	64	3	12	7	13	1.1

RT = R1 + R2//R3
RT = 270 + 280 = 550 ohms
Ammeter reading = I = 12/550 = 21.8 mA
Voltmeter reading = V = 21.8m × 280 = 6.1 V

Some marks were awarded if the working was correct but the student used the wrong values for the total resistance, or if the incorrect current value from the ammeter reading was used to calculate the voltage.

Question 3c.

Marks	0	1	2	Average
%	61	7	32	0.7

$$I = \frac{V}{(R_1 + R_2)} = \frac{12}{(270 + 560)} = \frac{12}{830}\,A = 14.5\text{ mA}$$

Some marks were awarded if the working was correct but the student used the wrong resistance value.

Question 4a.

Marks	0	1	Average
%	75	25	0.3

Component 7805 is a voltage regulator that changes the +12 V to a constant +5 V.

Component 7805 is a major component of a simple power supply circuit. Students' understanding of power supplies needs to be improved.

Question 4b.

Marks	0	1	Average
%	31	69	0.7

As the temperature rises, the thermistor resistance decreases.

The majority of students read the graph correctly and gave the trend in resistance.

Question 4c.

Marks	0	1	2	3	Average
%	56	27	2	15	0.8

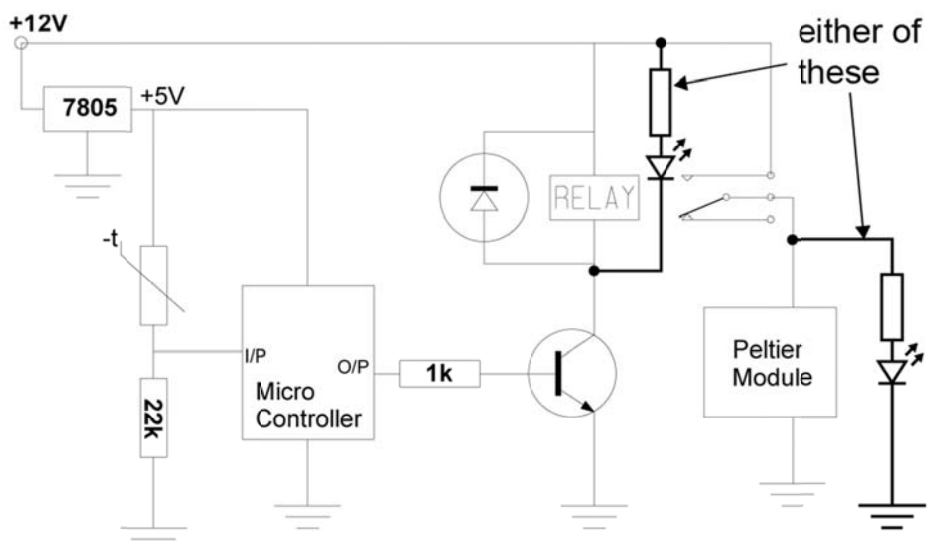
At 10 °C, the thermistor resistance is 2k ohms.

The voltage at the input of the microcontroller is $V = 5 \times 2k/4k = 2.5$ V.

Performing calculations was an area of weakness for students.

Question 4d.

Marks	0	1	2	3	Average
%	61	31	5	3	0.5



Many students connected the LED with the correct polarity but struggled to modify the existing circuit. Modifying an existing circuit is a skill required by electronic technicians and should be developed.

Question 5

The majority of students understood the factors causing power loss in a cable.

Question 5a.

Marks	0	1	2	Average
%	81	1	17	**0.4**

R = V/I R = 20/20 = 1 ohm

The majority of students struggled to work out the resistance. Students are reminded that cables have resistance. Taking cable resistance into consideration is a skill required in troubleshooting.

Question 5b.

Marks	0	1	2	Average
%	76	1	22	**0.5**

$P = V \times I = 20 \times 20 = 400W$

Question 5c.

Marks	0	1	2	Average
%	32	44	24	**0.9**

- long cable run and wire too thin
- resistance in a cable join

Question 5d.

Marks	0	1	Average
%	60	40	**0.4**

Use a heavier gauge wire, move the pump closer to the power source or check all cable joins for resistance.

Many students suggested using a higher voltage source; however, this is a dangerous solution and only licensed electricians are permitted to do this. No marks were awarded for answers such as this.

Question 5e.

Marks	0	1	2	Average
%	33	19	48	**1.2**

Cable length, cross-sectional area of wires, resistivity of conductor material (temperature was not accepted as it is not a property of the cable)

Question 6

The majority of students did not perform well in part a. but scored some marks for partially correct answers. Students performed well on part b. It is important that students are able to represent the logic function of a gate so that the knowledge can be applied to create a circuit from requirements or to modify any circuit.

Question 6a.

Marks	0	1	2	3	4	Average
%	61	7	15	6	11	**1**

Logic function $X = \overline{\overline{\overline{A} + B} + \overline{C}}, \quad X = \left(\overline{A} + B\right) \bullet C$

Question 6b.

Marks	0	1	2	3	4	Average
%	6	9	23	24	38	**2.8**

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

Question 7

Parts a. to d. were answered well by many students, which indicated that they have a fundamental understanding of how a counter works and that they are able to understand and interpret circuit diagrams correctly. However, students did not respond well to part d. Although edge-triggered devices are common, students should learn about both level and edge-triggered flip flops and how to distinguish between them.

Question 7a.

Marks	0	1	Average
%	59	41	**0.4**

Logic 1

Question 7b.

Marks	0	1	Average
%	95	5	**0.1**

The reset is kept at logic level 0 until the reset button is pressed.

Question 7c.

Marks	0	1	Average
%	80	20	**0.2**

6 laps

Question 7d.

Marks	0	1	Average
%	80	20	**0.2**

A and D

Question 7e.

Marks	0	1	2	Average
%	85	15	0	**0.2**

7ei.
The dot indicates an active low input.

7eii.
The arrow indicates that it is edge triggered on the transition from high to low.

Question 8
Students struggled with the calculations required in parts a. and b. of this question. Charging and discharging circuits have many applications in electrotechnology.

Question 8a.

Marks	0	1	2	3	4	Average
%	83	4	8	1	5	0.4

8ai.
Answer = 20 mS

8aii.
V = 12v × .63 = 7.56V

Some marks were awarded if the correct value of resistance for charging was identified but the final answer was incorrect.

Question 8b.

Marks	0	1	2	Average
%	95	2	3	0.1

$\tau = 1 \times 10^{-6} \times 100 = 100\ \mu S$
5τ = time required
Answer: 500 μS

Question 9a.

Marks	0	1	2	Average
%	31	44	25	1

9ai.
Power cord safe – not frayed or damaged.

9aii.
Tip seated firmly

Question 9b.

Marks	0	1	2	Average
%	39	19	42	1.1

Resistor 1
Reason: R2 under strain, R1 is bent at 90 degrees or at a right angle

Question 9c.

Marks	0	1	2	Average
%	29	46	25	1

Two of:

- use lead-free solder
- use an exhaust fan and filter to reduce fumes
- wash hands
- use a well-ventilated area.

Question 9d.

Marks	0	1	2	Average
%	38	14	48	**1.1**

Risk: damage due to heat + ESD
Control: heat, sink tweezers, wrist strap and static mat

Question 9e.

Marks	0	1	Average
%	79	21	**0.2**

Resin acts as flux, cleans surface of copper

Question 10a.

Marks	0	1	Average
%	52	48	**0.5**

The function of T1 is to drop the voltage rom 240V AC to 12V AC

An alternative answer was that T1 is a step-down transformer.

Question 10b.

Marks	0	1	Average
%	68	32	**0.3**

Core material consists of soft iron laminations.

Copper was not accepted as a correct response.

Questions 10c. and d.

Marks	0	1	2	3	Average
%	24	11	25	40	**1.8**

10c.
Turns ratio = 240/12 = 20:1

An answer of 20 was also accepted. Ratios expressed as 1:20 were awarded partial marks.

10d.
The function of D1 to D4 is a full-wave bridge rectifier to turn AC into pulsating DC.

Questions 10e. and f.

Marks	0	1	2	3	4	Average
%	79	7	4	4	5	**0.5**

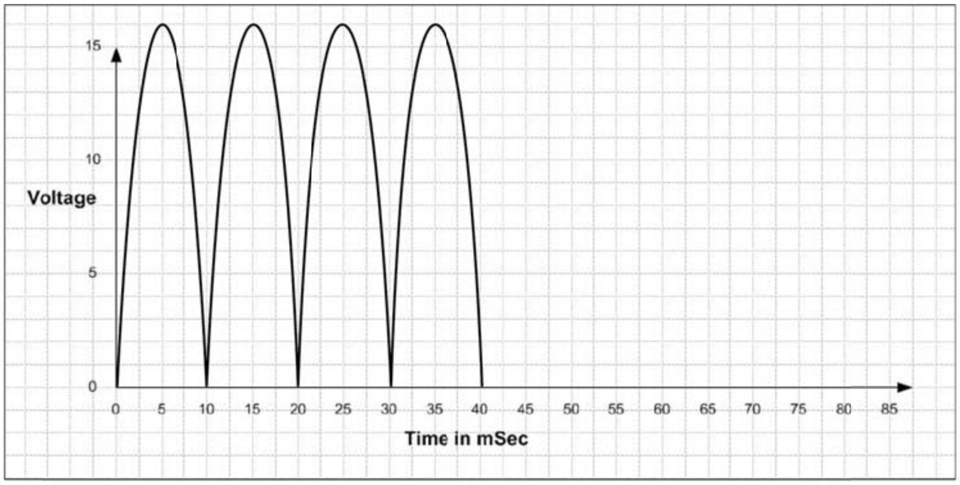
10e.

$V_p = 12 \times \sqrt{2} = 16.97\text{ V} - 1.2\text{ V} = 15.77\text{ V}$

Partial marks were awarded if the correct voltage was subtracted and then multiplied by $\sqrt{2}$.

Students struggled to complete this calculation. They did not show understanding of the relation between the peak and RMS values and where the diode drops should be subtracted. This knowledge and the ability to perform calculations are fundamental to power supply basics and should be revised.

10f.



Full marks were given if the maximum voltage was not correct but the wave shape and time was correct.