2010 VCE VET Electrotechnology: GA 2: Examination

GENERAL COMMENTS

In general, students performed well in questions on workshop safety, basic digital electronics and computer technology on the 2010 examination. Students struggled with calculations involving batteries, current and voltage.

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	6	25	66	2	1	Students should focus more on the topic of batteries during their examination preparation as this is a fundamental area of the study.
2	9	53	25	14	0	The symbols in options B and C were similar. Students must focus on components and their circuit symbols.
3	19	42	19	19	0	Students must ensure that they are able to determine the voltage and have knowledge of the current requirements for an Eletrotechnology system.
4	25	37	22	15	0	It is important that students focus on power calculations in electronic circuits as well as voltage and current calculations.
5	9	26	39	25	1	In digital electronics, binary and hexadecimal number systems are very important and areas that need to be practised. Converting to/from decimal to binary and/or hexadecimal needs to be done correctly.
6	61	9	14	15	1	Responses to this question showed that many students are familiar with converting from decimal to binary. Students should also focus on extending to hexadecimal and converting back to decimal.
7	34	12	47	6	0	
8	9	27	2	62	0	
9	9	24	41	27	0	In magnetism, eddy current loss is an important topic. As part of their examination preparation, students should focus on the factors causing these losses and how to reduce losses.
10	9	14	22	54	1	Students should concentrate on logic circuits and deriving a Boolean expression for the circuit.
11	32	15	28	24	1	
12	92	6	1	2	0	
13	36	21	33	10	1	Students are reminded that BCD is the most commonly used number system for digital displays.
14	14	3	31	51	1	
15	58	11	5	26	0	
16	3	19	59	18	1	

Question	% A	% B	% C	% D	% No Answer	Comments
17	31	34	11	24	0	Students must focus on the effect of increased and decreased resistance on the value of current in the circuit as these are practical applications of series and parallel circuits.
18	46	26	7	21	0	
19	13	70	10	7	0	
20	14	17	12	57	1	Carbon and silicon are semi conductors and are not insulators.

Section B

For each question, an outline answer (or answers) is provided. In some cases the answer given is not the only answer that could have been awarded marks.

Question 1

Marks	0	1	2	3	4	5	6	7	8	Average
%	1	2	3	5	10	2	15	0	63	6.6

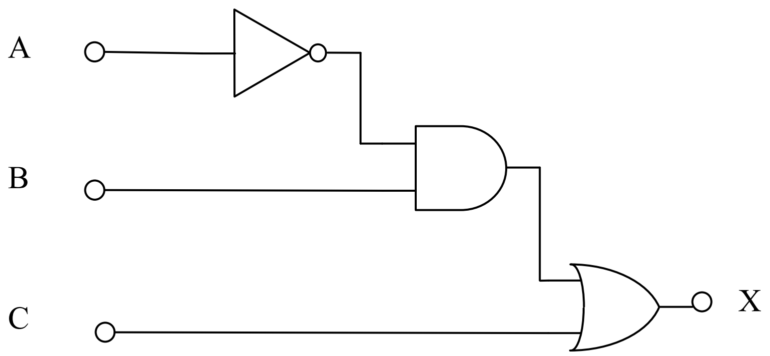
Component	Picture	Symbol
relay	**C**	**ii**
electrolytic capacitor	**D**	**i**
transistor	**A**	**iv**
light dependent resistor	**B**	**iii**

Students were required to identify the circuit pictures for the given components and 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	3	Average
%	36	9	4	52	1.7

$X = \bar{A} \cdot B + C$.



Some students tried to achieve $X = \bar{A} \cdot (B + C)$; however, this was incorrect. Partial marks were awarded if some inputs and outputs were drawn correctly. Students are reminded that all inputs and outputs need to be labelled correctly in questions such as this. The BODMAS principle also applies to logic circuits.

Question 2b.

Marks	0	1	2	3	4	Average
%	9	17	19	18	36	2.6

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

Question 3
Students needed to work out the voltage and current required by an electronic system as per the given requirements and then select a suitable battery. From the given data, the voltage requirement was 6 V and the total current requirement was 650 mA.

In Questions 3a. and 3b., many students did not seem to know the correct cell voltage or they had the voltages interchanged for alkaline and NMHi cells. Question 3c. was attempted poorly by many students. Many students performed well on Question 3d.

It is important that students understand the basics of batteries, types of batteries, cell voltage, how to calculate the number of cells required and for how long selected batteries will last.

Question 3a.

Marks	0	1	2	Average
%	68	1	31	0.7

4 alkaline cells

To determine the number of alkaline cells, students needed to know the voltage per alkaline cell, which was 1.5 V. They then needed to divide 1.5 V into 6 V to get the answer. If students gave the correct voltage per cell and used it in their calculation they were awarded one mark, even if the total voltage was incorrect.

Question 3b.

Marks	0	1	2	Average
%	82	0	18	0.4

5 NMHi cells

To determine the number of NMHi cells needed to operate the vehicle, students needed to know the voltage per cell for NMHi, which was 1.2 V. This value was then divided into 6 V to calculate the number of NMHi cells needed. If students gave the correct voltage per cell and used it in the calculation they were awarded one mark, even if the total voltage was incorrect.

Question 3c.

Marks	0	1	2	Average
%	48	20	32	0.9

Secondary cells, as they can be recharged

Students were awarded one mark if they stated that the cells were secondary but did not give a reason for their answer.

Question 3d.

Marks	0	1	2	Average
%	78	7	15	**0.4**

3.08 hours (3 hours was also acceptable)

To calculate the amount of time for which the cells would last, students needed to use the total current requirement. 650 mA is divided into 2 ampere-hours (= 2000 mA hr) to give 3.08 hours. Students were awarded one mark if 650 mA was identified and used in the calculation.

Question 3e.

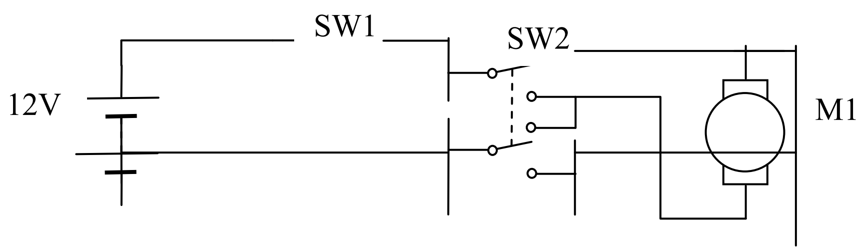
Marks	0	1	2	Average
%	35	32	33	**1**

Advantages
- rechargeable
- lasts longer
- holds voltage over discharge cycle
- are environmentally friendly

Disadvantages
- expensive
- a charger is required
- a power source is needed for charging
- less voltage per cell

Question 4a.

Marks	0	1	2	3	Average
%	19	24	24	34	**1.8**



One mark was awarded for each of the following steps:
- correct supply voltage to the poles of the SW2
- motor can rotate in one direction
- motor can rotate in the opposite direction.

Question 4b.

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

Acceptable answers included:
- transistor
- diode
- optocoupler
- motor drive
- integrated circuit chip.

Many students gave capacitor as their answer; however, this was not accepted.

Question 4c.

Marks	0	1	2	Average
%	21	33	46	1.3

SW1 – SPST
SW2 – DPDT

Some students gave answers that were not on the given list and were not awarded any marks.

Question 5
Students gave good responses for Questions 5a. and 5b; however, further focus is needed on using the correct units. It was evident that students lacked understanding of short circuits and their effects on circuit performance.

Question 5a.

Marks	0	1	2	Average
%	22	16	62	1.4

When SW1 is open, it has no effect on the given circuit. Hence the total resistance RT = R1 + R2 + R3; RT = 270 + 390 + 470; so RT = 1130 ohms.

Students needed to give the correct value and units for full marks. To gain partial marks, full working had to be shown.

Question 5b.

Marks	0	1	2	Average
%	42	13	45	1.1

Is = Vs / RT; Is = 9/1130; Is = 0.008 A or 8 mA

One mark each was awarded for the correct method and correctly calculated result with unit the included. Full marks were awarded if the incorrect value for RT from 5a. was used and the working was correct.

Question 5c.

Marks	0	1	2	3	Average
%	49	6	8	38	1.4

When SW1 is closed, the 470R resistance is shorted out. This reduces the total resistance to RT = 390 + 270; RT = 660 ohms. The new ammeter reading will now be Is = 9/660; Is = 0.0136 A or 13.6 mA.

Question 5d.

Marks	0	1	Average
%	55	45	0.5

Short circuit

Question 6
All parts of this question were answered well. Students demonstrated knowledge of safety awareness in a workshop, and the ability to foresee risks and introduce control measures. Many students knew the requirements of a good solder, and responses to Question 6b. showed that most students could use a pedestal drill safely.

It appeared that some students assumed that Question 6c. was asking them to identify a good solder point. It is essential that students read questions carefully.

Question 6a.

Marks	0	1	2	Average
%	16	12	72	1.6

Risks: solder burns, solder fumes, eye damage from solder or wire off-cuts, cuts or lacerations from tools and machines, foot damage from dropping tools, eye strain, electrocution, lead poisoning, electric shock, physical injury.

Control measures for the stated risk: safety glasses, lead-free solder, fume extraction/ventilation, protective clothing, hair nets, safety boots, safe work practices, good lighting, machine guards, circuit breaker, correct lifting procedure.

Control measures needed to be appropriate for the stated risk.

Question 6b.

Marks	0	1	2	3	Average
%	3	5	21	71	2.6

Safety precautions you would take before using a pedestal drill to drill a hole in a metal face plate include (three of):

- check for and remove loose off-cuts and swathe from around drill and floor
- inspect drill for damage
- wear correct safety gear
- ensure the drill bit is sharp and secured in the chuck
- ensure work to be drilled is secure
- make sure others are standing clear
- make sure the drill has a guard in place.

Question 6c.

Marks	0	1	2	Average
%	11	5	84	1.8

Solder joint i. is a 'bad' solder joint because:

- the solder is not covering the pad
- there is too much solder
- the solder is in a ball
- it is likely to dry the joint
- there is no connection to board.

Question 6d.

Marks	0	1	2	Average
%	6	19	75	1.7

Features of a 'good' solder joint include:

- even coverage over pad and lead
- not too much solder
- shiny
- no short circuit with other components.

Question 7a.

Marks	0	1	2	Average
%	49	4	48	1

$V_p/V_s = N_p/N_s$ $V_p = V_s \times N_p/N_s$

$V_p = 10 \times 960/80$ $V_p = 120$ V

Many students could apply the formula to calculate the primary voltage.

Question 7b.

Marks	0	1	2	Average
%	52	9	39	0.9

$I_s = V_s/R_L$; $I_s = 10/150$; $I_s = 0.067$ A or 67 mA

Some students used the value from 7a. to calculate the secondary current. If students used the correct values but gave an incorrect final answer they were awarded one mark.

Question 7c.

Marks	0	1	2	Average
%	79	3	18	0.4

$I_p = I_s \times N_s/N_p$; $I_p = 0.067 \times 80/960$; $I_p = 0.0056$ A or 5.6 mA

Many students calculated transformer current in the same way as voltage. For transformer calculations, primary voltage is secondary voltage multiplied by the turns ratio, but primary current is secondary current divided by the turns ratio. This is an area that needs further attention.

Question 7d.

Marks	0	1	2	Average
%	66	4	30	**0.7**

P = Vs x Is; P = 10 x 0.067; P = 0.67 W or 670 mW

Full marks were awarded for calculating the power correctly with units. Full marks were also awarded for using the value from Question 7b. and applying the formula with the correct units for power.

Question 8

To answer questions such as 8d., students should focus on developing their skills of applying the voltage divider formula.

Question 8a.

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

Logic level 1 or high

Question 8b.

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

Diode D1:

- dissipates current from back EMF (electromotive force) when relay coil is de-energised
- protects transistor Q1 from reverse current
- blocks reverse current
- sends current in one direction.

Question 8c.

Marks	0	1	2	3	Average
%	67	10	11	11	**0.7**

8ci.

P = V x I; P = 5 x 40 m, P = 200 mW

8cii.

The current through Q1 is 40 mA; this is the same as the current through RL1.

Question 8d.

Marks	0	1	2	Average
%	90	2	8	**0.2**

Vx = Vs x Rx/R_T; Vx = 5 x 1K/10K; Vx = 0.5 V

The correct answer involved the correct application of the voltage divider formula. The analogue input voltage at port 3 was the same as the voltage at the junction of R1 and the sensor resistance.

Question 8e.

Marks	0	1	Average
%	35	65	**0.7**

Any transducer whose output energy varies with intensity of light could be used, including:

- light dependent resistor
- photo transistor
- photo diode.

Question 9

Most of the electronic system has to interface with the real analogue values that need to be converted to digital values. Hence, an analogue to digital convertor is a key component that is used in such systems and students need to understand how they work.

There were poor responses to all parts of this question.

Question 9a.

Marks	0	1	Average
%	85	15	0.2

$2^8 = 256$ or the given value of 0.02V. Full marks were also given if 255 was used instead of 256 for levels.

The resolution can be given as the number of steps, levels or step voltage. Few students attempted this question.

Question 9b.

Marks	0	1	2	Average
%	79	2	19	0.4

Output changes from 0 to 5
Step voltage = 0.02V
Change in input voltage is 5 x 0.02 = 0.1 V

Question 9c.

Marks	0	1	2	3	Average
%	47	35	8	11	0.9

Sample Point	Analogue Voltage	Decimal Value	Binary Output
800 µSec	2.5V	125	1111101

At the sample point, the input value is 2.5V. The decimal value that is read by the analogue to digital convertor (ADC) is 2.5/0.02 = 125. This decimal value is then converted to binary.

One mark was awarded for each correct entry in the table. However, partial marks were awarded if the analogue voltage was incorrect but the binary output was correct for the decimal value written.

Question 9d.

Marks	0	1	Average
%	70	30	0.3

Analogue to digital conversion examples that were accepted include:

- sound card in a computer converts sound signal to digital
- temperature probe connected to digital multimeter converts analogue voltage to digital display
- digital multimeter converts all measured voltages and currents to digital format
- digital radio
- computer keyboard.

Question 10

The responses to Questions 10a. and 10b. showed that the majority of students need to focus more on this area of study. Some students:

- were unable to represent the data from MSB to the LSB. To answer this type of question correctly, students need to focus on number systems
- did not realise that when only seven bits (B6 to B0) are used for transmitting a character, the eighth data bit is 0
- could not convert binary to hexadecimal
- displayed poor chart-reading technique. For example, if 3H is to be read from chart, the character corresponding to 30H was chosen instead of the correct character corresponding to 03H.

Question 10a.

Marks	0	1	2	3	4	5	6	Average
%	65	6	12	5	9	1	3	1

Data	Binary number	Hexadecimal number	Character
Character 1	0110000	30H	0
Character 2	0111001	39H	9

Each correct answer was awarded one mark. Marks were awarded for the correct hexadecimal conversion from incorrect binary and correct reading of character from graph.

Questions 10b–c.

Marks	0	1	2	3	Average
%	63	22	5	11	0.7

10b.
f = 10000 BPS or 10k BPS

Transmission speed or frequency is given by $f = 1/T$; $f = 1/0.0001$ sec.

10c.
A type of serial interface that may be found on a personal computer is (any of):
- USB
- serial port
- fire wire
- SATA interface
- serial mouse port
- network connector
- Bluetooth
- modem.

This question was well answered by many students. The responses indicated that the students are keeping up with technology.