2013 VCE VET Integrated Technologies GA 2: Examination

GENERAL COMMENTS

The 2013 VCE VET Integrated Technologies examination assessed knowledge and skills in the areas of component identification, occupational health and safety (OH&S), electrical power generation, drawing interpretation, using engineering units, capacitance, single source series, and parallel and series parallel circuits. Students' understanding of DC electrical concepts could be improved. In preparation for the examination, students should review past examinations to be aware of the types of questions that may be asked.

Section B of the examination was based on DC fundamentals. Students were required to show their knowledge of engineering notation, identify resistor values, interpret a circuit description and circuit board layout, analyse a circuit containing a light-dependent resistor (LDR), use the power formula in a parallel circuit, analyse a series and parallel circuit, find series and parallel capacitance, identify hazards in a workplace, and identify the effect of wire resistance in an installation. For a number of students, basic knowledge of Ohm's law concepts, as they apply to either series or parallel circuits, needs improvement. Students need to carry out practical circuit tasks to build on their knowledge of fundamental concepts.

SPECIFIC INFORMATION

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding errors resulting in a total less than 100 per cent.

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	11	40	14	35	0	
2	30	12	38	21	0	
3	28	44	22	6	0	
4	43	47	3	7	0	
5	4	51	11	32	1	
6	33	15	27	24	1	
7	43	8	36	14	0	
8	23	9	26	41	0	
9	65	8	22	5	0	
10	10	13	15	61	1	The resistor 'pulls up' the line to the supply voltage.
11	7	11	15	67	0	A thyristor is an 'electronic' switch.
12	4	45	38	13	0	
13	4	7	25	64	0	
14	23	34	33	9	1	
15	23	13	39	24	1	
16	7	50	12	32	0	The voltmeter has very high internal resistance (ideally infinite), therefore, no current is flowing and no voltage is dropped across the lamps. All the voltage is across the voltmeter, which is effectively an open circuit.
17	4	2	94	0	0	
18	17	51	23	8	1	
19	7	31	19	44	0	
20	21	27	44	6	2	An ammeter is effectively a 'short circuit' (zero ohms), so when placed across resistor R_1 the resistance of the circuit is halved and, therefore, the current flowing will double.

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Section B

Question 1

Marks	0	1	2	3	4	5	6	7	8	Average
%	20	9	13	9	10	10	8	7	15	**3.6**

Value	Engineering notation	Value	Engineering notation
0.0556 A	**55.6 mA**	0.115 mV	**115 μV**
22 000 nF	**22 μF**	52 764 μV	**52.764 mV**
47 000 Ω	**47 kΩ**	2000 KV	**2 MV**
6 800 000 Ω	**6.8 MΩ**	0.075 W	**75 mW**

Converting a value into engineering notation proved to be a weakness for many students.

Question 2a.

Marks	0	1	2	3	Average
%	34	5	6	54	**1.8**

1 kΩ + 1.2 kΩ = 2.2 kΩ

Many students did not refer to the colour codes given to find the resistance.

Question 2b.

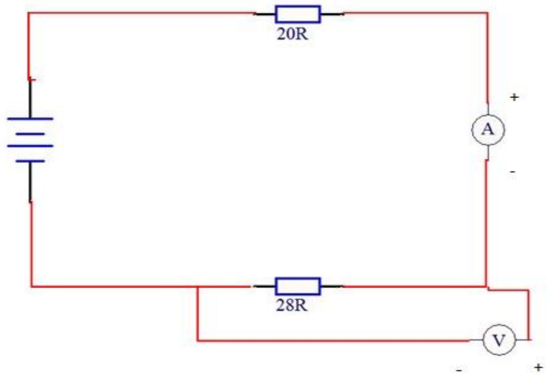
Marks	0	1	Average
%	59	41	**0.4**

5% of 2.2 kΩ = 2.09 kΩ (950 + 1140 = 2090 = 2.09 kΩ)

Many students were unable to answer this question correctly.

Question 3a.

Marks	0	1	2	3	4	5	6	Average
%	4	0	2	11	10	35	38	**4.8**



Many students performed well on this question. Some students included an extra voltmeter, but this was not required.

Question 3bi.

Marks	0	1	2	Average
%	42	16	42	**1**

I = V/R = 7/28 = ¼ = 250 mA

Question 3bii.

Marks	0	1	2	Average
%	45	10	45	1

$V_S = V_{20\,R} + V_{28\,R}$

$V_{20\,R} = I \times 20\ R = ¼ \times 20 = 5$ volts

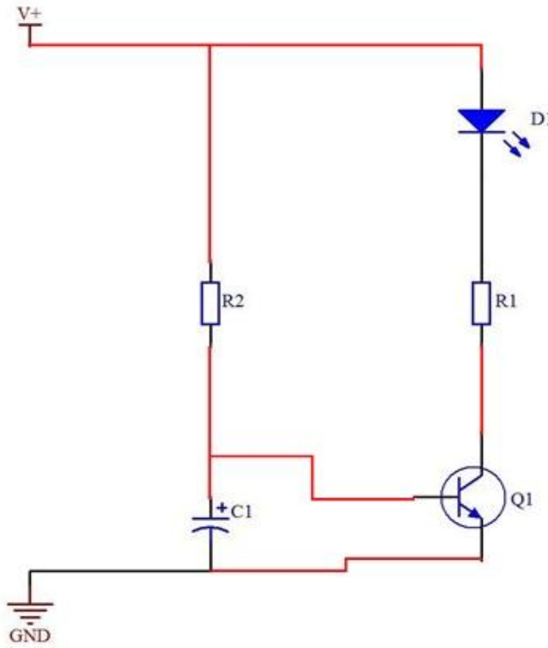
$V_{28\,R} = I \times 28\ R = ¼ \times 28 = 7$ volts

$V_S = 12$ volts

This was a basic series circuit implementing Kirchhoff's voltage law.

Question 4

Marks	0	1	2	3	4	5	6	Average
%	4	0	0	2	0	9	84	5.6



The majority of students answered this question correctly. Some students were not sure how to connect the base of the transistor to the capacitor; they drew a line to the middle of the capacitor symbol.

Question 5a.

Marks	0	1	2	Average
%	55	5	41	0.9

As the light on the LDR (R_1) increases, the resistance of the LDR decreases. The voltage across resistor R_2 increases and the output voltage of the amplifier increases.

Question 5b.

Marks	0	1	2	3	Average
%	38	38	16	8	0.9

400 lm: $R_{LDR} = 2\ k\Omega$ ($12\ V \times R_2 \div (R_1 + R_2) = 12 \times 150 \div 2150 = 837.2$ mV)

OR

$R_{tot} = R_{LDR} + R_2 = 2150\Omega$, $I = V_s \div R_{tot}$, $12 \div 2150 = 5.58$ mA

$V_{in} = R_2 \times 5.58 \times 10^{-3}$ $150 \times 5.58 \times 10^{-3} = 837$ mV

Many students could not interpret the graph of an LDR and apply the result to a basic series circuit (a voltage divider).

Question 5c.

Marks	0	1	2	3	4	Average
%	79	14	1	2	3	0.4

$V_{in} = 10.9 \div 10 = 1.09$ V

Students could use voltage divider rule to find R_1 resistance or find the current I flowing through R1 first:

$R_1 = (150 \times 12 \div 1.09) - 150\ \Omega = 1.5\ k\Omega$

from graph light intensity = 550 lm

OR

Find $I = V_{in} \div R_2 = 1.09 \div 150 = 7.27$ mA

$R_1 = (V_s - V_{in}) \div I_{R_1} = (12 - 1.09) \div 7.27 \times 10^{-3}\ \Omega = 1.5\ k\Omega$

from graph light intensity = 550 lm

This was a basic series circuit, but students were unable to work backwards to find 1.09 V across R_2.

Question 6

Parts b., c. and d. of Question 6 highlighted that students' understanding of the applications of the power formula could be improved.

Question 6a.

Marks	0	1	Average
%	71	29	0.3

0 volts

Students' answers to this question showed a lack of understanding of electrical concepts. With the switch closed, there is zero resistance and, therefore, 0 volts across the switch.

Question 6b.

Marks	0	1	2	Average
%	55	5	40	0.9

$P = V^2 \div R = 12^2 \div 8 = 144 \div 8 = 18$ W

Question 6c.

Marks	0	1	2	Average
%	58	8	34	0.8

$I = P \div V = 50 \div 12 = 4.167$ A

Question 6d.

Marks	0	1	2	Average
%	57	5	38	0.8

$P_{tot} = P_{LP1} + P_{LP2} + P_{R_L} = 9 + 50 + 18 = 77$ W

Question 6e.

Marks	0	1	2	3	Average
%	79	3	6	13	**0.5**

Find $I_{total} = P_{tot} \div V = 77 \div 12 = 6.417$ A

Fuse size: Looking at an 'average time current curve' for a 3AG fuse, unless the components vary > 10%, a 7 Amp fuse will be fine.

Students showed limited understanding of fuse selection. Many thought a fuse was rated in watts.

Question 7a.

Marks	0	1	2	Average
%	59	16	25	**0.7**

$R_{tot} = R_1 \parallel ((R_2 \parallel R_3) + R_4) = 2\ k\Omega \parallel (500 + 500)\ \Omega = 2k\Omega \parallel 1\ k\Omega = 666.67\ \Omega$

In this series parallel circuit, some students were unable to determine what was in series and what was in parallel.

Question 7b.

Marks	0	1	2	Average
%	40	34	26	**0.9**

$I_{tot} = V_S/R_{tot} = 150 \div 666.67$ A = 225 mA

Question 7c.

Marks	0	1	2	Average
%	87	2	11	**0.3**

$V_{R_2} = V_{(R_2 \parallel R_3)} = 75$ V

Question 7d.

Marks	0	1	2	Average
%	82	8	10	**0.3**

$I_{R_3} = V_{R_3} \div R_3$ 75 ÷ 1 kΩ = 75 mA

This question was poorly answered. Students seemed unable to use conventional current flow to follow current paths through a circuit to determine what was in series and what was in parallel. Students were unable to predict the circuit's behaviour through observation.

Question 8a.

Marks	0	1	2	Average
%	63	4	33	**0.7**

$(1 \div C_{tot}) = (1 \div C_1) + (1 \div C_2) = (1 \div 2 \times 10^{-6}) + (1 \div 12 \times 10^{-6})$

$= 1.714\ \mu F$

Question 8b.

Marks	0	1	2	3	Average
%	64	5	3	27	**0.9**

$(1 \div C_{tot}) = (1 \div (C_1 + C_3)) + (1 \div C_2) = (1 \div 6 \times 10^{-6}) + (1 \div 12 \times 10^{-6}) = 4\ \mu F$

Question 8c.

Marks	0	1	2	Average
%	73	5	23	**0.5**

Non-polarised

The capacitors are in an AC circuit. Polarised electrolytic capacitors could explode due to the di-electric material reacting to the reverse voltage.

Question 8d.

Marks	0	1	2	Average
%	50	16	35	**0.9**

If the voltage rating is exceeded, the capacitor may explode because of the di-electric breakdown between plates, causing a short circuit. This, in turn, can cause injury.

Students showed limited knowledge of capacitors in a circuit, whether series or parallel. Knowledge of capacitor types and voltage ratings could be improved.

Question 9

Marks	0	1	2	3	4	5	6	Average
%	7	5	6	18	29	30	5	**3.7**

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	• cleanliness of the work area, especially around the drill • lighting level is appropriate • no oil or water on the floor • ensure appropriate personal protective equipment (PPE) is worn or available	• have area cleaned and made safe for work • wear appropriate PPE prior to proceeding to drill area	boss/sup/me
inspect and check pedestal drill for correct operation and documentation	• Are the ‘Safe Operating Procedures’ (SOP) near the drill? • Check for frayed/damaged power lead • Are the belts on the drill in good condition? • Can the work platform be raised and lowered – in good mechanical condition? • Where is the safety cut-out switch? Is it easy to use?	• check the SOP for drill operation • if the drill is unsafe, due to electrical or mechanical issues, remove from the power point and ‘tag’ the machine	boss/sup/me
method of securing job	clamp vice required to secure the job	do not carry out the job until you can secure the job	boss/sup/me
drill bit selection	• inspect drill bit to ensure it is not damaged – pitted or blunt • be careful when handling the drill bit in case of injury	if the drill bit is not serviceable, replace it	boss/sup/me

drilling holes in the aluminium plate	• Is the job secure? • no excessive drill travel • PPE (face mask, safety shoes, no loose clothing, hair net) • drill bit secured in chuck • Is the drill spinning safely when power applied? • safety switch accessible • swarf	• secure job • wear appropriate PPE • no loose clothing • remove swarf • SOP read?	sup/me
clean up	• Has drill been left in safe condition? • swarf, floor and bench area	• ensure power is off • remove swarf by sweeping or vacuuming	me

Most students were able to answer some parts of this question. As part of the practical component of their course, students would have carried out a job safety analysis (JSA) when starting a project. The need for students to be responsible in the workshop environment is highlighted through the responses accepted.

Question 10a.

Marks	0	1	2	Average
%	30	16	54	**1.3**

Any two of

- type of conductor material (its resistivity)
- length
- cross-sectional area of conductor
- size
- temperature.

Question 10b.

Marks	0	1	2	Average
%	47	8	44	**1**

$P = V \times I = 12 \times 10 = 120$ W

Question 10c.

Marks	0	1	2	Average
%	54	6	40	**0.9**

$P = \sqrt{V^2 \div R}$ $R = \sqrt{(V^2 \div P)}$ $R \sqrt{(12^2 \div 120)} = 1.2\ \Omega$

Question 10di.

Marks	0	1	2	3	Average
%	63	14	15	8	**0.7**

Cable resistance = $27 \times 10^{-3} \times 8 = 216$ mΩ

Using voltage divider rule: $V_{amp} = V_S \times 1.2 \div (1.2 + 0.216) = 10.169$ V

A voltage drop was accepted if 10 A flowing was assumed.

Voltage drop on cable @10 A = 2.16 V, therefore 9.74 V at the amplifier.

Question 10dii.

Marks	0	1	Average
%	67	33	**0.3**

No

The voltage drop across the cable is too high. The specifications state that the allowable supply voltage range is 11.1 V to 15 V, so the amplifier will not operate. To solve the problem, a power cable with a larger diameter is required or the cable length must be reduced.

This question related to the ‘resistivity’ of a conductor. Overall, the question was poorly answered. Many students did not attempt this question. Knowledge of cable selection and Ohm’s law was required to answer the question.