2014 VCE VET Integrated Technologies GA 2: Examination

GENERAL COMMENTS

The 2014 VCE VET Integrated Technologies examination consisted of two sections: Section A comprised 20 multiple-choice questions (20 marks), and Section B comprised 10 short-answer questions (80 marks), which required students to give written explanations and show working. Students were required to use correct engineering prefixes when providing answers where a value was required.

A number of students displayed a poor understanding of Ohm's law. This was highlighted in Section B questions where this fundamental knowledge was required. The inability to complete circuit connections showed that students needed more exposure to practical applications, such as measuring resistance, voltage and current in series and parallel circuits. Knowledge of the power formula and energy usage, whether supplied from an alternate energy source or an electricity supplier, was required.

SPECIFIC INFORMATION

This report provides 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 resulting in a total more or 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	22	0	17	62	0	
2	73	10	9	8	0	
3	38	31	17	14	0	
4	49	27	14	10	0	
5	1	31	21	47	0	
6	1	6	6	86	0	
7	46	17	15	22	0	The internal resistance of the voltmeter (approximately 1 MΩ) affects the meter reading.
8	14	54	8	24	0	The ammeter is a short circuit, I = 6A, voltmeter = 0
9	12	45	24	19	0	
10	88	9	0	3	0	
11	21	53	21	6	0	
12	4	23	71	3	0	
13	19	42	26	13	0	Stepping the voltage up by five times will reduce the power loss as the current on the wires will be five times less. As $P = I^2R$, power loss will be 25 times greater at 240 V.
14	86	4	4	6	0	
15	4	44	33	19	0	
16	24	27	1	47	0	
17	14	29	53	4	0	
18	23	12	8	56	1	
19	12	49	22	18	0	
20	28	6	24	41	0	

Section B

Some students completed Section B to a high standard. One area requiring improvement is the understanding of the application of Ohm's law, whether in a series circuit, a parallel circuit or a circuit where cable resistance affected the voltage level being supplied to a load. Students should be encouraged to develop this understanding by carrying out practical wiring tasks and using a multimeter to confirm correct operation.

Question 1

Marks	0	1	2	3	4	5	6	7	8	Average
%	4	3	9	7	13	14	10	19	22	5.3

	Component	Symbol
relay	**B.**	**7.**
LDR	**C.**	**5.**
capacitor	**I.**	**4.**
transistor	**H.**	**11.**

One mark was awarded for each correct component and each correct symbol.

Question 2

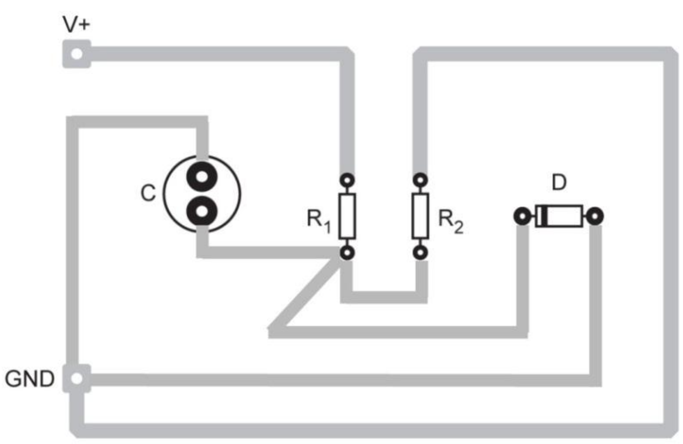
Marks	0	1	2	3	4	5	6	7	8	Average
%	24	3	12	10	18	8	13	5	8	3.4

Value	Engineering notation	Value	Engineering notation
8.2×10^5 Ω	820 kΩ	*33×10^6 pF*	33 μF
25×10^{-6} A	25 μA	*66 000 V*	66 kV
0.125 g	125 mg	*0.00357 A*	3.57 mA
5700 W	5.7 kW	*0.56 kΩ*	560 Ω

One mark was awarded for each correct engineering notation. The written form of measurement – for example, kilowatts and milliamps – was also accepted.

Question 3

Marks	0	1	2	3	4	5	Average
%	13	19	28	15	2	22	2.4



Marks were awarded for correct connections.

Question 4a.

Marks	0	1	2	Average
%	72	0	28	0.6

$P = I^2R$

$P = (50 \times 10–3)^2 \times 330$ W

= 825 mW

Question 4b.

Marks	0	1	Average
%	62	38	0.4

$V_{R1} = I \times R_1 = 50 \times 10^{-3} \times 330$

= 16.5 volts

Question 4c.

Marks	0	1	2	Average
%	62	1	37	0.8

$V_s = V_{R1} + V_{R2} + V_{R3}$

$V_{R3} = I \times R_3 = 50 \times 10^{-3} \times 560 = 28$ V

V_s = 49.5 volts

Question 4d.

Marks	0	1	Average
%	59	41	0.4

$R_2 = V_{R2}/I = 5/50 \times 10^{-3}$

= 100 Ω

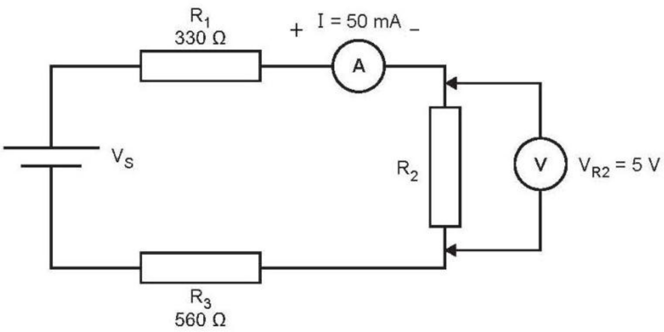
Question 4e.

Marks	0	1	2	Average
%	46	15	39	0.9

$R_{tot} = R_1 + R_2 + R_3 = 990$ Ω

Question 4f.

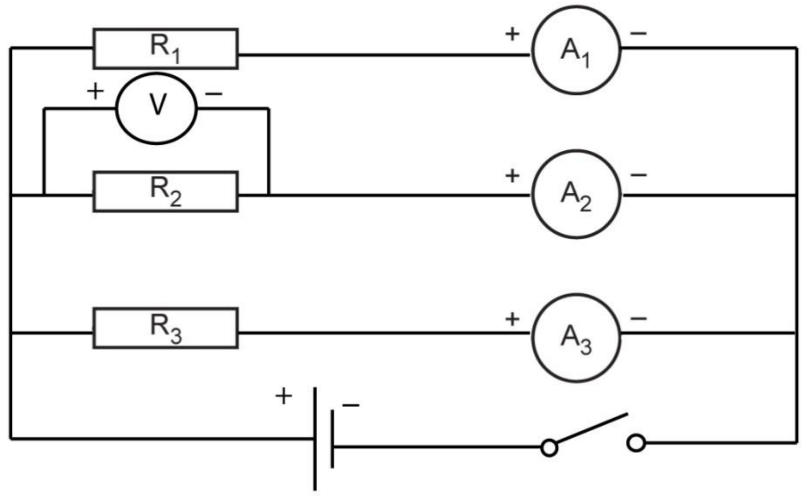
Marks	0	1	Average
%	67	33	0.4



It was evident that students' lacked understanding of the basic fundamentals of Ohm's law and the power formula.

Question 5a.

Marks	0	1	2	3	4	5	6	Average
%	10	4	21	14	19	8	24	**3.5**



The voltmeter could be connected differently, as long as it reads the voltage of R_2.

The meter polarity needed to be shown.

The correct connection for (R_1 and A_1), (R_2 and A_2) and (R_3 and A_3) should have been given, and the correct connection for voltmeter, power source and switch should have been given. The voltmeter must measure the supply voltage when the switch is closed.

Question 5b.

Marks	0	1	2	Average
%	53	4	43	**0.9**

$V_{R2} = V_{total} = 20\text{ V}$

$$I = \frac{V}{R} = \frac{20}{220} = 0.09\text{A} = 90\text{ mA } (90 - 91\text{ mA})$$

Question 6a.

Marks	0	1	2	3	Average
%	51	19	5	24	**1**

$R_{tot} = (R_3 + R_4) \parallel R_2 \parallel R_1$

$R_a = (R_3 + R_4)\text{: } = 300\ \Omega$

$R_b = R_2 \parallel R_1 : {}^1/_{Rb} = {}^1/_{R1} + {}^1/_{R2} = 150\ \Omega$

$R_{tot} = R_b \parallel R_a : {}^1/_{Rtot} = {}^1/_{Ra} + {}^1/_{Rb} = 100\ \Omega$

${}^1/_{Rtot} = {}^1/_{R1} + {}^1/_{R2} + {}^1/_{Ra} = 100\ \Omega$

Question 6b.

Marks	0	1	2	Average
%	44	7	49	**1.1**

$I_{R2} = V_s/R_2$
$= 30/300\text{ A} = 100\text{ mA or } 0.1\text{ A}$

Question 6c.

Marks	0	1	2	Average
%	71	3	26	0.6

Using the voltage divider rule:

$R_4 \times V_S/(R_3 + R_4)$

$V_{R4} = 25$ V

OR

Find I then V_{R4}:

$I = V_S/(R_3 + R_4)$ t

$V_{R4} = I \times R_4 = 25$ V

Question 6d.

Marks	0	1	Average
%	78	22	0.2

$I_{R3} = V_S/R_a$

= 30/300 A = 100 mA or 0.1 A

Question 7ai.

Marks	0	1	2	Average
%	69	11	20	0.5

T = CR

$1 \times 10^6 \times 2 \times 10^{-6}$ sec = 2 sec

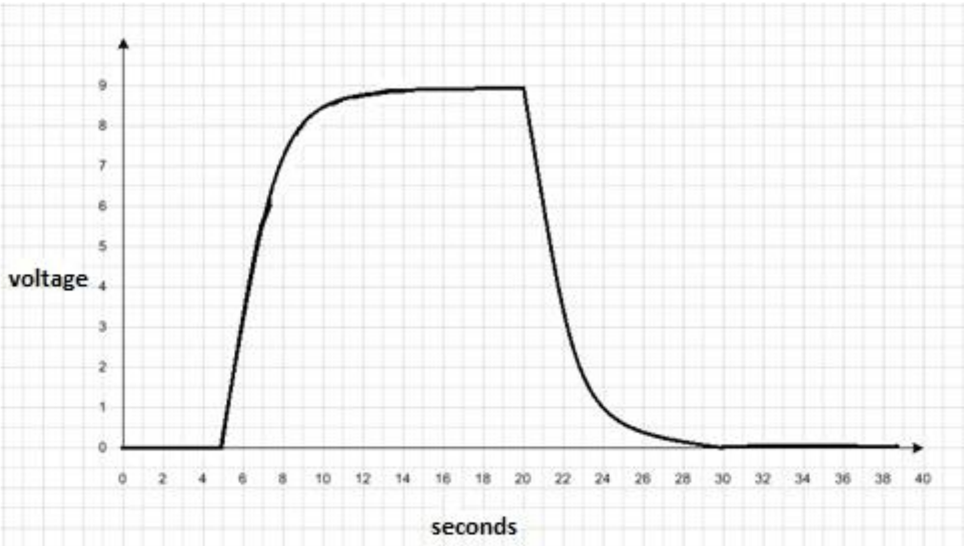
Question 7aii.

Marks	0	1	Average
%	88	12	0.1

5 time constants, 2 × 5 = 10 sec

Question 7aiii.

Marks	0	1	2	3	4	Average
%	80	10	6	2	2	0.4



Students displayed a lack of understanding of capacitor action.

Question 7b.

Marks	0	1	2	Average
%	35	0	65	1.3

$C_{tot} = C_1 + C_2 = 200\ \mu F$

Question 7c.

Marks	0	1	2	Average
%	53	6	40	0.9

$1/C_{tot} = 1/C_1 + 1/C_2$

$= 50\mu F$

Question 8a.

Marks	0	1	2	Average
%	60	26	14	0.6

Length, and cross-sectional area

Question 8b.

Marks	0	1	Average
%	65	35	0.4

It will increase the resistance.

Question 8c.

Marks	0	1	2	3	Average
%	89	6	0	5	0.2

$R_V = 100\ \Omega$ to be in the same ratio as $R_{sg}/R_2 = R_V/R_1$

$R_{sg}(0\text{ mm str}) = 200\ \Omega$

$R_{sg}/R_2 = 1$ (strain gauge at rest)

$R_V/R_1 = 1$ therefore $R_V = R_1 = 100\ \Omega$

Question 9a.

Marks	0	1	2	Average
%	54	7	38	0.9

$E = P_t$

$= 2.0\text{ kW} \times 3 \times 24\text{ h} = 144\text{ kWh}$

KW, instead of kWh, was accepted.

Question 9b.

Marks	0	1	2	Average
%	54	3	44	0.9

$$I = \frac{P}{V}$$

$$= \frac{1800}{240} = 7.5\text{ A}$$

Question 9c.

Marks	0	1	Average
%	25	75	0.8

One of:

- air conditioner
- electric hot water system.

Each of these devices will draw a current greater than 10 A.

Question 9d.

Marks	0	1	2	Average
%	35	6	59	1.3

No. These two devices draw a total of 12.9A; the power board is rated at 10A.

$P_{TOT} = 1100 + 2000 = 3100W$

$I = 3100/240 = 12.9$ A

Question 9e.

Marks	0	1	2	Average
%	42	10	49	1.1

15 A

$I = \frac{P}{V} = \frac{3600}{240} = 15$ A or 20 A fuse

Question 10a.

Marks	0	1	2	3	Average
%	76	19	3	2	0.3

Cable resistance = ρL/A, total length of active and neutral wires = 200 m
$= (1.72 \times 10^{-8} \times 100 \times 2)/(1 \times 10^{-6})$

$= 3.44\ \Omega$

Question 10b.

Marks	0	1	2	Average
%	96	2	3	0.1

Using the voltage divider rule: $3.44/(3.44 + 10) \times 240$
$= 61.43$ V

Question 10c.

Marks	0	1	2	Average
%	94	4	2	0.1

$P = V^2/R_{Loss} = (61.43)^2/3.44$ W
$= 1.01$ kW

Question 10d.

Marks	0	1	Average
%	65	35	0.4

The voltage drop on the cable could be minimised by:

- using a larger diameter cable
- using a transformer
- using a better conductor
- using a lighter load
- reducing the number of appliances.