

2015 VCE VET Integrated Technologies examination report

General comments

The 2015 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) that 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 electrical fundamentals and engineering notation. Many were unable to correctly analyse series, parallel and series/parallel circuits in Section B.

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	Comments
1	12	12	6	70	
2	4	9	48	40	Students who selected options A and B understood the concept but did not identify the keyword 'imbalance' in option C.
3	63	13	17	6	
4	12	12	66	10	
5	6	48	9	38	
6	29	24	13	33	Students needed to refer to the formula sheet to determine the capacitance value of the capacitor shown.
7	17	27	17	39	The neutral wire colour in an extension lead is blue (option A).
8	9	35	45	11	

Question	% A	% B	% C	% D	Comments
9	32	4	23	41	The choice of option A showed a lack of understanding of the function of an IR tester.
10	28	22	28	22	Students need to use an IR tester to test for insulation breakdown.
11	80	5	6	9	
12	4	60	23	13	
13	16	70	7	7	
14	72	7	11	10	
15	17	52	15	16	When the switch is closed, the lamp 'loads down' the circuit, causing the voltmeter reading to fall and the lamp to glow dimly.
16	21	12	57	10	The device is a varistor, also known as a 'voltage dependent resistor', and is used as an overvoltage protection device. It is not adjustable.
17	27	17	55	1	No current is flowing, so there is no voltage drop across the resistor.
18	17	33	38	12	
19	11	48	22	20	
20	1	67	4	28	

Section B

Some students completed Section B to a high standard. Students need to develop basic analytical skills in series, parallel and series/parallel circuits. Students also need to be competent in the practical use of multimeters and insulation testers. Students' understanding of Ohm's law, power formulas, Kirchhoff's voltage and current laws requires improvement.

Question 1

Marks	0	1	2	3	Average
%	10	36	33	21	1.7

	Item	Why it was selected
1.	side-cutting pliers	to cut the leads/wires
2.	safety glasses	to protect from flying swarf/effects
3.	long-nose pliers	to bend/hold wire and components

Question 2

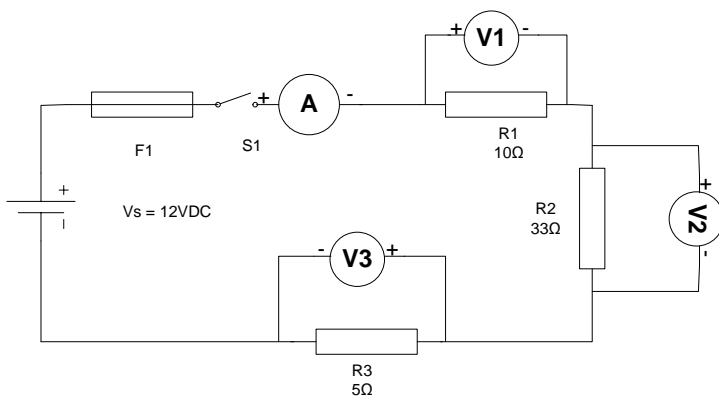
Marks	0	1	2	3	4	5	6	7	8	Average
%	29	1	13	11	7	10	6	14	8	3.4

Value	Engineering notation	Value	Engineering notation
100 000 V	100 kV	0.0001 A	100 μ A
0.00005 F	50 μ F	64 000 $\times 10^6$ B	64 GB
600 000 Hz	600 kHz	0.15 $\times 10^4$ Ω	1.5 k Ω
19 000 W	19 kW	2.44 $\times 10^{-8}$ Ω/m	24.4 n Ω/m

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

Question 3a.

Marks	0	1	2	3	4	5	6	Average
%	16	2	6	8	6	12	50	4.2



Question 3b.

Marks	0	1	2	Average
%	65	11	24	0.6

$R_{total} = 48 \Omega$, $I = 250 \text{ mA}$, $P_{R2} = 2.06 \text{ W}$; therefore, the power rating for $R_2 > 2.06 \text{ W}$; for example, 5 W

Question 3c.

Marks	0	1	Average
%	46	54	0.6

300 mA

Question 3d.

Marks	0	1	Average
%	32	68	

Band 1	Band 2	Band 3	Band 4
green	black	gold	gold

As gold was not listed as a multiplier on the formula sheet, the following variations were accepted:

- green, black, black, gold
- black, green, black, gold
- black or green in the first two bands
- black, black, green, gold.

Question 4a.

Marks	0	1	2	3	Average
%	76	2	3	19	

$$V_{R_1} = V_S - V_{D_1} = 24 - 3.7 \text{ V} = 20.3 \text{ V}$$

$$R_1 = \frac{V_{R_1}}{I_1} = \frac{20.3}{20 \times 10^{-3}} \Omega = 1.015 \text{ k}\Omega (1 \text{ k}\Omega)$$

Question 4b.

Marks	0	1	2	Average
%	37	13	50	

$$I_{R_3} = \frac{V_S}{R_3} = \frac{24}{1.8 \times 10^3} \text{ A} = 13.33 \text{ mA}$$

Question 4c.

Marks	0	1	2	3	Average
%	63	8	5	24	

$$I_s = I_1 + I_2 + I_{R_2}$$

$$I_{R_2} = \frac{V_S}{R_2} = \frac{24}{220} \text{ A} = 109.09 \text{ mA}$$

$$I_s = 20 + 13.33 + 109.09 \text{ mA} = 142.42 \text{ mA} (142 \text{ mA})$$

Question 4d.

Marks	0	1	2	Average
%	53	22	26	

$$P_{total} = \frac{V_S}{I_s} = \frac{24}{142.42 \times 10^{-3}} \text{ W} = 3.42 \text{ W}$$

Question 5a.

Marks	0	1	2	3	4	Average
%	56	1	14	3	25	1.4

$$R_{total} = ((R_1 + R_2) \parallel (R_4 + R_5)) + R_3$$

$$R_{total} = ((100 + 56) \parallel (1000 + 560)) + 33 \Omega$$

$$R_{total} = ((156) \parallel (1560)) + 33 \Omega$$

$$R_{total} = 141.818 + 33 = 174.82 \Omega$$

Question 5b.

Marks	0	1	2	Average
%	49	28	23	0.8

$$I_s = \frac{V_s}{R_{total}} = \frac{15}{174.82} A = 85.8 \text{ mA}$$

Question 5c.

Marks	0	1	2	Average
%	87	4	10	0.3

$$I_1 = \frac{(V_s - V_{R_3})}{(R_1 + R_2)} A$$

$$\text{find } V_{R_3} : V_{R_3} = I_s \times R_3 \therefore V_{R_3} = 85.8 \times 10^{-3} \times 33 V = 2.83 V$$

$$I_1 = \frac{(15 - 2.83)}{(56 + 100)} A = 78 \text{ mA}$$

Question 5d.

Marks	0	1	2	Average
%	71	8	20	0.5

$$V_{R_3} = I_s \times R_3 = 85.8 \times 10^{-3} \times 33 V = 2.83 V$$

Question 6ai.

Marks	0	1	Average
%	57	43	0.5

Flexible and low resistance, noise reduction, shielding

Question 6aii.

Marks	0	1	Average
%	59	41	0.4

Good contacts, do not corrode (tarnish) – high conductivity

Question 6bi.

Marks	0	1	Average
%	66	34	

Interference from electrical machines, electromagnetic radiation

Question 6bii.

Marks	0	1	Average
%	83	17	

Using twisted wire pairs, shielding of cables with a grounded outer sheath

Question 7a.

Marks	0	1	2	Average
%	68	3	29	

Materials	Resistivity (ρ) at 20 °C ($\Omega\cdot\text{m}$)	Rank from lowest resistivity to highest resistivity
aluminium	2.82×10^{-8}	4
copper	1.7×10^{-8}	2
gold	2.44×10^{-8}	3
iron	1.0×10^{-7}	6
tungsten	5.6×10^{-8}	5
nichrome	1.10×10^{-6}	8
mercury	9.8×10^{-7}	7
silver	1.59×10^{-8}	1

Question 7b.

Marks	0	1	2	Average
%	31	14	56	

Cross-sectional area, length, type of material, diameter, radius

Question 7c.

Marks	0	1	2	3	4	Average
%	66	21	8	1	3	

$$R = \frac{\rho \ell}{A} \quad \text{therefore} \quad \ell = \frac{RA}{\rho}$$

$$A = \frac{\pi d^2}{4} = \frac{\pi (0.5 \times 10^{-3})^2}{4} = 0.1963 \text{ mm}^2$$

$$\text{Therefore } \ell = \frac{1.8 \times 0.1963 \times 10^{-6}}{1.1 \times 10^{-6}} R_1 = \frac{V_{R1}}{I_1} = \frac{20.3}{20 \times 10^{-3}} \Omega = 1.015 \text{ k}\Omega (1 \text{ k}\Omega) = 321.3 \text{ mm}$$

Question 8ai.

Marks	0	1	Average
%	55	45	0.5

Relay K_1 will become energised when S_1 is pressed, causing a current path through S_1 , the normally closed (nc) contacts of S_2 and the coil of K_1 .

Question 8aii.

Marks	0	1	Average
%	70	30	0.3

K_{1-1} latches K_1 through K_{1-1} and the nc contacts of S_2 .

Question 8aiii.

Marks	0	1	Average
%	56	44	0.5

When S_2 is pressed, K_1 is de-energised by breaking the current path to its coil.

Question 8bi.

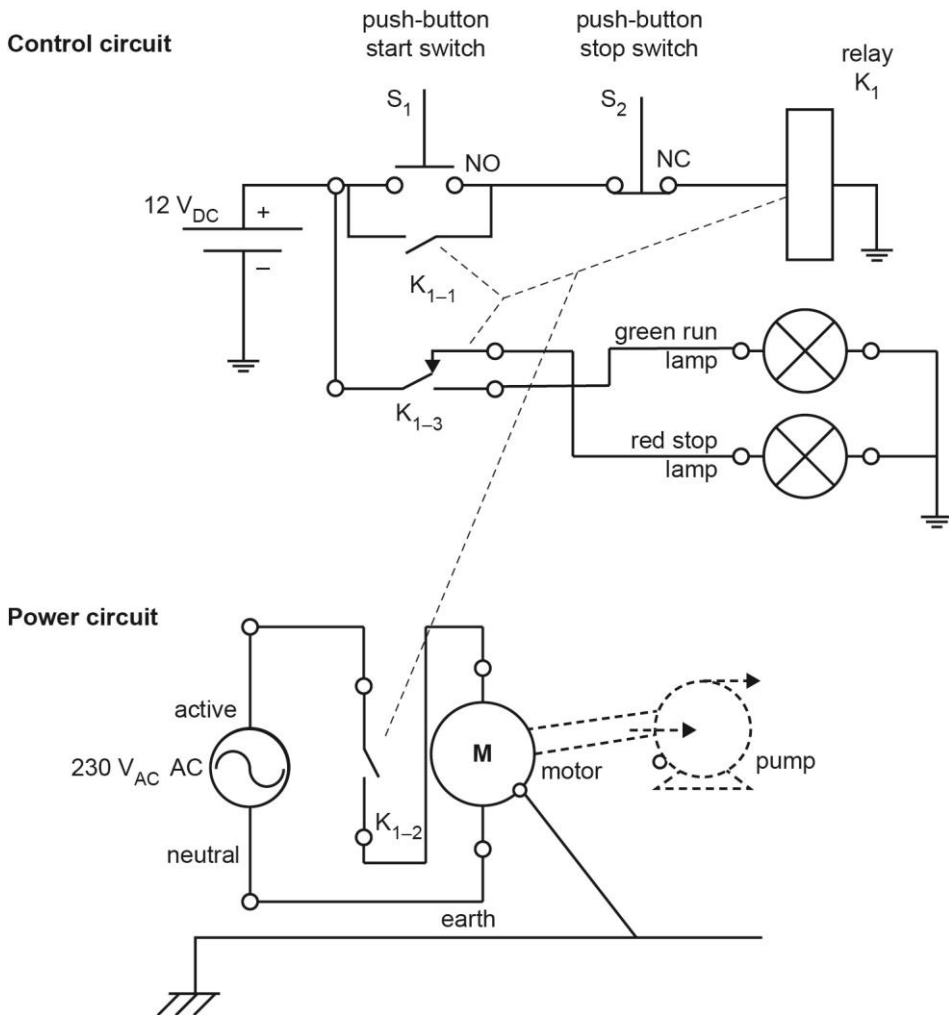
Marks	0	1	2	3	Average
%	74	2	4	20	0.7

The required connections are shown in the 'Power Circuit' diagram below.

Question 8bii.

Marks	0	1	2	3	Average
%	66	17	8	10	0.6

The required connections are shown in the 'Control Circuit' diagram below.



Question 8biii.

Marks	0	1	2	Average
%	65	0	35	0.7

Contact resistance = 500 Ω

Question 9a.

Marks	0	1	Average
%	38	62	0.6

30 μF

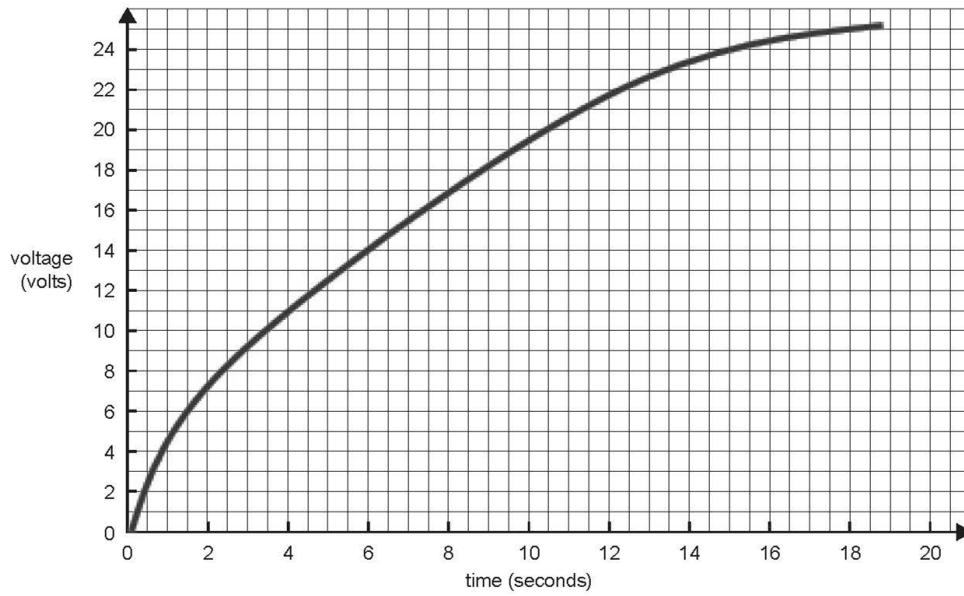
Question 9b.

Marks	0	1	2	3	Average
%	62	18	4	17	0.8

$\tau = C R = 3.6 \text{ sec}$; 5 time constants = 18s

Question 9c.

Marks	0	1	2	Average
%	74	14	11	



Question 10ai.

Marks	0	1	2	Average
%	59	11	29	

13 panels

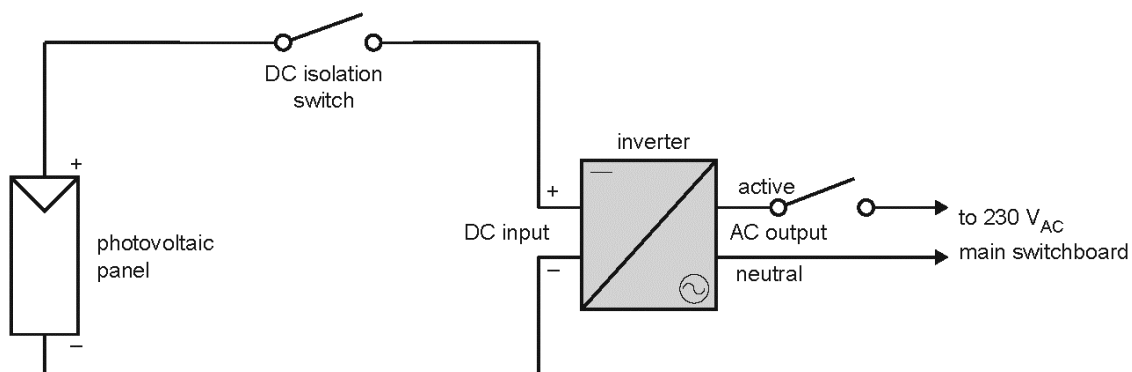
Question 10aii.

Marks	0	1	Average
%	62	38	

Series connection

Question 10b.

Marks	0	1	2	3	Average
%	47	5	23	25	1.3



Question 10c.

Marks	0	1	2	Average
%	74	10	17	0.5

$$13 \times 29.7 \times 7.59 \text{ W} = 2930.5 \text{ W}$$

Question 10d.

Marks	0	1	2	Average
%	64	14	22	0.6

$$P_{\text{output}} = \frac{0.94 \times 2930.5}{100} = 2.754 \text{ kW}$$