

2017 VCE VET Integrated Technologies examination report

General comments

The 2017 VCE VET Integrated Technologies examination consisted of two sections: Section A, which comprised 20 multiple-choice questions (20 marks), and Section B, which comprised 12 questions (80 marks) that required students to give written explanations and show working. In 2017, the revised 22289VIC Certificate II in Integrated Technologies study was assessed.

Students were required to use correct engineering prefixes when providing answers where a value was required and complete electrical circuits showing connections in some questions.

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	24	66	0	10	
2	71	0	22	7	
3	32	32	24	12	The characteristic impedance of a coaxial cable cannot be measured using an ohmmeter, which measures resistance. The impedance is made up of the resistance and the AC reactance of the cable of infinite length.
4	10	7	12	71	
5	10	78	10	2	Solder melts at around 188 °C (not °F). A general electronic temperature-controlled soldering system can heat up to 450 °C.
6	17	24	56	2	
7	71	0	2	27	
8	5	76	15	5	
9	32	0	37	32	Lead-free solder was introduced to reduce the use of lead in the environment.
10	2	0	90	7	
11	46	29	2	22	Bluetooth® functions in the ISM band 2.4 to 2.485 GHz in the ultra-high frequency radio frequency – UHF RF spectrum – which is above the high-frequency RF spectrum.

Question	% A	% B	% C	%D	Comments
12	27	0	5	68	
13	12	15	24	49	
14	2	5	90	2	
15	5	85	2	7	
16	5	2	73	20	
17	12	7	78	2	
18	2	12	54	32	
19	49	12	2	37	The circuit is connected to a DC supply of 6.5 V. The diagram does not suggest that this would be connected to an AC supply, and even if this were done, the device could not function correctly with just the rectified AC without any smoothing or filtering.
20	2	51	32	15	

Section B

Some students completed Section B to a high standard. Some students found difficulty in applying Ohm's law in a basic circuit.

Question 1a.

Marks	0	1	Average
%	73	27	0.3

The logarithmic scale is best because it is non-linear and so the graph is skewed towards the higher values and remains a workable size. Being non-linear, the graph is a good way to represent the complete data set or large range of frequencies.

Question 1b.

Marks	0	1	2	Average
%	27	23	49	1.3

Lower frequency	Higher frequency
90 Hz	5.5 kHz

Question 1c.

Marks	0	1	Average
%	44	56	0.6

The performance between 100 Hz and 1000 Hz is consistently good and relatively flat, with the dB output varying only between 95 dB and 100 dB.

Question 1d.

Marks	0	1	Average
%	59	41	

The graph shows a steep decline in performance of frequencies from 3.5 kHz to 20 kHz.

Question 2ai.

Marks	0	1	2	Average
%	38	23	38	

- the peak or maximum voltage of the waveform (V_{peak}) is 56 V – 59V
- the peak-to-peak voltage ($V_{\text{p-p}}$) is 112 V – 118 V

Question 2aii.

Marks	0	1	2	Average
%	41	1	58	

Using the V_{peak} from Question 2ai.:

$$V_{\text{RMS}} = 56 \times 0.707 = 39.59 \text{ V}$$

$$V_{\text{RMS}} = 59 \times 0.707 = 41.73 \text{ V}$$

Question 2b.

Marks	0	1	Average
%	49	51	

$$T = 2 \times 500 \mu\text{S} = 1 \text{ ms or } 1000 \mu\text{S}$$

Question 2c.

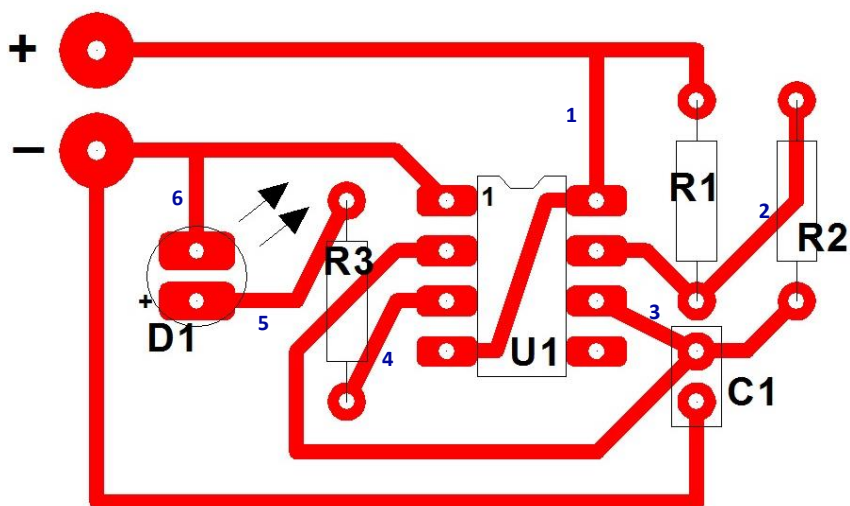
Marks	0	1	Average
%	67	33	

$$f = 1/T = 1/1\text{ms} = 1 \text{ kHz or } 1000 \text{ Hz}$$

Question 3a.

Marks	0	1	2	3	4	5	6	Average
%	33	11	15	12	7	6	16	

There were six tracks missing from the artwork. As it is a single-sided printed circuit board (PCB) artwork, no crossovers were permitted as they would result in a short circuit on part of the board, causing the finished product not to operate. The inserted tracks in the diagram below are labelled 1–6.



Question 3b.

Marks	0	1	2	Average
%	68	9	23	0.6

Time-constant for the circuit:

$$22\text{ k} + 1\text{ k} = 23\text{ k}$$

$$23\text{ k} \times 100\ \mu\text{F} = 2.3\text{ s time constant} = 2.3\text{ s}$$

Question 3ci.

Marks	0	1	Average
%	61	39	0.4

Altium, Eagle, DIYLC, Paint, Visio desktop, Arduino, Fritzing, Protel, Proteus

Question 3cii.

Marks	0	1	2	3	Average
%	51	16	20	13	1

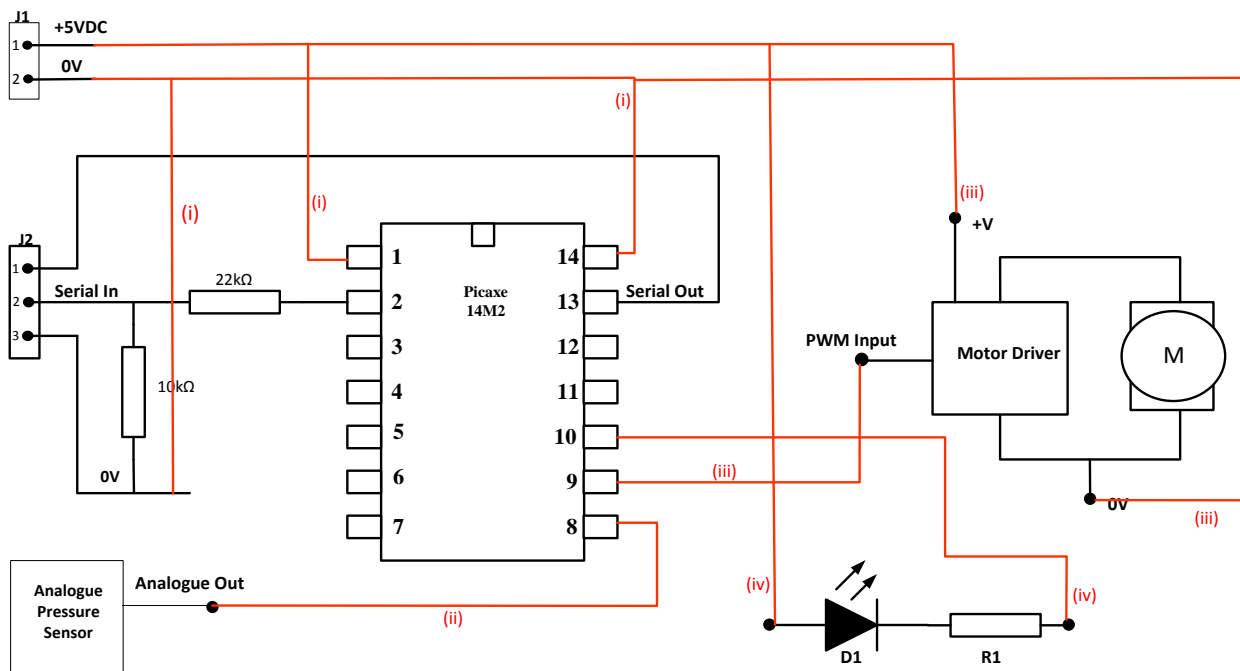
1. Draw circuit, making sure connections are correct.
2. Ensure all component values are correct.
3. Activate or simulate a test circuit.

Question 4

Marks	0	1	2	3	4	5	6	Average
%	23	21	16	20	9	9	2	2.1

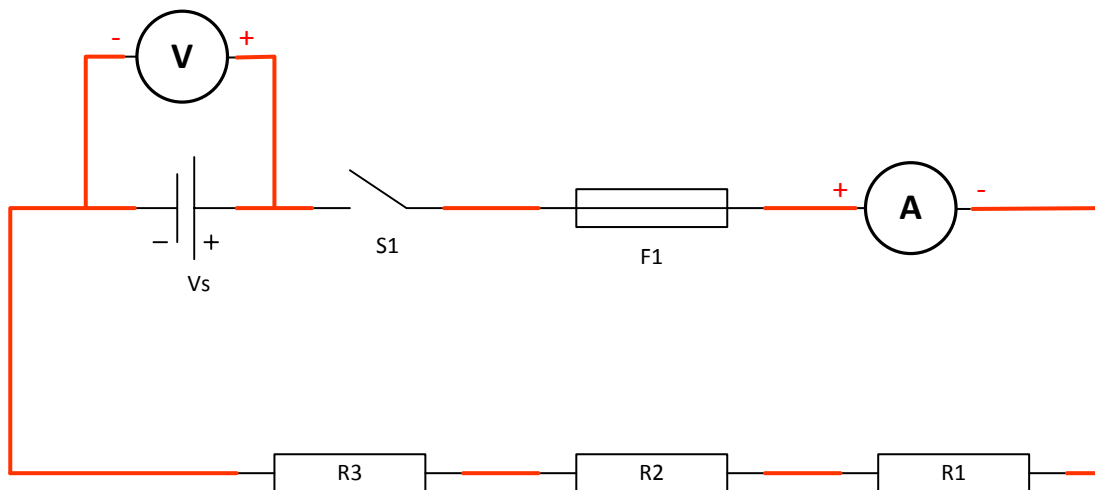
The diagram below shows the completed microcontroller system. Analogue and digital I/O needed to conform to the table for full marks.

- J_1 pins 1 and 2 – connection to all +V, 0 V, pin 1 and pin 14 of microprocessor
- analogue pressure sensor – to any one ADC pin listed in table
- pwm motor driver – pwm input to any pwm pin on micro
- LED D_1 , so that a logic '0' from the microcontroller turns the LED on



Question 5a.

Marks	0	1	2	3	Average
%	29	21	21	29	1.5



Polarities needed to be indicated on both meters, the series circuit correctly connected and the voltmeter in the correct position.

Question 5b.

Marks	0	1	2	Average
%	23	6	71	1.5

Total resistance $R_T = 56 + 39 + 10 = 105 \Omega$

Ammeter reading: $50/105 = 0.476 \text{ A}$ or 476 mA

Question 6a.

Marks	0	1	2	Average
%	34	3	64	1.3

$V = 0.95 \times 230 \text{ V}$

Voltage across motor = 218.5 V

Question 6b.

Marks	0	1	2	Average
%	69	4	28	0.6

$V_{\text{cable}} = 230 - 218.5 = 11.5 \text{ V}$

Cable resistance: $R = V/I = 11.5/15 \Omega = 0.77 \Omega$ ($770 \text{ m}\Omega$)

Question 6c.

Marks	0	1	Average
%	54	46	0.5

Increasing the cross-section of the cable or using a better conducting material in the cable

Question 6d.

Marks	0	1	Average
%	56	44	0.5

- CB_1 provides circuit protection for the motor and electrical wiring.
- CB_1 detects excessive current.

Question 7ai.

Marks	0	1	Average
%	28	72	0.7

CB_1 , S_1 , S_2 and S_3 are closed.

Power is now consumed by the lighting circuit.

$$P = 30 + 20 + 50 = 100 \text{ W}$$

Question 7aii.

Marks	0	1	2	Average
%	52	0	48	1

Current flowing from the power supply:

$$I = P/V$$

$$I = 100/12 = 8.33 \text{ A}$$

Question 7b.

Marks	0	1	2	Average
%	65	20	16	0.5

- Much more light will be produced by the 50 W of LED lighting.
- The heat produced from the 50 W of LED lighting will be much less.
- Power loss would be reduced.

Question 8a.

Marks	0	1	2	3	Average
%	48	7	4	41	1.4

Total resistance of the circuit (R_{total}):

$$R_S = 470 + 820 + 330 = 1620 \text{ } \Omega$$

$$R_P = 1/1620 + 1/100$$

$$= 618 \text{ } \Omega$$

Question 8b.

Marks	0	1	2	Average
%	72	1	27	

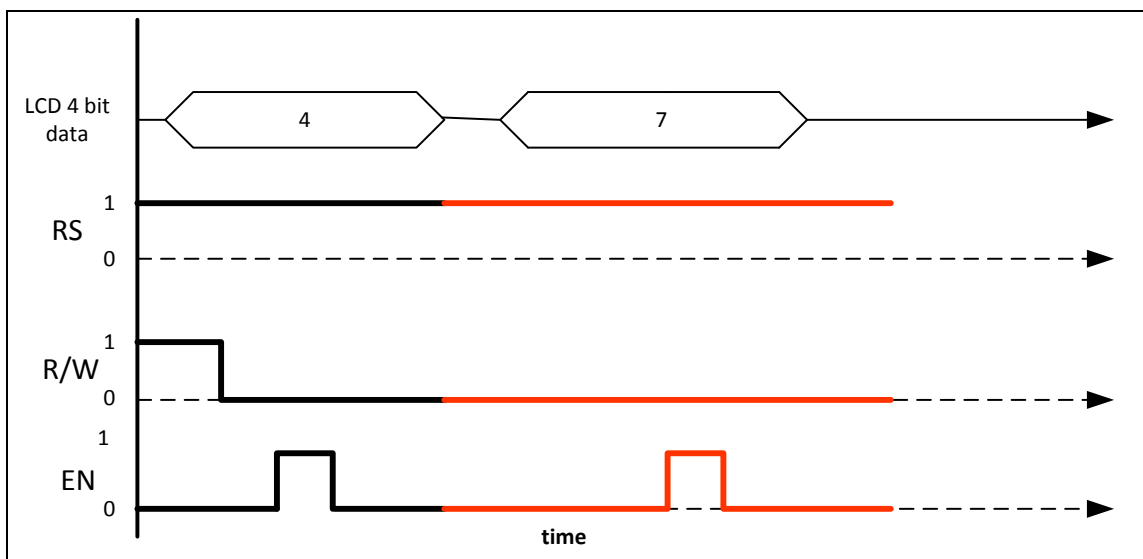
Voltage drop across resistor R_3 :

$$I = 120/1620 = 0.074 \text{ A}$$

$$V = 0.074 \text{ A} \times 820 = 60.74 \text{ V}$$

Students could also have used the voltage divider rule to find the result.

Question 9



Question 9a.

The completed timing diagram is shown above. The diagram needed to show the state of each line.

Question 9ai.

Marks	0	1	2	3	Average
%	48	12	12	28	

Note: the most significant nybble (4) has already been sent to the LCD.

RS line = 1

R/W line = 0

EN line is a pulse in the middle of the data nybble (7)

Question 9aii.

Marks	0	1	Average
%	49	51	

Byte 47H is: G.

Question 9b.

Marks	0	1	Average
%	73	27	0.3

The ports provide connection points to other external devices – inputs and outputs to/from the microcontroller.

Question 9c.

Marks	0	1	2	Average
%	32	30	38	1.1

The following are examples of types of memory used in a microcontroller system:

- RAM
- ROM
- PROM
- EPROM
- EEPROM
- flash memory
- dynamic RAM
- static RAM.

Question 9d.

Marks	0	1	Average
%	84	16	0.2

- The real-time clock chip provides calendar, time, date, etc. to the microcontroller
- 24-hour clock or alarm clock

Question 9e.

Marks	0	1	Average
%	98	2	0

- transfers the data via serial bus from transducers to a microcontroller
- allows microcontrollers and devices to communicate with each other in applications without a host computer

Question 10a.

Marks	0	1	2	Average
%	58	23	19	0.6

Possible answers included digital radios, digital TV, CD player, DVD player, computer, mobile phone.

Question 10b.

Marks	0	1	2	Average
%	85	4	11	0.3

$$11/(2^4 - 1) \times 10 \text{ V} = 7.333 \text{ V}$$

Question 10c.

Marks	0	1	Average
%	90	10	

If the 4-bit digital to analogue converter (DAC) is replaced with a 12-bit DAC a one-bit change represents a step voltage (resolution) of 2.442 mV.

$$1/(2^{12} - 1) = 1/4095 \times 10 \text{ V} = 2.442 \text{ mV}$$

Question 11

Marks	0	1	2	3	4	5	6	Average
%	26	4	6	2	2	4	56	

- scalable
 - images can be adjusted
 - vector diagrams can be rescaled
- imports component objects
 - you don't need to draw all components from scratch, so saves time
 - can reuse previously drawn components
 - can import standard/commonly used components
- relocatable toolbar
 - quicker access to software drawing tools, rather than using menus
 - vertical and/or horizontal resizable toolbars speed up circuit design work
 - allows the user to customise their workspace
- exports different file formats
 - can produce files that are compatible with printers and other software packages
 - allows for images of completed circuits to be exported to a 3D printer
 - completed circuit designs can be opened in other software
- PCB design function
 - ability to easily design printed circuit boards
- auto-route function
 - allows a design or circuit schematic diagram to be imported
 - the software designs the track paths for the circuit automatically
- simulation function
 - can test the performance of a circuit to see if it will work as designed
 - saves time and cost through simulation rather than building a circuit before testing that it works

Question 12a.

Marks	0	1	2	3	Average
%	79	7	11	2	

peak voltage is 16.3 V – 0.7 V for diode = 15.6 V

Question 12b.

Marks	0	1	Average
%	87	13	

Half-wave rectification

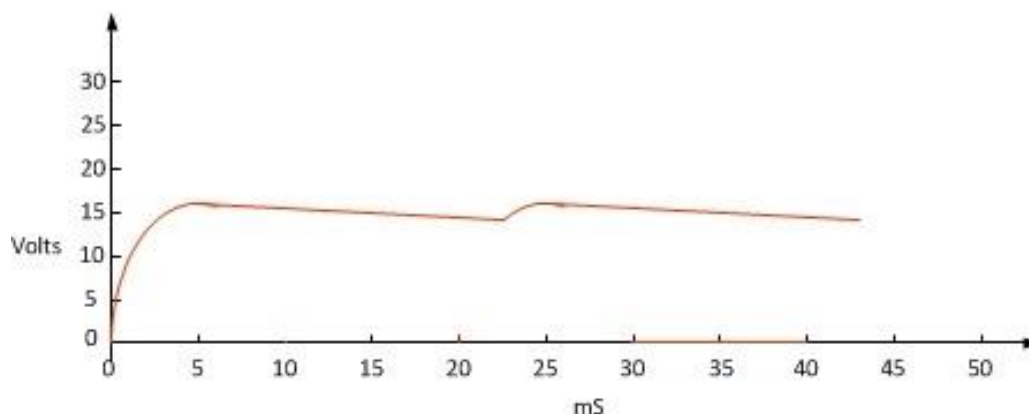
Question 12c.

Marks	0	1	Average
%	98	2	

As the input voltage waveform to the regulator is dropping to 0 V, the regulator will not regulate the voltage, so a 0 V or low voltage reading on the voltmeter would be expected.

Question 12di.

Marks	0	1	2	Average
%	88	5	7	



Expect the waveform to ramp down to 14 V approximately.

Question 12dii.

Marks	0	1	Average
%	82	18	

12 V, as long as the input voltage to the regulator does not fall below the threshold voltage required by the LM7812

Question 12diii.

Marks	0	1	2	Average
%	77	1	22	

$$I = P/V$$

$$= 1.2/230$$

$$= 5.2 \text{ mA or } 0.0052 \text{ A}$$