2021 VCE Systems Engineering external assessment report

General comments

Several questions this year highlighted the importance of reading questions carefully and answering what is being asked. For example, in Question 7 in Section B, many students did not mention cradle-to-cradle analysis even though it was specifically mentioned in the stem of the question. In other written responses correct information was given but the question was not answered.

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 resulting in a total more or less than 100 per cent.
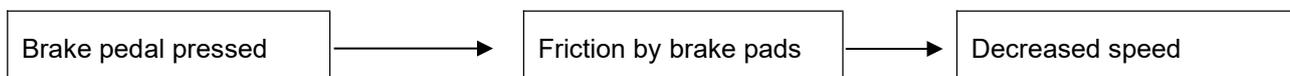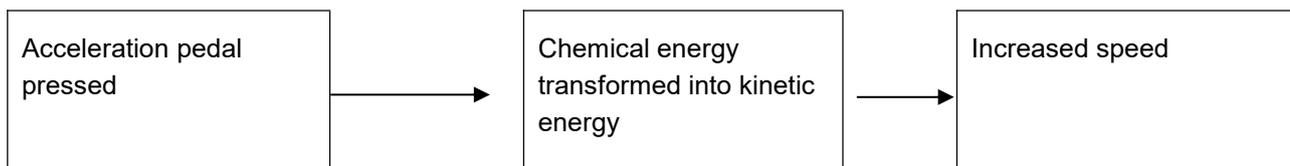
Section A – Multiple-choice questions

Question	Correct answer	% A	% B	% C	% D	Comments
1	A	72	2	14	11	$$\frac{1}{3} \times 60 = 20$$
2	C	33	2	63	2	
3	B	4	76	15	5	
4	C	1	9	56	33	There are three parts of the rope connected to the moving pulley $\frac{960}{3} = 320$ N
5	C	8	5	67	19	
6	D	14	62	12	12	Torque = force × distance 18 = 90 × d d = 0.2 m = 20 cm; d is the radius, therefore the diameter is 40 cm
7	C	10	15	67	8	
8	B	16	52	20	11	Force down is 52 × 10 = 520 N $$520 \times \frac{1}{6.5} = 80 \text{ N}$$
9	C	3	8	82	6	
10	B	26	36	12	26	The gear ratio is $\frac{number\ of\ teeth\ on\ driven\ gear}{number\ of\ teeth\ on\ driver\ gear}$ $\frac{8}{16} \times \frac{8}{24} = \frac{1}{6} =$ 1 : 6
11	B	14	61	8	17	
12	A	54	6	4	36	
13	D	28	26	3	43	
14	D	1	1	6	91	
15	D	13	25	33	28	
16	D	17	2	5	76	The counterweight provides the stability of the crane. The force down of the counterweight is mass × gravity
17	B	2	69	5	24	
18	B	9	79	7	5	
19	A	53	7	26	15	30 mA × 12 V = 0.030 × 12 = 0.36 W
20	A	93	4	2	0	

Section B

Question 1

Mark	0	1	2	3	4	Average
%	21	3	16	9	51	2.7

Acceleration pedal pressed	→	Chemical energy transformed into kinetic energy	→	Increased speed

Brake pedal pressed	→	Friction by brake pads	→	Decreased speed

Some students incorrectly gave an energy flow diagram.

Question 2

Mark	0	1	2	3	4	Average
%	31	19	4	21	25	1.9

S_1	S_2	I_1 (A)	I_2 (A)	I_3 (A)
OFF	OFF	0	0	0
ON	OFF	4	0	4
OFF	ON	0	2	2
ON	ON	4	2	6

Some students incorrectly gave voltages as answers.

Question 3

Mark	0	1	2	3	4	Average
%	67	5	9	8	12	0.9
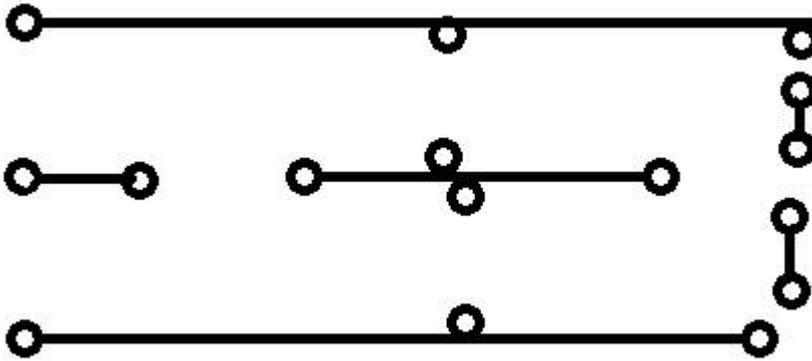
Having a component overlay was accepted but the tracks needed to be clear.

Question 4a.

Mark	0	1	2	Average
%	30	51	18	0.9

The correct answer was capacitor. It is used to reduce the ripple of the output or to filter the output.

Question 4b.

Mark	0	1	2	Average
%	45	9	46	1.0

$$\frac{V_p}{N_p} = \frac{V_s}{N_s}$$

$V_{s1} = V_{s2} = 60$ V

Question 5

Mark	0	1	2	Average
%	30	3	66	1.4

The 200 W lamp shines on the solar panel so the input is 200 W. The panel output is 10 ×15 = 150 W

$$efficiency = \frac{input}{output} \times 100\% = \frac{150}{200} \times 100\% = 75\%$$

Question 6

Marks	0	1	2	3	4	5	6	Average
%	4	7	17	27	20	23	2	3.3

The correct responses in order were:

- light dependent resistor (LDR)
- piezo buzzer or crystal oscillator
- potentiometer
- power supply, cell, battery
- switch
- photo transistor.

Question 7

Marks	0	1	2	3	4	5	Average
%	13	28	33	17	6	2	1.8

Several issues in the stem of the question needed to be addressed by the student. The town being coastal meant that it had a lot of wind energy that could be harvested. Wind is renewable and once constructed, the towers needed no other input apart from maintenance. The answer needed to refer to cradle-to-cradle analysis. Just mentioning the words were not enough. Students needed to justify the decision to use wind energy and a demonstration of the cradle-to-cradle concept was necessary. For example, the wind farm being close to the town meant that the energy did not have to be transferred far.

Other correct statements were given but to get marks, the issues in the question needed to be justified.

Question 8a.

Mark	0	1	2	Average
%	38	8	54	1.2

The correct answer was Class 2, as the load is in the middle of the effort and fulcrum.

Question 8b.

Mark	0	1	2	Average
%	77	1	22	0.4

16 + 40 = 56

Some students incorrectly used 40 as the length of the lever.
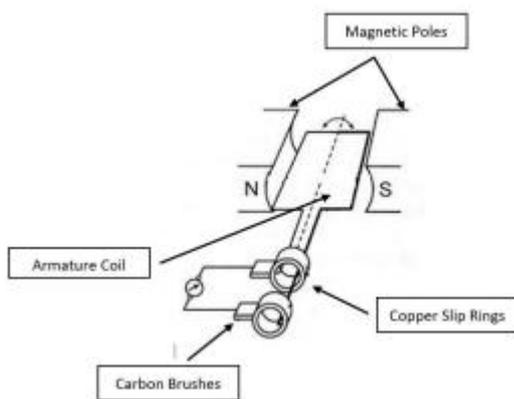
$$\frac{56}{16} \times 120 = 420 \text{ N}$$

Question 8c.

Mark	0	1	2	Average
%	21	14	65	1.4

The longer lever would increase the mechanical advantage as the ratio of the distance from the effort to pivot compared to the distance from the load to the pivot is increased.

Question 9

Mark	0	1	2	3	Average
%	2	8	24	66	2.5

Question 10a.

Mark	0	1	2	Average
%	28	20	52	1.2

The chemical energy is transformed to heat when the coal is burnt. The heat boils water and the steam produced drives a turbine, producing electricity.

Question 10b.

Mark	0	1	2	3	Average
%	45	11	26	19	1.2

A variety of technologies was accepted. One was carbon capture and subsequent storage of the carbon.

Question 11a.

Mark	0	1	2	Average
%	59	3	38	0.8

Pressure at A = pressure at B= $\frac{600}{0.5} = 1200$. Force at A = pressure at A × area = 1200 × 1.5 = 1800 N

A simpler method was to use a ratio of areas 600 × 3 = 1800 N

Question 11b.

Mark	0	1	2	Average
%	59	27	14	0.6

The correct answer was air can be compressed and the system would become spongy.

Question 12a.

Mark	0	1	2	Average
%	4	15	81	1.8

Correct answers included coal, natural gas, oil, petroleum and nuclear.

Question 12b.

Mark	0	1	2	Average
%	4	6	90	1.9

Correct answers included wind, hydroelectricity, solar power, tidal, hydrogen and wave.

Question 13a.

Mark	0	1	2	Average
%	38	23	39	1.0

Hot water and/or steam are generated from heat within the earth. The hot water or steam is then used to drive turbines to produce electricity.

Question 13b.

Mark	0	1	2	Average
%	57	19	24	0.7

The correct answer was the cost of drilling and casing the deep holes. There are no geothermal active sites close to large populations in Australia.

Question 13c.

Mark	0	1	Average
%	42	58	0.6

The correct answer was household heating.

Question 14a.

Mark	0	1	Average
%	55	46	0.4

The correct answer was spur gear, pinion.

Question 14b.

Mark	0	1	2	Average
%	50	36	14	0.6

Correct answers included space saving, gate cannot be forced due to worm gear, high torque.

Some students appeared to misread the question and gave answers in terms of rotary and linear motion.

Question 14c.

Mark	0	1	2	Average
%	66	9	26	0.6

As each tooth is 5 mm, there are 200 teeth over 1 m. The motor rotates at 300 rpm so it will take 200/300 minutes or 40 seconds.
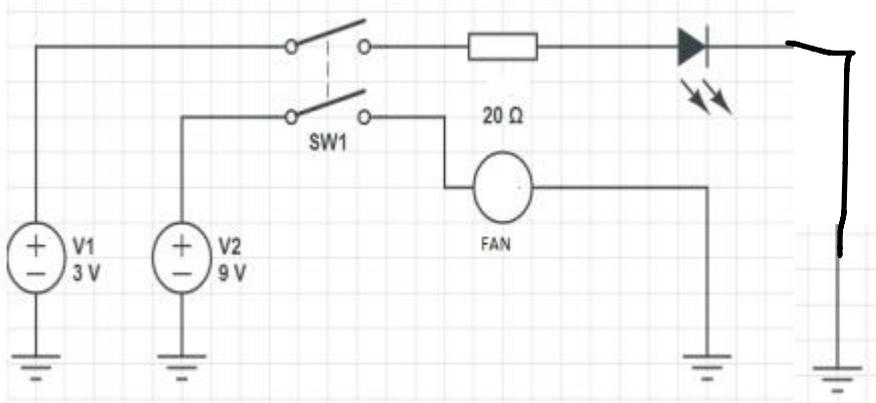
Question 15a.

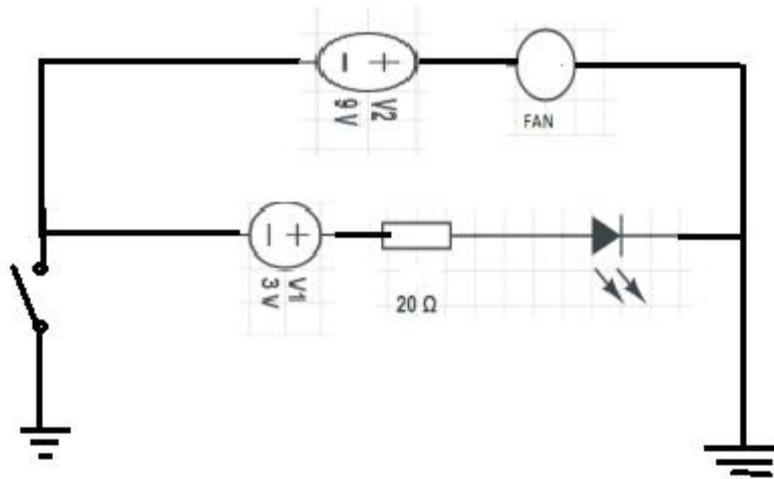| Mark	0	1	Average
%	80	20	0.2

The correct answer was double pole single throw.

Question 15b.

Mark	0	1	2	3	4	Average
%	74	7	5	5	8	0.7

Other correct responses were accepted.

Question 16a.

Mark	0	1	2	Average
%	16	29	55	1.4

The six steps as given in the study design (pages 9–10) were needed.

Question 16b.

Mark	0	1	2	Average
%	43	37	20	0.8

The correct answer was to produce an efficient, optimised quality system.

Question 16c.

Mark	0	1	2	Average
%	23	28	49	1.3

The correct answer was understanding what the system would be used for or what it will be required to do. The system should also be cost effective, as users expect both quality and value.

Question 17a.

Mark	0	1	2	Average
%	31	14	55	1.2

A correct answer was light-emitting diode (LED) lighting. It has low power consumption.

Some students gave correct statements but did not answer the question.

Question 17b.

Mark	0	1	2	Average
%	21	31	48	1.3

It is a renewable, non-polluting form of energy. Economical to run in the long term.

Question 17c.

Mark	0	1	2	Average
%	23	28	49	1.3

The panels need to be cleaned, significant cost of installation, electricity generated needs to be stored and the panels need to be located to receive light.

Question 18.

Mark	0	1	2	Average
%	72	3	25	0.5

The mechanical advantage of incline is $\dfrac{500}{3} = 166\dfrac{2}{3}$

$$\dfrac{500}{3} = 166\dfrac{2}{3} \text{ or } 167 \text{ N}$$