VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2009 Systems Engineering GA 3: Examination

GENERAL COMMENTS

The 2009 Systems Engineering examination was based on all Areas of Study in Units 3 and 4 of the *VCE Systems Engineering Study Design*. The examination was based on the key knowledge and skills of the outcomes for Units 3 and 4. Students were required to answer all questions.

There was a good spread of marks with all students achieving some success. The degree of difficulty of questions was similar across each of the main areas of the study design.

To determine the amount of detail required in a response, students should look at the number of marks allocated to a question. If one mark is allocated, a simple, straightforward answer is expected. If two marks are allocated, students should show some working or give a descriptive answer. Students are required to give answers in the correct unit where specified.

Teachers and students should note that flowcharts are a part of the study design as Question 19 in the Multiple-choice section was done very poorly.

This report should be read in conjunction with the 2009 Systems Engineering examination.

SPECIFIC INFORMATION

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	76	1	2	21	0	The gear ratio was 2:1. That is, every time the gear goes around twice, gear B rotates once. Therefore, 1500 rpm/2 = 750 rpm.
2	2	80	15	3	0	
3	40	41	11	9	0	
4	38	27	32	2	0	Ratchet and pawl is the name for the complete system. Component A is the pawl.
5	7	38	53	2	0	The gear ratio is expressed as driven: driver.
6	90	1	4	5	0	
7	10	1	2	87	0	
8	50	27	17	5	0	
9	5	86	2	7	0	
10	2	17	38	43	0	The hydrogen fuel cell uses the energy released when oxygen and hydrogen is converted to water.
11	10	57	19	14	0	
12	8	8	62	23	0	With S2 closed, the current will bypass the 6R resistor. S1 needs to be closed for any current to flow. Both S1 and S2 must be closed.
13	12	9	14	64	0	
14	12	66	13	9	0	Students should be familiar with AND, OR and NOT gates.
15	4	3	87	6	0	Students should be familiar with safety hazards in the classroom.
16	10	63	17	10	0	
17	14	4	60	22	0	
18	30	24	18	28	1	A transformer and coil both work on the principle of inductance. A capacitor basically contains two metal plates. A light-emitting diode (LED) is a semiconductor.

Question	% A	% B	% C	% D	% No Answer	Comments
19	45	31	12	12	0	The inside loop completes five loops. The outside loop completes five loops. Five lots of five is twenty-five.
20	20	74	4	2	0	

Section B – Short answer questions

Question 1

Marks	0	1	Average
%	32	68	**0.7**

The type of motion of the baggage on the conveyor belt is linear.

Question 2

Marks	0	1	2	Average
%	14	9	77	**1.7**

Calculation of the speed of the bag is:
s = d/t
5/10 = 0.5 m/s

Question 3a.

Marks	0	1	Average
%	55	45	**0.5**

The number of bags entering the conveyor must be the same as the bags leaving the conveyor; therefore, 20 bags a minute reach the far end of the transfer conveyor belt.

Question 3b.

Marks	0	1	Average
%	62	38	**0.4**

Twenty bags a minute gives one every 3 seconds. As the conveyor is moving at 2 ms^{-1}, the distance in meters between one bag and the bag following it on the conveyor belt is 6 m (3 x 2 = 6).

Question 4a.

Marks	0	1	Average
%	32	68	**0.7**

One item of test equipment that could be used to test the speed of the dispatch conveyor belt is a radar gun. There are other possibilities, such as a stopwatch.

Question 4b.

Marks	0	1	2	Average
%	33	29	37	**1.1**

A test procedure to measure the speed of the dispatch conveyor is: stand in front of the conveyor belt, aim the radar gun at a bag, press the trigger and read the speed.

As the question was worth two marks, at least two feasible steps were required. Students' answers needed to relate to the instrument named in Question 4a.

Question 5a.

Marks	0	1	Average
%	25	75	**0.8**

A potential safety hazard of the pulley and belt drive system is that clothing could get caught or the belt could fray and break.

The safety hazard must have been valid.

Question 5b.

Marks	0	1	Average
%	30	70	**0.7**

The solution to the hazard must have related to the answer given in Question 5a.

Question 6

Marks	0	1	2	Average
%	73	2	24	**0.5**

To receive full marks, the product of the gear ratio should have given 24. One possible pulley selection to achieve a pulley system with a reduction ratio of 24:1 is shown below.

	diameter
pulley 1	50 mm
pulley 2	300 mm
pulley 3	50 mm
pulley 4	200 mm

It was evident that students still have trouble with the multiplication principle of compound gears and pulleys.

Question 7

Marks	0	1	2	Average
%	56	15	29	**0.7**

Sealed bearings would be appropriate as a maintenance-free alternative. An oil reservoir or similar device was not accepted as maintenance is still required.

Question 8a.

Marks	0	1	2	Average
%	62	21	17	**0.6**

A possible solution was an idler pulley with an appropriate engagement/disengagement system.

Even though some diagrams were drawn well, the mechanism had to be functional and feasible. There were several valid solutions given to this question.

Question 8b.

Marks	0	1	Average
%	63	37	**0.4**

The operation of the mechanical engagement/disengagement system needed to be explained, such as pull the handle up or down to slacken or tighten the belt.

Question 9

Marks	0	1	2	Average
%	30	36	34	**1.1**

Circuit A would cause a short circuit. Circuit B would enable the motor to turn on and off as required.

Question 10a.

Marks	0	1	Average
%	49	51	**0.5**

Voltage Alternating Current

Question 10b.

Marks	0	1	2	Average
%	34	5	61	**1.3**

P = V x I
240 x 10 = 2400 W or 2.4 KW

Question 10c.

Marks	0	1	2	Average
%	42	5	53	**1.1**

R = V/I

240/10 = 24R or 24Ω

Question 11

Marks	0	1	2	3	Average
%	44	27	18	10	**1**

Input: electrical energy
Desired output: kinetic energy or movement energy
Undesired output: heat or sound

Many students did not read the question carefully. Instead of accepted forms of energy, some students gave devices. All of the answers needed to be forms of energy.

Question 12

Marks	0	1	2	3	Average
%	36	24	34	7	**1.1**

314 N

This was an application of F = P x A. The ability of a student to calculate the area of a circle is assumed. Any area should be in m^2 .The first step should be to change any millimetre measurements to metres.

To calculate this answer, students first needed to use the area of a circle formula (to work out the diameter of the rod), then use this area in the force equation.

Question 13a.

Marks	0	1	Average
%	42	58	**0.6**

B as it has greater mechanical advantage.

Question 13b.

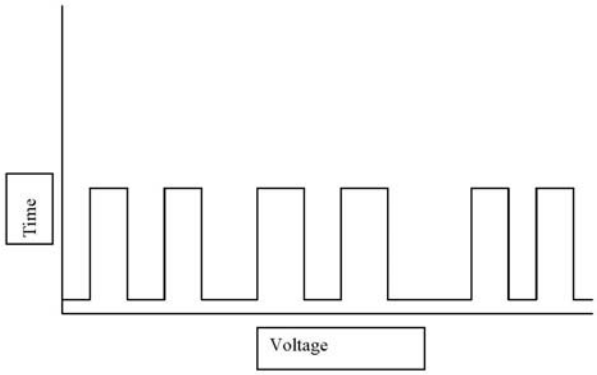
Marks	0	1	Average
%	63	37	**0.4**

The deflector arm would not move out as much.

Question 14

Marks	0	1	Average
%	51	49	**0.5**

The digital signal shown on the axis should be drawn above the axis and should be a square wave.



Question 15a.

Marks	0	1	Average
%	50	50	**0.5**

The voltage reading for the deflector to be activated is 2V.

Question 15b.

Marks	0	1	Average
%	66	34	**0.4**

The changes that would need to be made to the resistor or capacitor to decrease the time delay would be to lower the value of the resistor or lower the value of the capacitor.

This question demonstrated that many students had done little work on capacitors. Most students who attempted this question obtained full marks.

Question 16a.

Marks	0	1	Average
%	12	88	**0.9**

The arrow needed to point towards V on the multimeter.

Question 16b.

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

Circle the socket next to 10A on the multimeter.

Students did not read this question carefully. Students needed to circle the socket which was not used.

Question 16c.

Marks	0	1	2	Average
%	41	41	18	**0.8**

9V. Pin 1 is connected to the negative of the supply. Pin 8 is connected to the positive of the supply.

Question 16d.

Marks	0	1	2	Average
%	51	17	32	**0.8**

V = I x R
0.01 x 680 = 6.8V

Care needs to be taken in converting mA to A. Many students forgot to do this and only got one mark. Other students were not able to identify the series circuit.

Question 16e.

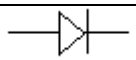
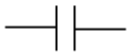
Marks	0	1	2	Average
%	37	18	44	**1.1**

R1 + R2 = 820 + 39000 = 39820Ω or 39.82kΩ

The main error students made was to not convert R1 and R2 to the same unit. Students could have worked with either unit.

Question 17

Marks	0	1	2	3	Average
%	41	25	19	15	**1.1**

Transformer	Step-up/down voltage or current	
Diode	Allows current to pass in one direction	
Capacitor	Smooths DC	

Any valid alternative for the function or component was awarded marks.

Question 18a.

Marks	0	1	2	Average
%	31	50	19	**0.9**

Question 18b.

Marks	0	1	Average
%	20	80	**0.8**

Question 18c.

Marks	0	1	Average
%	38	62	**0.7**

The environmental impact identified in Question 18a. must have been as a result of the operation of the cart. Other environmental impacts which were not from the cart were not accepted. Responses to Questions 18b. and 18c. had to relate to the impact described in 18a., for example, particulates that could affect health, carbon dioxide emissions, etc.