2014 Examination Report

2014 Systems Engineering GA 3: Examination

GENERAL COMMENTS

In the 2014 VCE Systems Engineering examination students' scores were spread across the range available. In Section A, the majority of students performed reasonably well. However, less than 50 per cent of students obtained the correct answers for Questions 5, 6, 8, 15, 18 and 20.

Students should ensure that they are careful with units when completing calculations. If the unit is not given in the answer box, students will have to provide it with their answer; for example, if the answer is 3 kW and 'kW' is not provided, submitting an answer of just 3 is not acceptable. The ability to understand diagrams and to present information diagrammatically is an important aspect of the study. Many students' diagrams were difficult to decipher. The practice of drawing diagrams should be encouraged.

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 errors resulting in a total less than 100 per cent.

Section A

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	1	4	53	41	Even though all tools can be used, a ring spanner is best.
2	4	1	1	93	
3	76	6	14	5	
4	26	60	14	0	
5	11	6	41	42	$F = P \times A$ As the pressure must be the same, due to the connecting pipe, the greater the area the greater the force.
6	9	46	23	21	The pressure must be the same in both the master cylinder and the brake cylinder due to the connecting pipe.
7	56	23	11	9	
8	12	29	37	21	Many students did not take into consideration the loss of area due to the driving rod. Others used the diameter instead of the radius in their calculations.
9	74	19	1	6	
10	6	7	56	31	
11	61	14	23	2	
12	3	27	61	10	Correct use of test equipment is essential.
13	1	78	13	7	
14	20	3	57	19	$I = \frac{V}{R}$, therefore $I = 3$ A $P = V \times I$, so P = 36 W
15	19	29	26	26	Truth tables are useful for solving these logic problems.
16	16	8	3	72	$R = 5 + \frac{8 \times 8}{8 + 8} = 9$ R
17	24	58	6	11	Researching feasibility comes before the design of the product.
18	39	11	40	10	There is no burning in a hydrogen cell.
19	5	58	16	20	$\frac{6 \text{ kWh}}{12 \text{ h}} = 500$ W
20	32	20	26	21	The D0 loop repeats 5 five times for 2 two seconds each loop. (10 seconds). D1 is repeated 4 four times. $4 \times 10 \text{ seconds} = 40 \text{ seconds}$

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Section B

Question 1

Marks	0	1	Average
%	14	86	**0.9**

Rotary motion

Question 2

Marks	0	1	Average
%	34	66	**0.7**

Anticlockwise

Question 3

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

A ratio or fraction was needed.

24:8 = 3:1

Question 4

Marks	0	1	2	Average
%	11	5	85	**1.8**

torque = force × distance = 50.0 × 0.2 = 10 Nm

Question 5

Marks	0	1	2	Average
%	25	49	27	**1**

The double-gear system allows the gears to be engaged even when the ringer rollers move apart. The rollers will always rotate in opposite directions.

Question 6

Marks	0	1	Average
%	56	44	**0.5**

Compression

Question 7

Marks	0	1	2	Average
%	22	40	38	**1.2**

As the top roller moves up, the compression spring forces the lever up so that Gear C and Gear D are in constant contact.

Question 8

Marks	0	1	Average
%	18	82	**0.8**

Hair and fingers can be caught in the wringer. Exposed gears are another danger.

Question 9

Marks	0	1	2	3	4	Average
%	8	11	23	42	16	2.5

There was some confusion about differentiating between the terms reciprocating motion and oscillating motion. The glossary in the study design defines reciprocating motion as ‘motion alternately backward and forward, or up and down, as of a piston rod’. Oscillating motion is defined as ‘circular motion in two directions – backwards and forwards’.

Component	Type of motion
rotating disc	rotary
drive rod	reciprocating
sliding yoke	reciprocating
agitator	oscillating

Question 10

Marks	0	1	Average
%	45	55	**0.6**

Replace the slide mount with bronze or roller bearings.

'Lubrication' was also accepted.

Question 11

Marks	0	1	Average
%	82	18	**0.2**

Many students suggested making the rotating disc larger, but this would have no effect on the length of stroke. The placement of the crank pin was critical. Students needed to suggest changing the distance of the crank pin on the rotating disc towards or away from the centre of the rotating disc.

Question 12

Marks	0	1	2	3	Average
%	16	19	38	28	**1.8**

Any three of the following were acceptable responses.

Type of energy	Location of type of energy
1. electrical	motor
2. kinetic	gearbox
3. sound	motor or gearbox
4. heat	in any moving part

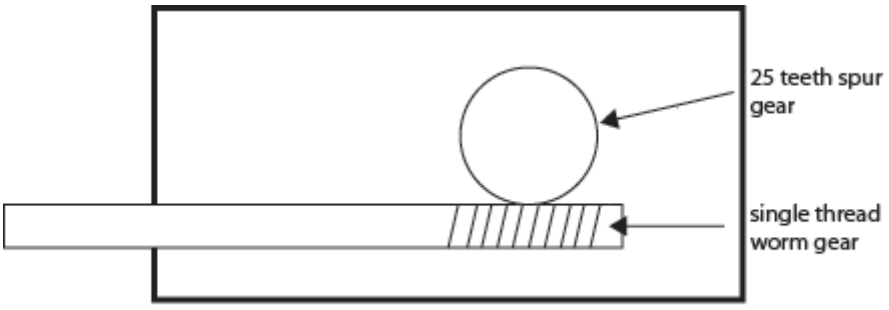
Friction is not a type of energy, it is a force.

Question 13

Marks	0	1	2	3	4	5	Average
%	32	19	22	14	7	6	**1.6**

The simplest design was to draw a single thread worm gear with a 25-teeth spur gear. Other design answers would have been to include a combination of bevel and spur gears in gear train. One possible solution is given below.

Some students did not read the question carefully and failed to see they had to design a gearbox with all components fitting within the case.



Question 14

Marks	0	1	2	3	4	5	6	7	8	Average
%	11	3	5	10	13	14	19	12	13	4.7

Possible responses are listed in the table below.

Life-cycle phases of a washing machine	Environmental cost	Method of reducing the environmental cost
1. manufacture	effects of mining of materials used to make the washing machine	use recycled materials
2a. operational energy supply	effects of coal mining (used to produce energy to operate the washing machine) greenhouse gas production	use energy-efficient machines, install solar panels or invest in carbon offsets
2b. operational water supply	use of drinking water for washing has an effect on dams and rivers	use water-efficient washing machines or use recycled water for washing
3. disposal	contributes to landfill	recycle as many parts as possible

Question 15

Marks	0	1	Average
%	29	71	0.7

Diode

Question 16

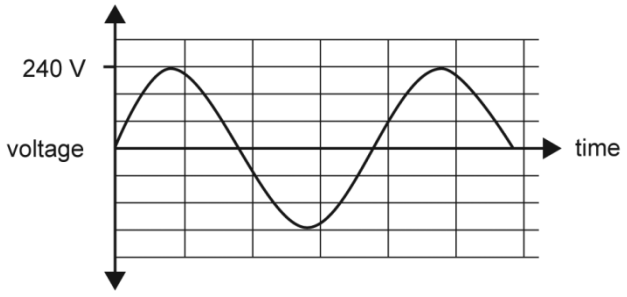
Marks	0	1	2	Average
%	44	3	53	1.1

$\frac{15}{240} = \frac{N_s}{2000}$ $N_s = 125$ windings

Question 17a.

Marks	0	1	2	Average
%	39	15	47	1.1

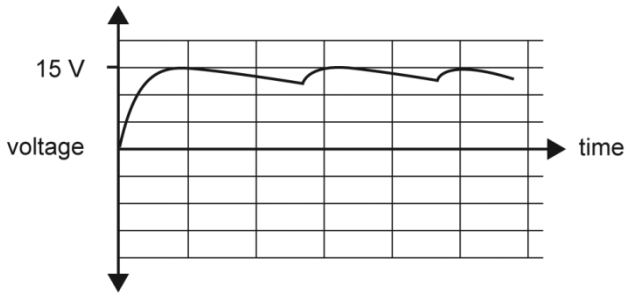
A sine wave as depicted below was required. However, as the study design does not distinguish between peak–peak AC voltage and RMS AC voltage, both answers were accepted.



Question 17b.

Marks	0	1	2	Average
%	58	23	19	**0.6**

A constant DC voltage of about 14 V was required. Students who gave a full wave rectified wave form were given one mark.



Question 18a.

Marks	0	1	Average
%	80	20	**0.2**

Ohmmeter

Simply stating 'multimeter' was not specific enough.

Question 18b.

Marks	0	1	Average
%	82	18	**0.2**

A reading of 8 ohms

Question 19a.

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

brown black black gold

Question 19b.

Marks	0	1	2	Average
%	59	1	40	**0.8**

Lowest resistance reading 9.5 ohms
Highest resistance reading 10.5 ohms

Question 20

Marks	0	1	Average
%	46	54	**0.6**

Use a heat sink or a fan.

Question 21

Marks	0	1	2	Average
%	62	10	28	**0.7**

A BD680 should be used as it is a PNP and the specifications are higher than the BD438.

Question 22

Marks	0	1	2	Average
%	11	51	38	**1.3**

Any electronic circuits in a washing machine must be protected from water. Any electronic circuits must be protected from moving parts (heat). Vibrations can damage or loosen components.

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Question 23

Marks	0	1	2	3	Average
%	43	51	3	3	0.7

The question referred to the construction of the printed circuit board. The Systems Engineering process as described in the study design needed to be followed. One possible order of the processes for the construction of the printed circuit board is given below.

Process	Order
Drill the circuit board.	5
Etch the circuit board.	4
Select the components.	2
Design the circuit board.	3
Test the circuit board.	7
Simulate the circuit.	1
Install the components of the circuit board.	6

Question 24

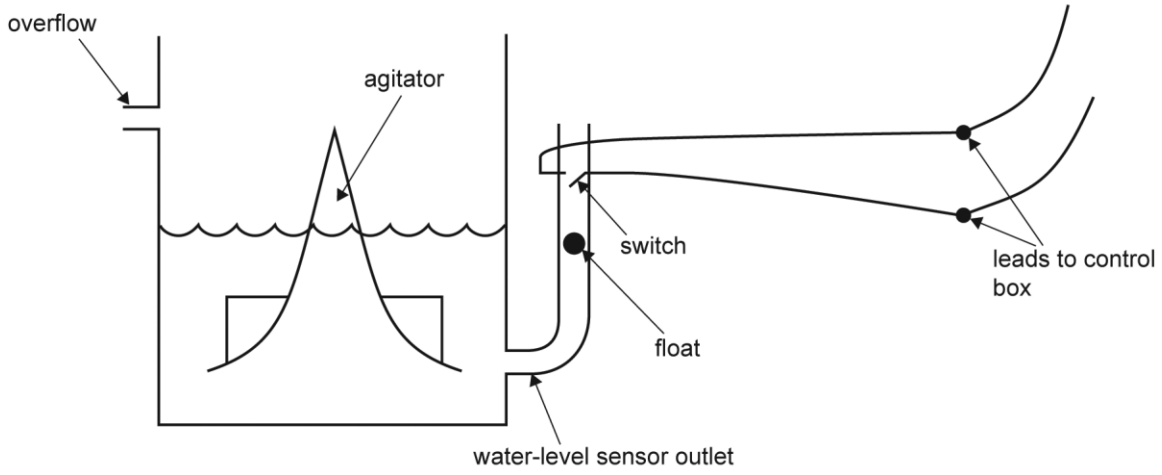
Marks	0	1	2	Average
%	9	19	72	1.7

Injury could occur when drilling or etching the circuit board.

Question 25a.

Marks	0	1	2	3	Average
%	25	29	33	13	1.4

The question asked for a water-level sensing device. Some students just placed sensors in the washing machine without designing a device. Other students did not label their device. One possible device is shown below.



Question 25b.

Marks	0	1	2	Average
%	25	37	38	1.1

As the water rises, so does the float. Just before the height of the overflow level, the float triggers a switch.

Question 26

Marks	0	1	2	Average
%	37	55	8	0.7

As the rubber impeller rotates, centripetal force forces water out. The eccentricity of the impeller causes lower pressure at the input and higher pressure at the output.

Question 27

Marks	0	1	2	Average
%	45	38	17	**0.7**

energy = power × time

620 W × 0.5 h + 160 W × 0.25 h = 350 Wh or 0.35 kWh

Care must be taken with the unit. The correct unit must be given.

Question 28

Marks	0	1	2	Average
%	36	2	62	**1.3**

$\frac{3200}{400} = 8$ hours

Question 29

Marks	0	1	2	Average
%	39	9	52	**1.2**

$0.95 \times 0.75 = 0.7125$

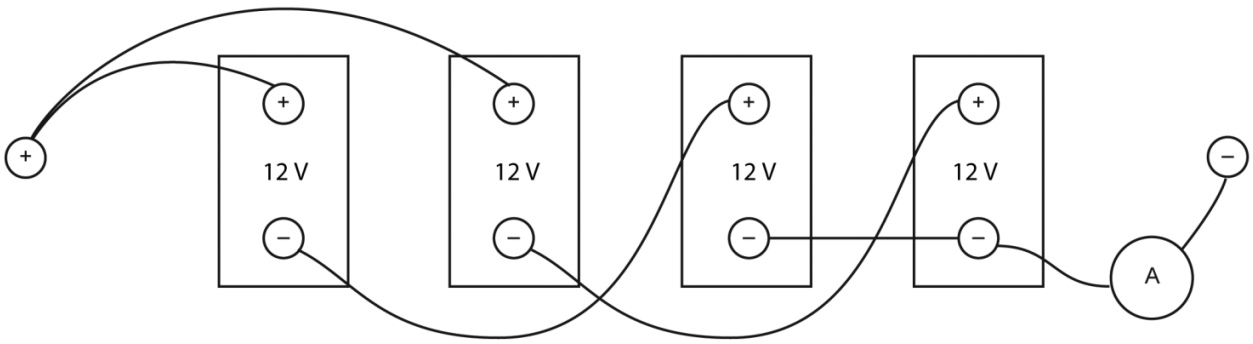
71%

Question 30a.

Marks	0	1	2	Average
%	77	4	19	**0.4**

Question 30b.

Marks	0	1	Average
%	72	28	**0.3**



Question 31a.

Marks	0	1	2	Average
%	36	31	33	**1.0**

Input devices could include a lid sensor, vibration sensor, timer or other feasible sensor to indicate the end of the cycle.

Question 31b.

Marks	0	1	2	Average
%	44	23	33	**0.9**

A water pump, buzzer or light to indicate the end of the cycle would be appropriate.

Question 32

Marks	0	1	2	3	4	5	Average
%	14	12	21	29	19	6	2.5

This question asked what issues needed to be resolved before drones could be used. Low-scoring students listed the advantages or disadvantages of drones. High-scoring students were able to explain and discuss the critical issues such as privacy, accuracy of delivery, safety and cost.