2010 Assessment Report

VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

2010 Systems Engineering: GA 3: Examination

The 2010 Systems Engineering examination was based on all Areas of Study in Units 3 and 4 of the *VCE Systems Engineering Study Design*. The examination assessed the key knowledge and skills of the outcomes for Units 3 and 4. Students were required to answer all questions.

Most students made a reasonable attempt at the examination, but significant errors were made when students did not read the questions carefully. For example, in Section A, Question 19, the question asked for a system; however, most students gave the D – feedback loop.

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	Comments
1	4	1	3	92	
2	57	24	7	12	
3	12	9	75	5	Pulley B and Pulley C were idler pulleys, so they had no effect on the drive. Therefore, 16 x 4/16 = 4.
4	44	2	12	42	
5	19	34	10	37	Many students did not take the given unit of measurement into consideration. 100N/0.001m^2 = 100 000 pa or 100 kpa.
6	42	18	16	24	Work done = force x distance, so force = work done/distance Force = 60 / 0.2 = 300N
7	61	21	15	3	The fact that a hydraulic pump was used did not affect the rate of rotation.
8	10	46	30	14	
9	2	12	7	80	
10	9	10	77	3	
11	49	40	9	3	Many students did not understand the difference between voltage and current.
12	12	10	47	31	
13	3	8	71	19	
14	11	59	16	14	Students needed to apply the transformer formula to calculate the number of output windings.
15	20	18	16	46	
16	34	8	8	50	
17	11	25	16	48	
18	16	4	48	32	
19	11	9	19	61	The system in box X was a control system, so it is a part of the feedback loop rather than the feedback loop itself.
20	39	13	37	11	The period is the time for one complete cycle. One second on, then one second off, gives a period of two seconds.

Section B – Short answer questions

Question 1

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

The response needed to explain that the forklift is an integrated system because it contains electronic/electric and mechanical/hydraulic subsystems.

Question 2

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

As the complete system requires human input, it is open loop. Stating that it has no feedback loops was also accepted.

Question 3

Marks	0	1	2	Average
%	5	38	57	**1.5**

Reasons why it is unsafe to drive a forklift while the load is raised high included:

- the centre of gravity increases so the forklift is unstable
- visibility is decreased
- raised forks could be lethal.

Question 4

Marks	0	1	Average
%	90	10	**0.1**

The distance that the 2000 N load is raised is 1 metre.

Question 5

Marks	0	1	Average
%	31	69	**0.7**

Mechanical advantage is $\frac{load}{effort} = \frac{2000}{4000} = 0.5$. This should have indicated to students that if the hydraulic cylinder was raised 500 mm, the load needed to be raised twice that amount.

Question 6

Marks	0	1	2	Average
%	28	32	40	**1.1**

Force x distance = 2000 x 0.6 = 1200 J or 1.2 kJ

Students were required to show working and to include units. A common incorrect answer was 2000 x 600 = 1 200 000 J. In making the calculation, the distance needed to be in metres (that is, 0.6 m) rather than millimetres.

Question 7

Marks	0	1	2	3	Average
%	39	34	19	8	**1.0**

Area of the piston is π x $(.075\ m)^2 = 0.01766$
Force = pressure x area = 100000 x 0.01766 = 1766 N

Students were required to show working and to include units. It was evident from students' responses that they need more practice with calculations.

Question 8

Marks	0	1	2	Average
%	38	29	32	1.0

The force will be less as the area is smaller and the hoses will move up and down but, more importantly, the pressure in the cylinder will force the load down and not up.

Question 9

Marks	0	1	2	Average
%	33	11	56	1.2

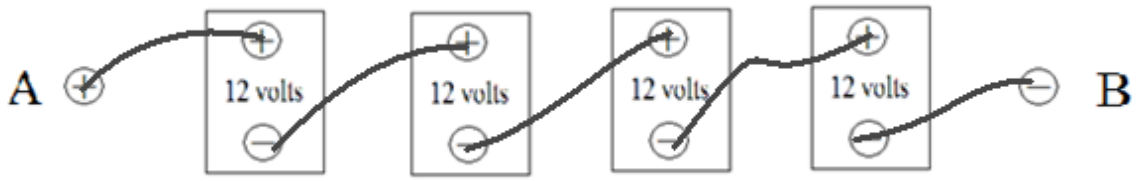
P= V x I = 48 x 200 = 9600W or 9.6kW

Students were required to show working and to include units.

Question 10

Marks	0	1	Average
%	63	37	0.4

The following is an example of a possible solution.

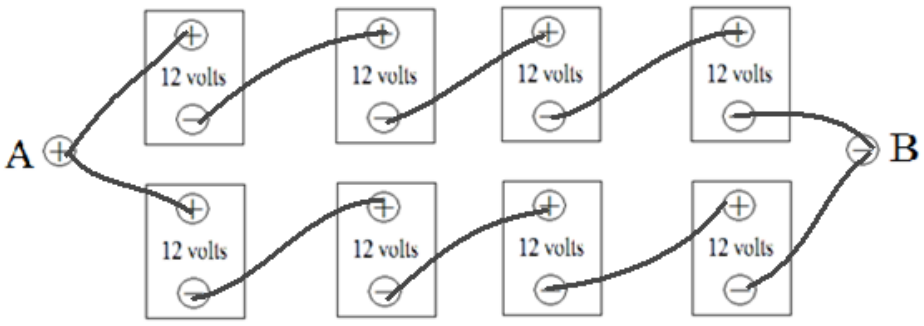


The batteries needed to be in series.

Question 11

Marks	0	1	Average
%	77	23	0.3

The following is an example of a possible solution.



Question 12a.

Marks	0	1	Average
%	19	81	0.8

The diagnostic test instrument that can be used to test the voltage output of the batteries could be a voltmeter or a multimeter. If students gave multimeter as their answer, they needed to mention the correct setting.

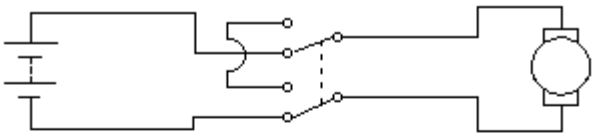
Question 12b.

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

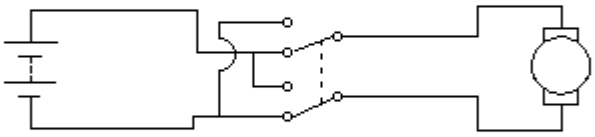
If one of the batteries is found to be open circuit, the expected reading on the test instrument is 0 volts. No current can flow so there can be no potential difference.

Question 13

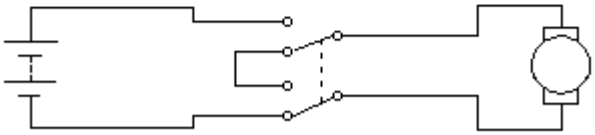
Marks	0	1	2	3	Average
%	17	17	23	43	**1.9**



The motor would be able to be switched on and off.



The motor would be able to be switched forwards and in reverse.



The motor would not operate, no matter which way the switch was turned.

Question 14

Marks	0	1	Average
%	40	60	**0.6**

Bevel gears were used in the differential assembly.

Question 15

Marks	0	1	Average
%	78	22	**0.2**

The main function of the differential is to allow the wheels to rotate at different speeds while the vehicle is turning.

Question 16

Marks	0	1	2	Average
%	33	8	59	**1.3**

$\frac{\text{Gear A rpm}}{\text{Gear B rpm}} = \frac{\text{number of teeth gear B}}{\text{number of teeth gear A}}$ gives $\frac{\text{gear A rpm}}{1000} = \frac{36}{12}$, hence the rpm of the drive shaft is 300 rpm.

Students were required to show their working.

Question 17

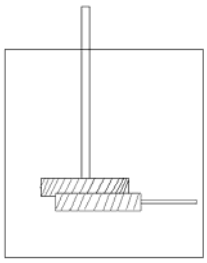
Marks	0	1	2	Average
%	62	10	27	0.7

If the axle rotates at 100 rpm and the circumference of the wheel is 1 m, the speed is 100 x 1 = 100m per minute or 1.666 m/s.

Other answers were also accepted. Students were required to show working and include units.

Question 18

Marks	0	1	2	3	Average
%	50	26	17	8	0.8



The functional gearbox to give the reduction ration of 12:1 could be a single-start worm gear with a 12-teeth worm wheel.

Question 19

Marks	0	1	2	3	Average
%	27	22	32	19	1.4

Subsystem	Input form of energy	Output form of useful energy
Solar cells	Solar energy	Electrical energy
Battery	Electrical or chemical energy	Electrical energy
Motor	Electrical energy	Kinetic energy (Mechanical energy)

Students needed to refer to electrical energy rather than electricity in their answer.

Question 20

Marks	0	1	2	Average
%	36	7	57	1.2

18% of 450 = 81 Joules

Students needed to show working.

Question 21

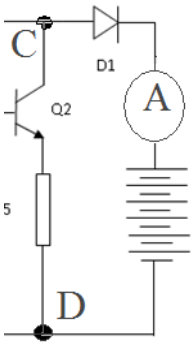
Marks	0	1	2	Average
%	41	32	27	0.9

Negative impacts on the environment of the solar cell (during its life cycle) include (two of):

- mining of raw materials
- landfill for disposal of solar cells
- pollution from the production of cells.

Question 22

Marks	0	1	Average
%	68	32	0.3



The ammeter that students drew needed to be in series with the battery between C and D.

Question 23

Marks	0	1	Average
%	51	49	0.5

The four colours in order for the register were: brown, grey, brown, gold.

Many students gave brown, grey, black, gold; however, this was incorrect.

Question 24

Marks	0	1	Average
%	40	60	0.6

The combined resistance was $\frac{330 \text{ x } 330}{330 + 330} = 165R$ **.**

Question 25

Marks	0	1	2	Average
%	32	20	48	1.2

The component is a diode. Current passes through in one direction only.

Question 26

Marks	0	1	Average
%	97	3	0.1

The modification that can be made to keep the transistors functioning under the conditions described is a heat sink or small fan.

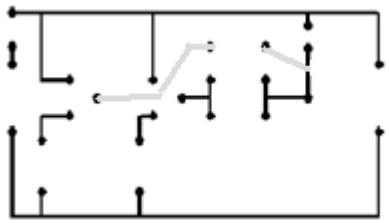
Question 27

Marks	0	1	Average
%	56	44	0.5

Transistor number 4

Question 28

Marks	0	1	Average
%	84	16	0.2



The two missing tracks are shown above. To gain one mark, both tracks needed to be shown correctly.

Question 29a.

Marks	0	1	2	Average
%	39	24	38	1.0

Drilling holes in a printed circuit board, etching the printed circuit board, using a UV light box

This question asked for two processes in the construction of a circuit board where people may be exposed to the risk of injury. Students who gave answers that were not a process were not awarded marks for this question.

Question 29b.

Marks	0	1	2	Average
%	47	30	23	0.8

Wear glasses when drilling, use a soldering iron stand when the soldering iron is not in use, use a fume cupboard and gloves when etching the printed circuit board in acid.

The precaution needed to relate to the process stated.