GENERAL COMMENTS

The 2002 examination was based on all areas of study of Units 3 and 4 of the Systems and Technology Study Design. The following criteria were used to set the examination:

1. Knowledge of technological concepts and principles associated with integrated systems
2. Knowledge of technological principles associated with the control of integrated systems
3. Understanding of the function of, and interrelationships between, a system and its subsystems
4. Understanding of the relationship between technological systems and the natural environment
5. Understanding of the role of diagnosis, evaluation and repair
6. Understanding of the role of design in the production of a technological system.

Students were required to answer all questions on the paper.

The 2002 examination showed a higher level of student achievement. The average mark frequency per question improved and more students answered all questions in comparison to previous years. However, there are still students who do not attempt to answer some questions. This is of particular concern in questions where multiple marks are available. Students should attempt all questions to improve their chances of gaining higher marks.

The 2002 examination contained a greater number of questions to test knowledge of technological concepts and principles associated with integrated systems and students handled this change well. Students were required to show understanding of both electronic and mechanical systems and this was managed successfully. A large number of students achieved full marks for questions which required them to analyse integrated systems.

Areas of strength and weakness

Strengths included:

- explaining the system they had constructed
- analysing the related subsystems
- explaining how their chosen systems were controlled
- demonstrating knowledge of mechanical concepts
- demonstrating knowledge of electrical/electronic concepts
- explaining the implications of systems on the environment
- analysing logic circuit diagrams.

Weaknesses included:

- writing a plan for the diagnostic test
- naming a technical publication which provided information for the diagnostic test
- explaining how forward and reverse direction is achieved in the gear system
- explaining how forward and reverse direction is achieved in the motor system
- analysing of the flashing light warning system
- application of formulas to solve problems.

Following are comments about each question and how marks were assigned. In some cases, sample answers have been supplied.

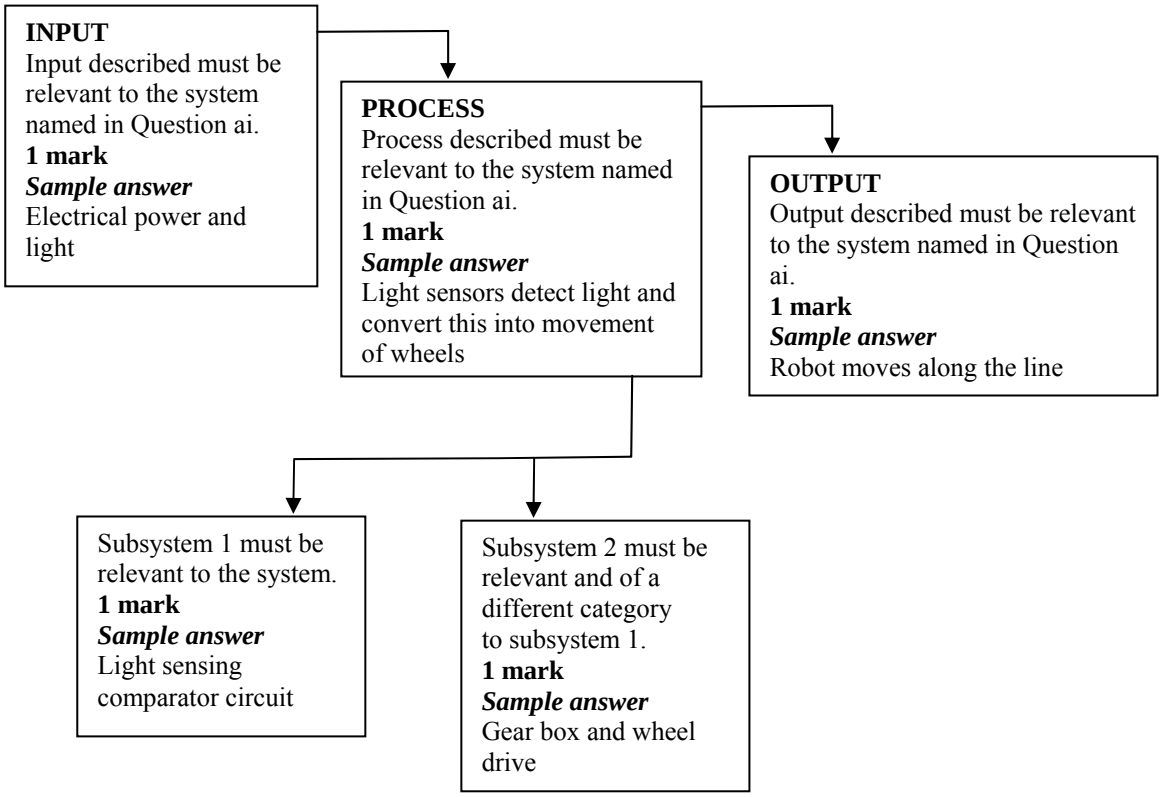
SPECIFIC INFORMATION

The following should be read in conjunction with the Systems and Technology 2002 examination paper.

Question	Marks	%	Response
Question 1	**Systems and subsystems** Students were required to demonstrate understanding of their production work. There was a range of different answers given. The advice provides an example of the detail required in answering this question.		
	ai 0/2 1/2 2/2 (Average mark 1.82)	 4 9 87	The system named should be an integrated system. The subsystems students listed needed to include one example from the electrical/electronics category and one example from the mechanical, pneumatic or hydraulic category. ***Sample answer*** White line following robot Briefly describe the system – this can include any valid comments of what it is, its function, etc. ***Sample answer*** A robot electronically follows a white line on a black surface.

aii	
0/5	3
1/5	1
2/5	3
3/5	14
4/5	26
5/5	53
(Average mark 4.18)	

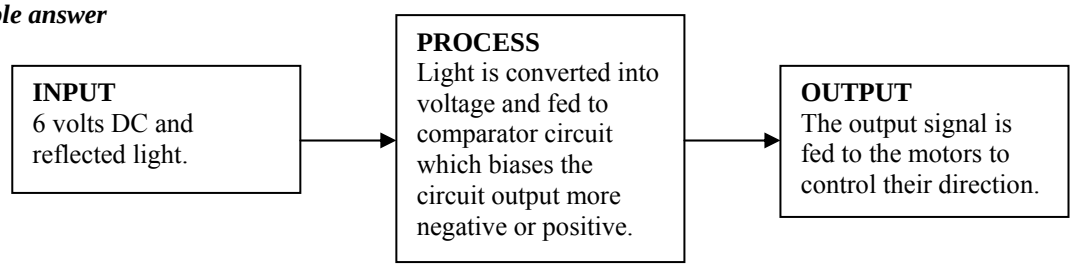
Students were required to describe the operation of the integrated technological system they named in Question ai using the given diagram.



bi	
0/5	19
1/5	3
2/5	5
3/5	20
4/5	31
5/5	22
(Average mark 3.06)	

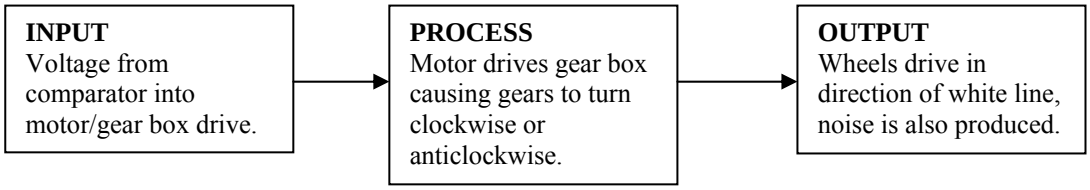
Students were required to draw a systems block diagram to describe the operation of the electrical/electronic subsystem named in Question 1aii.
The 5 marks were allocated as follows:
1 mark – use of a system block diagram
3 marks – 1 mark each for the correct description of the input, process and output of the electrical/electronic subsystem named in Question 1aii.
1 mark – stating an applicable specific value related to this subsystem.

Sample answer

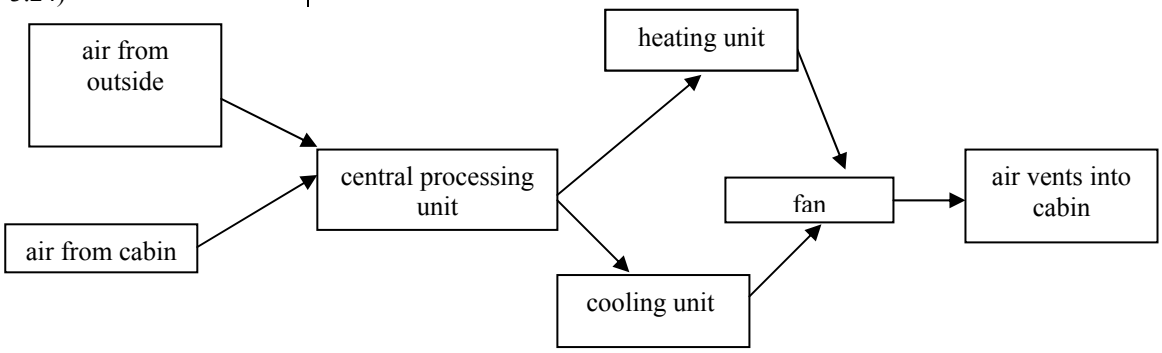


bii	
0/5	27
1/5	2
2/5	5
3/5	21

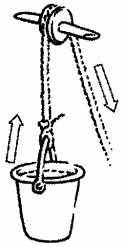
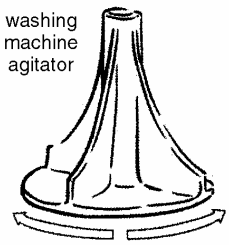
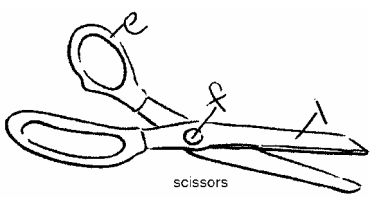
Students were required to draw a systems block diagram which describes the operation of the mechanical, hydraulic or pneumatic subsystem named in Question aii.
The 5 marks were allocated as follows:
1 mark – use of a systems block diagram

	4/5 36 5/5 9 (Average mark 2.6)		**3 marks** – 1 mark each for the correct description of the input, process and output of the mechanical/hydraulic/pneumatic subsystem named in Question 1aii. **1 mark –** stating an undesirable output related this subsystem to obtain. ***Sample answer*** 
	c 0/2 13 1/2 12 2/2 75 (Average mark 1.61)		Select one of the subsystems named in Question 1aii and list two of the main component parts. ***Sample answer*** Electronic comparator circuit (subsystem) • Light dependent resistors • Switching transistors
	di 0/1 18 1/1 82 (Average mark 0.82)		Name the design or modification work you carried out on the system. An appropriate response that can be linked to the system was accepted. ***Sample answer*** Construction of a suitable track for the white line follower to run on.
	dii 0/2 19 1/2 32 2/2 49 (Average mark 1.29)		A description of the purpose appropriate to the task named in Question 1di. ***Sample answer*** The white line follower requires a white line against a black background for the maximum light reflection.
	diii 0/2 22 1/2 28 2/2 50 (Average mark 1.28)		A sketch and/or description that matches the task named in Question 1di. ***Sample answer*** This was constructed out of 19 mm particle board 1 metre long by 300 mm. The board was painted black and when dry a 40 mm wide curving line was painted over the black background.
Question 2	**Control of integrated systems** Students were required to demonstrate their knowledge of how systems are controlled.		
	ai–iii 0/6 11 1/6 5 2/6 4 3/6 13 4/6 21 5/6 18 6/6 28 (Average mark 3.91)		**ai** The control device named must be appropriate to the system named in Question 1ai. ***Sample answer*** Light dependent resistors **aii** No marks were given to a response of closed or open loop only but were given according to the accuracy and quality of the explanation. ***Sample answer*** This is a closed-loop system as the LDRs detect light is electronically transferred into a feedback signal that automatically controls the vehicle direction. **aiii** Students must be able to clearly state how the input/process and output is affected by the failure of the control device, with 1 mark each for individual responses for input/process and output. ***Sample answer*** Input – the LDRs are in an open circuit and as a result no light is detected. Process – as no information is fed into the comparator circuit it cannot analyse the required information. Output – the motor will drive the wheels only in a straight line.

	bi–ii 0/2 24 1/2 23 2/2 53 (Average mark 1.28)	**bi** This is an open-loop system as there is no form of automatic control of the cabin temperature, i.e. no thermostat, automatic switch, temperature control. Answers of switch only were not accepted. **bii** The device which would convert the system to a closed-loop system is a thermostat, automatic switch, temperature control. Answers of switch only were not accepted.
	biii 0/1 36 1/1 64 (Average mark 0.64)	The closed-loop system would operate by setting the thermostat to a predetermined temperature and turning the unit off and on to maintain that temperature.
	ci 0/2 31 1/2 23 2/2 46 (Average mark 1.15)	The exclusive OR gate can switch on **if only one** of the units is operating. Any other combination will keep the exclusive OR gate off.
	cii 0/6 18 1/6 4 2/6 11 3/6 17 4/6 20 5/6 17 6/6 14 (Average mark 3.24)	Students were asked to show how a climate control system functions using a systems block diagram and named components. One mark was given for every correct answer. No marks were awarded for drawing the block diagram as this was marked in the previous question. The following placement of components was interchangeable: • air from outside with air from cabin • heating units with cooling unit.



Question 3	**Diagnostic practices** Students were required to demonstrate their knowledge of diagnostic testing undertaken during the year. Due to the multitude of tests students may perform, variations in the sequence and order of work were evident. • name a test **(1 mark)** and purpose **(1 mark)** of the diagnostic test • if the name and purpose of the test did not relate to the named system or subsystem no marks were awarded • name **(1 mark)** of the specific **(1 mark)** type of advanced measuring equipment, i.e. digital multimeter = **2 marks** as this includes name and specific type	
	a 0/8 25 1/8 5 2/8 8 3/8 12 4/8 16 5/8 11 6/8 12 7/8 8 8/8 3	**Advanced testing and measurement** **Sample answer** Electronic comparator circuit. • reason for selecting this type of equipment, **1 mark** for a valid reason • set up procedures, **1 mark** if the set up is valid for the named equipment and test • the type of quantified results, **1 mark** for relevant unit of measurement. **One additional mark was awarded for the sequence of work.** The order of work after the first bullet point was assessed on the student's ability to relate the details of the test. The order given is a guide only.

	(Average mark 3.27)	• test the output resistances of the light dependent resistors against a varying light source to detect changes in resistance as described in the information sheet • digital multimeter and a light source (a torch) • digital multimeters give accurate readings in a numeric form; the torch is required to alter the light source • plug in probes into multimeter and set dial to ohms reading; the torch is turned on and its distance from the LDRs is varied • the readings will be in ohms; s readings will be in kilohms (kΩ) depending on the light source.
	b 0/2 57 1/2 16 2/2 28 (Average mark 0.7)	Name the technical publication used for information about the diagnostic test **(1 mark)**. Explanation of how this assisted you with the test **(1 mark)** ***Sample answer*** A detailed information sheet was supplied by the kit manufacturer and this specified the type of resistance readings and their variations according to the light source.
	ci–ii 0/4 29 1/4 6 2/4 17 3/4 20 4/4 28 (Average mark 2.13)	**ci** Expected result **(1 mark)** was awarded if valid. ***Sample answer*** A few hundred ohms under full light Actual result **(1mark)** if valid and possible. ***Sample answer*** 390 R under full light **3cii** Explanation **(1 or 2 marks)** depending on the quality of the response. ***Sample answer*** The information sheet supplied with the white line follower kit detailed a light dependent resistor reading of a few hundred ohms under full light. The actual test results were close to this reading displaying that the resistance reading of an LDR is low at full light. Other reading at different light levels detailed a change of resistance according to the level of light.
Question 4	**Concepts and principles** Students were required to demonstrate their knowledge of concepts and principles studied during the year.	
	ai 0/2 18 1/2 39 2/2 43 (Average mark 1.25)	Type of motion shown in the bucket was linear **(1 mark)** and reciprocating **(1 mark)** for the washing machine agitator.   linear motion reciprocating motion
	aii 0/2 11 1/2 10 2/2 79 (Average mark 1.68)	**1 mark** for f, l and e marked correctly in the diagram:  

aiii

0/2	24
1/2	21
2/2	55

(Average mark 1.31)

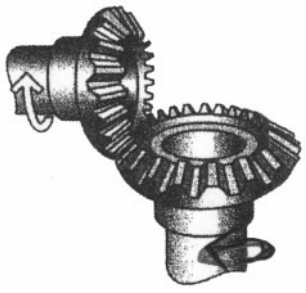
The types of force shown.
Torsion **(1 mark)**
Tension **(1 mark)**

aiv

0/2	8
1/2	11
2/2	81

(Average mark 1.72)

Students were asked to show the direction of movement of the driven gears.



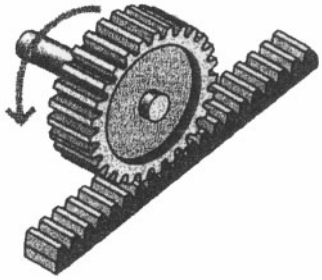
Bevel gear

av

0/1	66
1/1	34

(Average mark 0.34)

Students were asked to name the gear.



Rack and pinion

bi

0/5	6
1/5	9
2/5	18
3/5	20
4/5	18
5/5	29

(Average mark 3.21)

Students were asked to write the name of the component that matches the function.

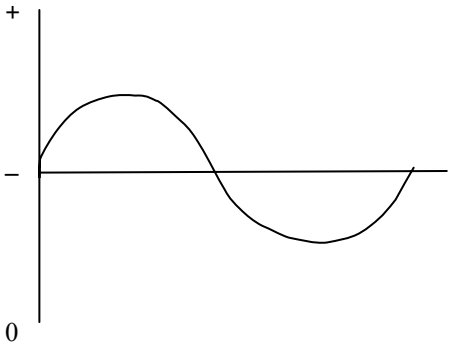
limits current in a circuit	*Resistor*	**1mark**
store electrical charge	*Capacitor*	**1 mark**
can switch two poles in two directions	*DPST switch or name of switch in full*	**1 mark**
acts as an electromagnetic switches	*Relay*	**1 mark**
can perform as a switch or an amplifier	*Transistor (with or without npn)*	**1 mark**

bii

0/1	33
1/1	67

(Average mark 0.67)

Students were asked to draw an example of an AC signal.



	biii 0/2 16 1/2 20 2/2 64 (Average mark 1.47)		AC – alternating current **(1 mark)** DC – direct current **(1 mark)**
	biv 0/1 79 1/1 21 (Average mark 0.21)		The term which best describes the conversion of AC to DC is rectify or rectification **(1 mark)**
	ci–ii 0/2 15 1/2 37 2/2 48 (Average mark 1.33)		**ci** Lifting device is safer for the person operating the system to be on the ground pulling downwards for following reasons: (1 mark for one reason) • both feet are firmly on the ground. You cannot overbalance and fall from the platform • you can clearly see what is happening. **cii** Ratio is 2:1 or 1:2
	ciii 0/1 15 1/1 85 (Average mark 0.85)		The ratchet and pawl allows the user to take their hands off the handle when lifting the bucket. The ratchet and pawl locks the bucket in any position.
	civ 0/1 13 1/1 87 (Average mark 0.87)		The pawl must be manually removed from the ratchet. Answers with a similar explanation were accepted.
	cv 0/3 30 1/3 13 2/3 28 3/3 30 (Average mark 1.58)		Number of revolutions $= \frac{\text{distance moved}}{\text{circumference of rope drum}}$ **(1 mark)** $= \frac{2500}{250}$ **(1 mark)** = 10 revolutions **(1 mark)**
	cvi 0/2 66 1/2 13 2/2 21 (Average mark 0.55)		Forward direction – gears A, C and D are engaged **(1 mark)** Reverse direction – gears A, B, C and D are engaged **(1 mark)**
	di 0/2 64 1/2 1 2/2 35 (Average mark 0.71)		Clockwise – the two switches closed are SW2 and SW3 **(1 mark)** Anticlockwise – the two switches closed are SW1 and SW4 **(1 mark)**

	dii 0/3 42 1/3 9 2/3 15 3/3 34 (Average mark 1.4)	P = IV **(1 mark)** =.95 x 12 **(1 mark)** = 11.4 W **(1 mark)**
	diii–v 0/4 51 1/4 19 2/4 13 3/4 8 4/4 9 (Average mark 1.03)	**diii** **Flashing light circuit** Students were asked to draw a waveform which represents a digital signal.  **div** The function of the transistors in this circuit is that the transistors act as switches. **dv** Students were asked to draw a circuit that allows the construction of a 10k resistance from 3k3 and 100R resistors.  1 mark for the resistors adding to 10k; 1 mark for the series connection.
Question 5	**Technology and the environment** Students were required to demonstrate knowledge of environmental issues concerned with systems that were studied during the year. Students were asked to name the system. ***Sample answer*** Wind mill generator.	
	ai–ii 0/6 9 1/6 3 2/6 13 3/6 27 4/6 21 5/6 14 6/6 13 (Average mark 3.38)	List a negative and a positive effect and provide an explanation. **ai** Negative effect – a negative effect that relates to the system named. **(1 mark)** Explanation – a relevant explanation **(1 or 2 marks** depending on the length and depth of the answer). ***Sample answer*** Noise The noise of the blades turning creates noise pollution. **aii** Positive Effect – a positive effect that relates to the system named. **(1 mark)** Explanation – a relevant explanation. **(1 or 2 marks** depending on the length and depth of the answer). ***Sample answer*** Clean Power The power generated is from a clean source creating no environmental damage and is also renewable.

	bi–ii 0/3 1/3 2/3 3/3 (Average mark 1.96)	 16 12 30 41	**bi** State one change that has been made to the system to improve its impact on the environment and explain. Students should state one plausible change **(1 mark)** The explanation could be brief but had to explain an improvement **(1 mark)** ***Sample answer*** They are placed in isolated places on cliff tops etc. as these are well away from human habitation and therefore the noise has no major impact. **bii** Name one other possible design or management change. This should be a plausible suggestion that relates to the named system. ***Sample answer*** Make the blades out of materials that do not make as much noise.