GENERAL COMMENTS

The 2001 examination was based on all areas of study and Units 3 and 4 outcomes of the revised *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 questions from both the mechanical and electrical/electronic fields, which reflect the integrated systems approach taken in Units 3 and 4 of the new study design. As a result, the paper did not have the mechanical or electrical choice sections of past examinations. As the examination criteria are directly related to the outcomes in the study design, student responses generally reflected a good understanding of and familiarity with the key knowledge and skills.

Following are comments about each question and how marks were assigned. In some cases, sample answers have been provided. It should be noted that in descriptive answers all variations that contained the correct content and detail were awarded full marks.

SPECIFIC INFORMATION

The following should be read in conjunction with the Systems and Technology examination paper for 2001.

Question 1

a. (Average mark 3.9/Available marks 6)

This question required students to demonstrate understanding of their production work related to Outcome/s 2 Units 3 and 4. Students' answers needed to relate to the specific production work that they undertook. As a result there were a range of different answers given. The advice that follows describes the detail required in answering this question.

Systems and sub-systems

ai.

Students were asked to name and describe the integrated system they had constructed and list an electrical/electronic subsystem and mechanical, pneumatic or hydraulic subsystem. The system students named needed to be an integrated system to receive 1 mark with a related description (1 mark).

Sample answer

Remote-controlled garden sprinkler tap controller (UHF).

aii.

Electrical/electronic subsystem

Responses that provided a clearly defined subsystem in this category were awarded two marks while less clear answers, which were in the subsystem category received 1 mark.

Sample answer

Timer circuitry set at 30 minutes.

aiii.

Mechanical, pneumatic or hydraulic subsystem

Responses that provided a clearly defined subsystem in this category received two marks while less clear answers, which were in the subsystem category, gained 1 mark.

Sample answer

Mechanical control over water movement via solenoid taps.

b. (2.58/5)

Students were asked to identify and describe on the block diagram, the input energy form, the process and the output energy form of the system named in part ai. Note that in the sample answers, the energy form is clearly stated.

INPUT	PROCESS	OUTPUT
Students needed to identify and describe an energy form related to the system, for example, mechanical, electrical or a fuel source. One or two marks awarded. A sample answer could be: Electrical energy 12 volts DC and monitoring of output	A brief correct statement of how the energy is converted to the output. One mark awarded. A sample answer could be: Electrical state monitoring via a closed loop system involving sensors, which provide feedback.	An energy form must be stated and described which related to the system output, for example, mechanical, electrical or appropriate energy output. One or two marks awarded. A sample answer could be: A variated output energy both mechanical and electrical.

c. (5.21/10)

Students were asked to describe the input, process and output of each of the subsystems named in parts aii. and iii.

ci.

Electrical/electronic subsystem

Input (2 marks)

Students needed to provide a clearly related description of the input with specific values for 2 marks or make a reasonable attempt to quantify data for 1 mark.

Sample answer

12 volts DC steady current.

Process (1 mark)

Students needed to describe how the input is processed for 1 mark.

Sample answer

The circuit utilised a 555 timer IC alongside a trimpot, transistors and relays to count down a preset time.

Output (2 marks)

Students needed to provide a clear and related description of the output with values or quantities for 2 marks.

Sample answer

When the preset time is reached the 12 volts passes through a switched transistor into the relay, energising it and through the relay process of an electromagnetic switch a secondary circuit is activated.

Mechanical, hydraulic or pneumatic subsystem

This section was marked in the same way as for the electrical/electronic subsystem (2 + 1 + 2 marks).

Input (2 marks)

Sample answer

24 volts AC (alternating current).

Process (1 mark)

Sample answer

The 24 volts AC will pass directly to the centre of the tap, energising a coil, creating a magnetic field.

Output (2 marks)

Sample answer

The magnetic field draws open a metal washer within the tap allowing the free flow of water to initiate.

The sample answers provide plenty of quantified data. The input, process, output descriptions are clearly articulated and demonstrate a sound understanding of the system.

Question 2

Diagnostic practices

This question relates to Unit 4 Outcome 3. Answers given by students had to relate to the diagnostic test carried out on their productions. There were many different answers and the following describes the expected detail of student responses.

Advanced testing and measurement

Responses could relate to any system/subsystem on which the student conducted their diagnostic test.

a. (0.87/1)

Students had to name the system or subsystem on which they conducted their diagnostic test for 1 mark, for example modified relay card kit 12V DC.

b. (1.25/2)

Students were asked to name the specific diagnostic test carried out. The test needed to relate to the system or subsystem named in part a above. Two marks were given for a specifically defined test, 1 mark for a less clearly defined test.

Sample answer
Diode check/test.

c. (1.79/3)
Students were asked to describe in detail the purpose of the test. Answers with appropriate and relevant detail received 3 marks and answers with less specific detail scored 1 or 2 marks.
Sample answer
To establish whether the erroneous output results were a direct result of shorted diodes, or in fact a larger problem with the linked circuit (harder to fix, due to its complexity).

d. (1.17/2)
If students provided an accurate description of **advanced** test equipment such as a Digital Multimeter, they were given 2 marks and 1 mark for naming simple test equipment.
Sample answer
Digital Multimeter equipped with a diode test feature and test leads.

e. (1.5/3)
In this part of the question, students had to explain in detail the set up procedures of the test equipment identified in part d. Students were given 3 marks for well-documented procedures outlined in a methodical manner that included at least three major steps and 1 or 2 marks for less detailed answers.

f. (1.37/3)
Students were asked what specific readings or values were obtained when using the test equipment. Three marks were awarded for related quantified data that included the correct units and 1 or 2 marks were given for less specific detail.
Sample answer
When forward biased, the diode would provide a '0' or near enough reading, however when polarity was reversed, the expected reading of '1' (infinite resistance) was not shown – instead it remained at '0'. This sample response incorporates correct use of terminology.

g. (1.36/3)
Students were asked how these readings or values assisted in the test. Students who showed an excellent understanding of their chosen system related the readings and values to formulate accurate detailed observations.

h. (1.49/3)
Students had to explain one relevant precaution taken when using the test equipment named in part d and explain why they took this precaution. Students who had a sound understanding of the equipment were able to explain a major precaution and were given 1 to 3 marks depending on the detail provided.

Question 3

ai–iv (3.4/6)

Control of Integrated Systems
This question relates to Unit 4 Outcome 1.

ai.
This part of the question asked students to briefly explain why the operation of the lights is an open-loop system. In the response, students needed to explain that the traffic lights run on a timed cycle, which does not monitor the traffic flow or adjust the light cycle accordingly.

aii.
The next part of the question asked how converting the traffic lights to a closed-loop system would advantage major road A. The response should have included that traffic on major road A would not have to stop until a car on the minor road approached and triggered the sensor to change the lights.

aiii.
Possible devices that were suggested to convert the traffic lights to a closed-loop system included light sensing devices, magnetic strips and pressure sensing devices. One mark was given for a correct answer.

aiv.
Students had to place an X on the diagram to indicate the position of the device. The position of the device needed to be appropriate for the device the student named, for example pressure mats and magnetic devices would be on the road and a photosensitive device would be at the side of the road. One mark was given for the correct answer.

av. (2.25/4)
Students were asked to explain how the device operates, and needed to demonstrate a clear understanding of the device they nominated and the operation recognisable in terms of the input, process and output.

bi–iii. (1.92/3)

bi. (1 mark)

This question asked the students about the integrated system named in Question 1. Students had to indicate whether the system is a closed- or open-loop system.

bii. (1 mark)

In naming the device or component which controls the system, students needed to name the control device.

biii. (1 mark)

A brief but correct description of how this device or component controls the system was required.

ci–ii. (4.26/6)

ci.

This part of the question related to two examples of an electric kettle. Students needed to correctly identify Example A as a closed loop and Example B as an open-loop system.

cii.

Students then had to briefly describe the operation and control of each example. Responses needed to include the following information:

Example A: Power is applied initially via the on/off switch to the heater element. The heating element transfers heat to the water until it reaches boiling point. At this point the automatic sensor switches the power off to the element. When the water temperature falls below boiling point the automatic sensor switches the element back on.

ciii.

Example B: Power is applied via the on/off switch to the element that transfers heat to the water. When the water reaches boiling point it will continue to boil until it is manually switched off.

Question 4

a–b. (1.28/3)

Concepts and principles

This question relates to Unit 3 Outcome 1.

a. (2 marks)

Students were asked to name the input and output energy forms of the food mixer shown in the diagram. One mark was given for each correct answer.

Input: The most frequently given answers were human, mechanical, or kinetic energy.

Output: The most frequently given answers included mechanical or kinetic

b. (1 mark)

The hand-operated mixer is difficult to operate because of friction in the gear assembly. Students were required to tick the box next to the answer that best defines friction. The last option ‘all of the above’ was the correct answer and was awarded 1 mark.

c–e. (2.45/5)

c. (1 mark)

The name of the gear wheels on the beater shafts in Figure 3 was bevel gears.

d. (1 mark)

The type of motion that exists in Figure 3 is rotary motion.

e. (3 marks)

The calculation of the output revolutions per minute of the beaters in Figure 3 when the handle is rotating at 60 rpm is as follows:

$$\text{Output rpm} = \text{input rpm} \times \frac{\text{number of teeth on driver gear}}{\text{number of teeth on driven gear}}$$

$$= \frac{60 \times 42}{18}$$

$$= 140$$

f–g. (1.14/2)

f. (1 mark)

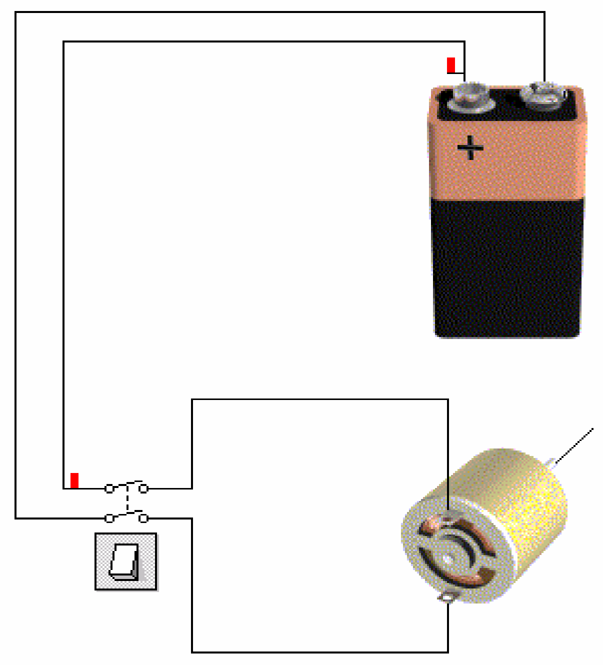
The beater in Figure 3 has too many efficiency losses. Students needed to identify the statement **‘**Where the input is greater than the output’ as best describing the term efficiency loss for 1 mark.

g. (1 mark)
Students were asked to name one reason why the system in Figure 4 is more suitable for electrical connection. Possible correct responses for 1 mark were the motor shaft is easily connected or speed reduction.

h–i. (1.86/3)

h. (1 mark)
The initials DC stand for Direct Current.

i. (2 marks)
The motor is to be run from a nine-volt battery and **both** motor conductors are to be switched via a DPST switch. Students were required to draw the required connections on the components to complete the circuit.



j–k. (1.7/4)

j. (3 marks)
Students were asked to calculate the resistance of the electric motor if it draws 350mA from the nine-volt battery.

$$R = \frac{V}{I} = \frac{9}{0.35}$$

$$= 25.7\ R$$

k. (1 mark)
The electrical calculation is based on the principle of Ohm’s law. Students were required to tick the box next to the statement that is the correct example of Ohm’s law. The correct statement is ‘If the voltage increases the current increases’.

An indicator light is to be added to indicate when the power is switched on. This requires the use of a resistor and a light emitting diode pictured below.

l–m. (1.34/3)

l. (2 marks)

Under each component students were required to draw its correct symbol.

Students needed to draw any commonly used resistor symbol and any commonly used LED symbol.

m. (1 mark)
To allow for variable speed control the motor is to be controlled by a digital signal.

To define the term digital students needed to include having only two states, on or off, binary or a similar statement.

Question 5

Technology and the Environment

This question relates to Unit 3 Outcome 3. Most students were able to apply their knowledge of the relationship between technological systems and the natural environment from class activities and the related assessment task.

a. (0.87/1)

Students were required to name a specific system which impacts on the environment.

b. (1.3/2)

Students had to state the energy source used to power this system. This needed to be specific for full marks (e.g. solar energy, electrical energy, petrol, diesel) while volts, battery, fuel, current, or two-stroke mix gained 1 mark.

c. (1.5/3)

Students needed to back up their positive or negative response to the question: 'Does this energy source create any environmental pollution?' with a sound reason that included the correct terminology.

d. (2.16/4)

In this part of the question, students were asked to create a logo, sign or table with three warnings and/or advisory statements to allow for the safe, friendly and effective use of the system named in part a. Three statements of advice had to be realistic and relevant and for a reasonable attempt at a logo, sign or table 1 mark was given.

Question 6

The role of design

a. (0.91/2)

Students were given 1 mark for correctly naming each energy output of the solar panel (heat) and the solar cell (electrical).

b. (0.99/2)

Students were given 1 mark each for correctly naming two practical applications where a solar panel and a solar cell could be installed and used efficiently. Correct answers could include a hot water system or solar pool heating for the solar panel and for the solar cell, to charge batteries, use in a calculator, remote location light or phone box. Both the solar panel and the solar cell will require storage systems to allow for energy storage in times of poor or no sunlight.

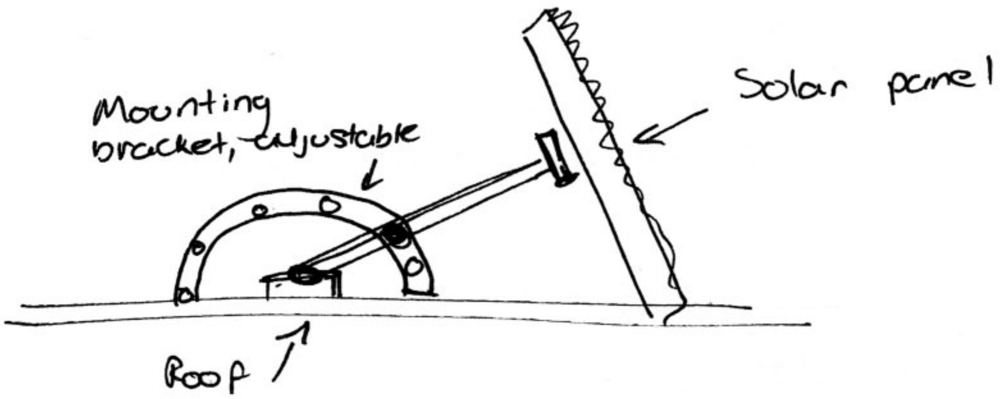
c. (0.64/2)

Students were required to name a suitable energy storage system for the solar panel and the solar cell. Possible answers included, the solar panel, a hot water storage tank and for the solar cell, a re-chargeable battery.

d. (1.37/2)

The solar panel shown required adjustment of its tilt angle throughout the year to optimise the available sunlight. In answering this question, students were asked to sketch a suitable device that would allow the panel to be adjusted through a minimum radius of 90°. Students had to make a clear sketch of any suitable device that would perform this function.

A sample sketch could look something like the following:



e. (1.15/2)

Students were required to re-draw the components in a circuit, which would correctly allow the booster element to operate. To obtain 2 marks, the drawing needed to show the three components connected in series.