VICTORIAN CURRICULUM AND ASSESSMENT AUTHORITY

Victorian Certificate of Education 2004

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

STUDENT NUMBER

									Letter
Figures									
Words									

SYSTEMS AND TECHNOLOGY

Written examination

Wednesday 17 November 2004

Reading time: 2.00 pm to 2.15 pm (15 minutes)
Writing time: 2.15 pm to 3.45 pm (1 hour 30 minutes)

QUESTION AND ANSWER BOOK

Structure of book

Number of questions	*Number of questions to be answered*	*Number of marks*
7	7	96

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 19 pages including formulas on page 19.

Instructions

- Write your **student number** in the space provided above on this page.
- All calculations must show appropriate formulas and working.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other electronic communication devices into the examination room.

Instructions

Answer **all** questions in the spaces provided.

Question 1

As part of your course you were required to construct an integrated system with a control device.

Name the integrated system you produced.

_____

a. Draw a systems block diagram which describes, in terms of input, process and output, the operation of the integrated system.

3 marks

Integrated systems are made up of subsystems from the electrical/electronic category and the mechanical, pneumatic or hydraulic category.

b. Name two subsystems that made your system an integrated system.

Subsystem 1 _____

Subsystem 2 _____

2 marks

c. Choose one of the subsystems you have named in part **b.** and describe in detail the input, process and output for that subsystem.

Subsystem name _____

Input

Process

Output

6 marks

d. Name a major component or device that was responsible for control in your integrated system.

1 mark

e. Explain in detail how control was achieved in your integrated system.

2 marks

When producing your integrated system you were required to carry out design or modification work. Identify the design or modification work.

f. What was the intended purpose of the design or modification work?

1 mark

g. Produce a detailed, labelled sketch and/or explanation of this design or modification work.

Explanation

4 marks

Total 19 marks

Question 2

As part of your course you were required to carry out a diagnostic test.

Name the integrated **system** on which you conducted a diagnostic or fault-finding test.

_____

a. Name the specific **subsystem** upon which the test was carried out.

_____

1 mark

b. Name the specific test that you carried out.

_____

1 mark

c. Explain in detail the purpose of the test.

_____

_____

_____

_____

2 marks

d. Name one piece of test equipment that you used to take measurements of the performance of this subsystem.

_____

1 mark

Test equipment can operate on either electrical/electronic, mechanical, pneumatic or hydraulic principles.

e. What is the operating principle for the item of test equipment you used?

_____

1 mark

f. Explain why you chose this category.

_____

_____

2 marks

g. Name the specific unit of measurement that you read from the test equipment that you named in part **d.**

_____

1 mark

Total 9 marks

Question 3

As part of your course you studied how a technological system interacts with the natural environment.

Name the system

---

a. Name a major specific negative environmental effect associated with the system. **You must use specific terminology when referring to any negative effects. Nonspecific terms such as pollution, greenhouse gas, exhaust gas, smoke, battery will not be given any marks.**

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1 mark

b. Explain in detail how this effect occurs. **You must write full answers with specific details to achieve full marks.**

---

3 marks

c. Explain in detail how the system design could be, or has been, changed to reduce this negative environmental effect.

---

2 marks

Total 6 marks

Question 4

A swimming pool is equipped with a thin swimming pool blanket mounted on a roll drum device at one end of the pool. When the blanket covers the pool, it rests against the right-hand end of the pool, and when the blanket is removed, the blanket rests on the left-hand end of the pool. A person operates the device. This person winds the handle to remove the pool blanket from the pool.

Figure 1 shows the pool and pool blanket roll drum device when the pool is uncovered.

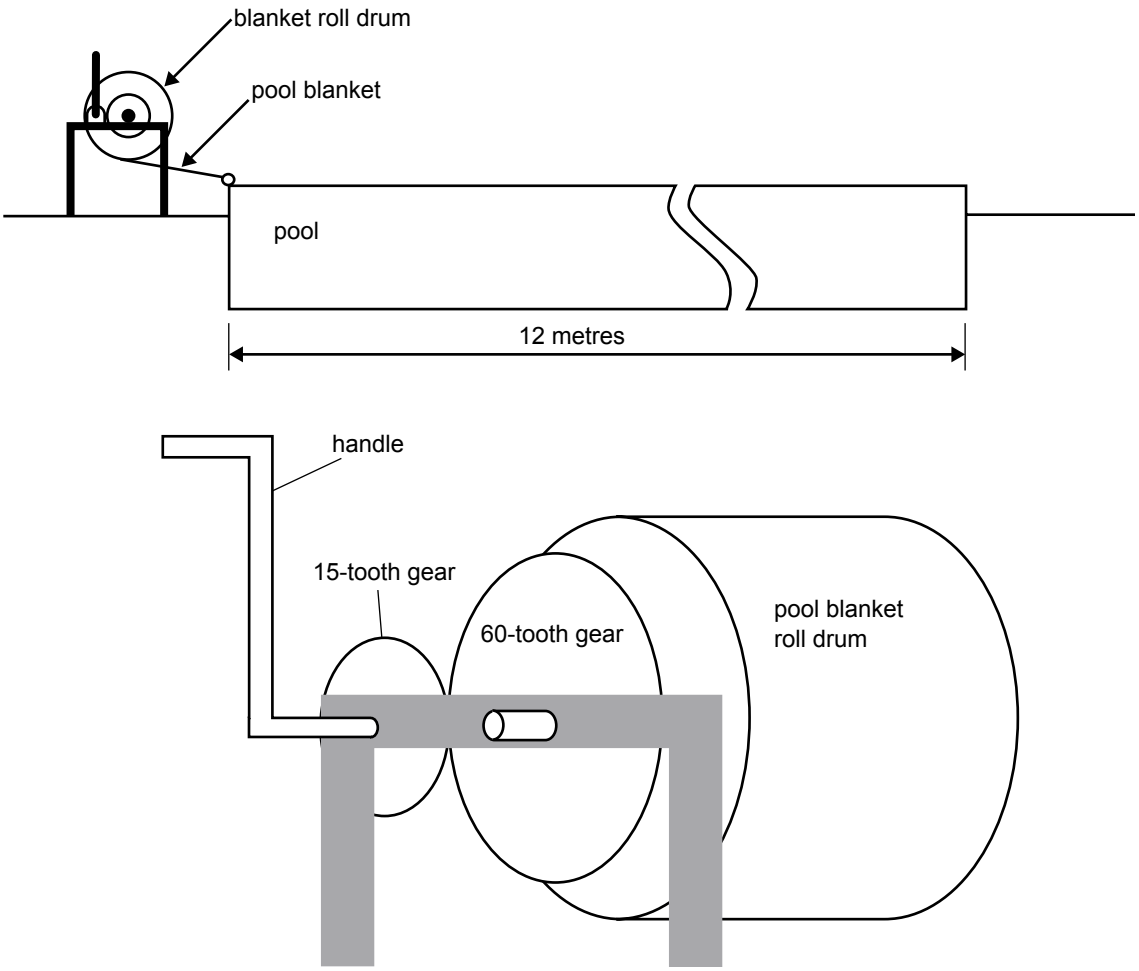


Figure 1

a. Describe the operation of the pool blanket roll drum device in terms of its input, process and output.

Input

Process

Output

3 marks

b. The pool blanket roll drum (Figure 1) has an average circumference of 1200 mm.

Calculate how many rotations of the pool blanket roll drum would be required to remove the blanket from the pool. Refer to the formula on page 19 and show all working.

2 marks

c. The handle which turns the pool blanket roll drum is connected to a 15-tooth gear. The gear drives a 60-tooth gear mounted on the blanket roll drum (Figure 2). Calculate the gear ratio involved in the gear set. (Refer to formula on page 19.)

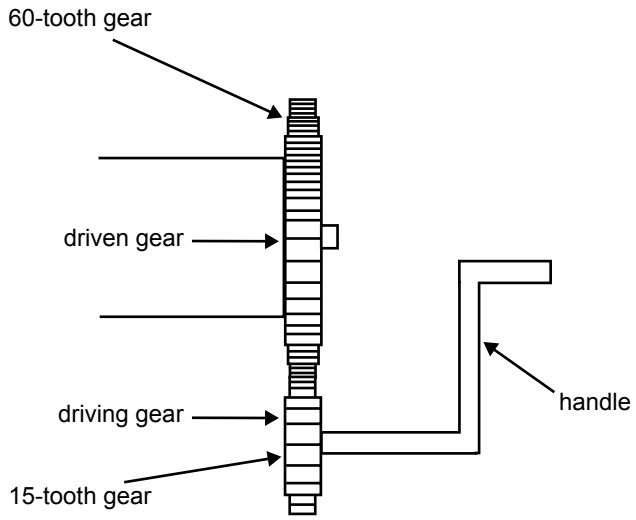


Figure 2

2 marks

The gear set illustrated in Figure 2, when operated, allows the handle to turn in the opposite direction to the blanket roll drum.

d. Sketch and label a simple mechanical gear solution that would enable the handle to rotate in the same direction as the pool blanket roll drum when operated.

2 marks

Figure 3 shows a form of lever designed to create a mechanical advantage.

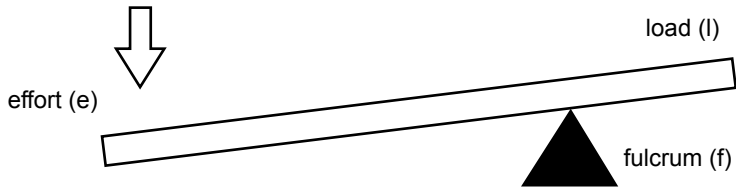


Figure 3

The handle on the pool blanket roll drum is a lever.

e. Mark on the roll drum handle diagram (Figure 4) the fulcrum (f), the load (l) and the effort (e).

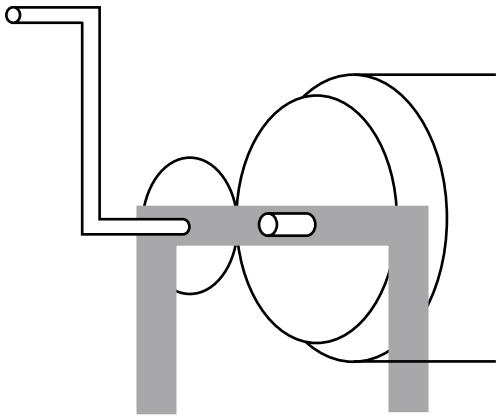


Figure 4

3 marks

f. A force of 20 newtons is applied to the handle (Figure 5). Calculate the torque applied to the 15-tooth gear. Refer to the formula on page 19 and show all working.

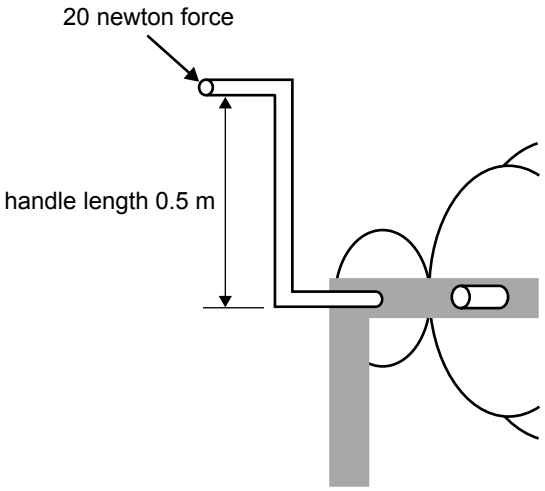


Figure 5

2 marks

A pool attendant has difficulty turning the pool blanket roll drum handle.

g. Suggest a practical solution to reduce the amount of effort required to turn the handle.

_____

_____

1 mark

When the pool blanket is rolled out to cover the pool it is usually pulled out by two attendants. The handle rotates with the roll drum at this time.

h. Draw and label a device that will allow the handle to be disengaged when the pool blanket is being rolled out. This device must allow the handle to be engaged when the blanket is being removed from the pool.

3 marks

Four types of forces are: compression, shear, torsion, tension.

i. Identify the type of force acting on the pool blanket when it is being removed from the pool.

_____

1 mark

Four types of motion are linear, rotary, reciprocating and oscillating.

j. Which two motions are **not** present in the operation of the **pool blanket roll drum** device?

1. _____ 2. _____

2 marks

k. Which type of motion does the **handle** use when it is being operated to remove the pool blanket.

_____

1 mark

Total 22 marks

Question 5

The pool owner is worried about children getting into the pool without supervision. He has a security fence but still thinks that the children may get into the pool. The owner decides to install a 12 volt DC electronic subsurface wave detection system as shown below in Figure 6.

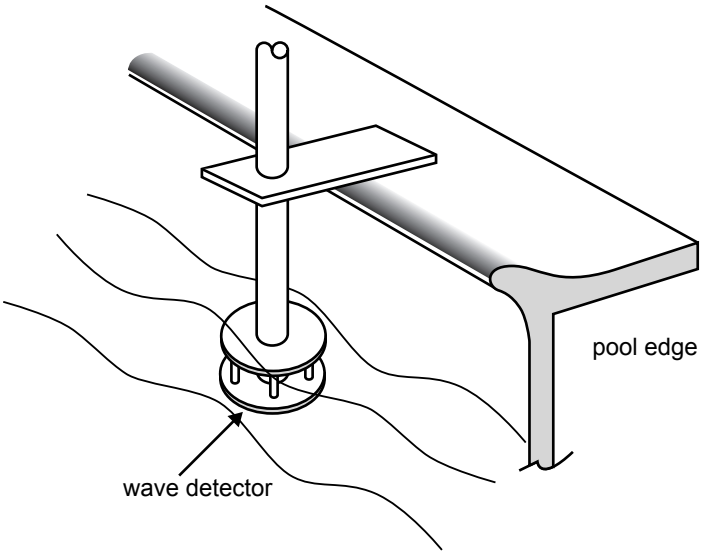


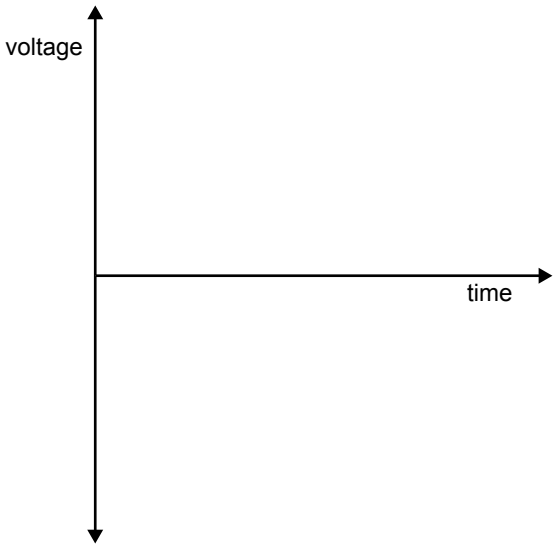
Figure 6

a. Explain why a 12 volt DC system would be preferred to a 240 volt AC system in this situation.

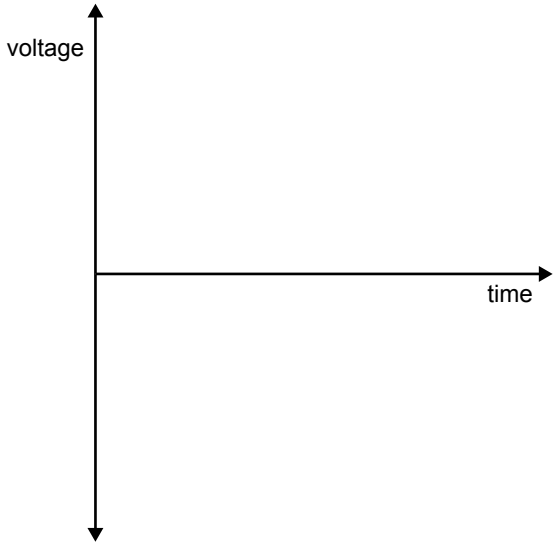
1 mark

b. Sketch a typical DC waveform and a typical AC waveform on the graphs below.

DC waveform



AC waveform



2 marks

The pool owner is still worried about children getting into the pool unsupervised, so he installs a motion sensor as well (Figure 7).

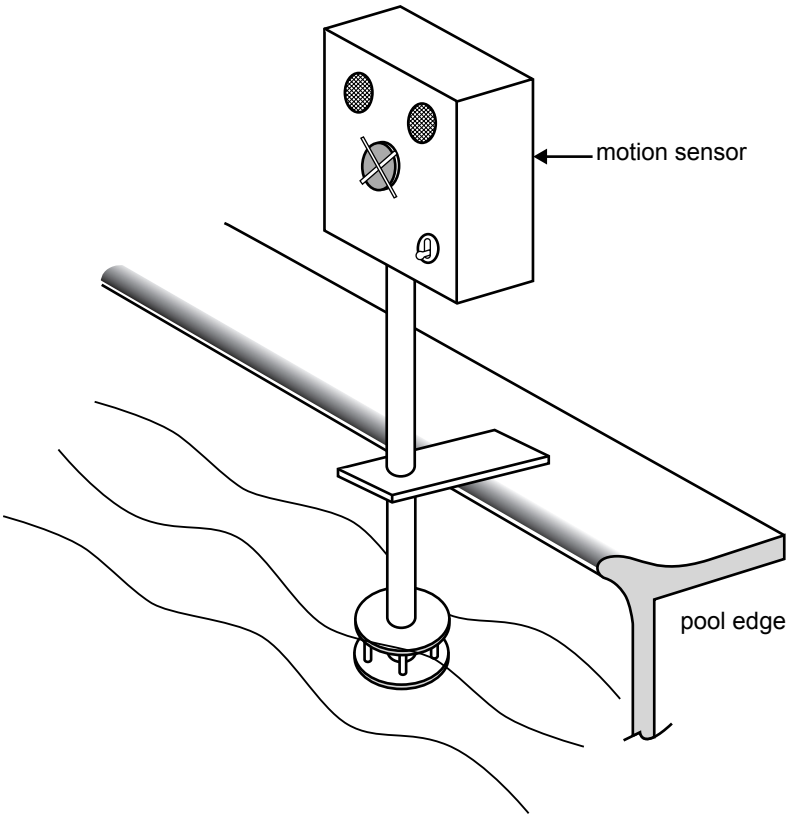


Figure 7

The pool owner then connects both the wave detector sensor and the motion sensor to an alarm via a logic gate. The logic gate must switch on the timer when either the motion sensor or the wave detector sensor or both sensors have a logic output of 1 (Figure 8).

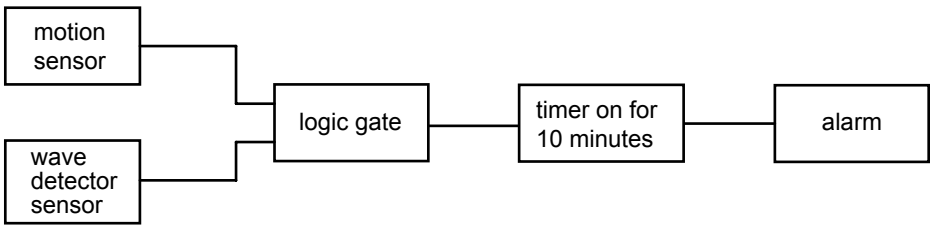


Figure 8

c. Which type of logic gate would best suit the situation described in Figure 8?

_____

1 mark

d. Explain why you chose this logic gate.

_____

1 mark

e. Complete the truth table for this logic gate on the table below.

A	B	Q (output)
0	0	
0	1	
1	0	
1	1	

2 marks

f. Explain in detail the operation of the system shown in Figure 8.

3 marks

g. Why is this system an open loop system?

1 mark

The logic gate and timer and alarm system circuit diagram are illustrated in Figure 9.

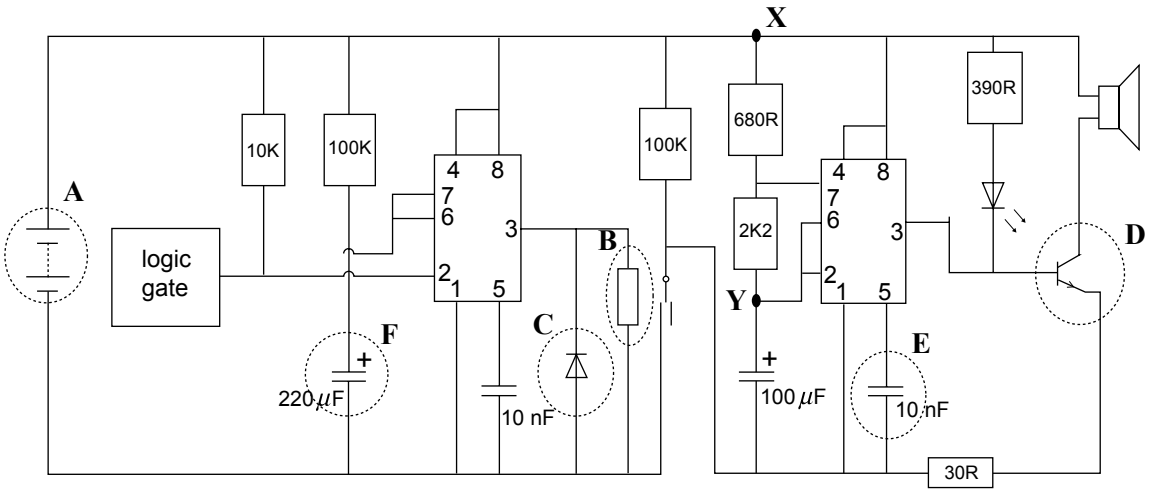


Figure 9

h. Name the following components that have been marked and labelled in Figure 9.

A _____

B _____

C _____

D _____

4 marks

i. What is the major difference between components **E** and **F**?

_____

1 mark

j. Component **E** has a value of 10 nF. What does the **nF** stand for?

_____

2 marks

k. Component **F** has a value of 220 μF. What does the ***μ*F** stand for?

_____

2 marks

l. Component **C** will have an A end and a K end. What do the initials **A** and **K** stand for?

A _____

K _____

2 marks

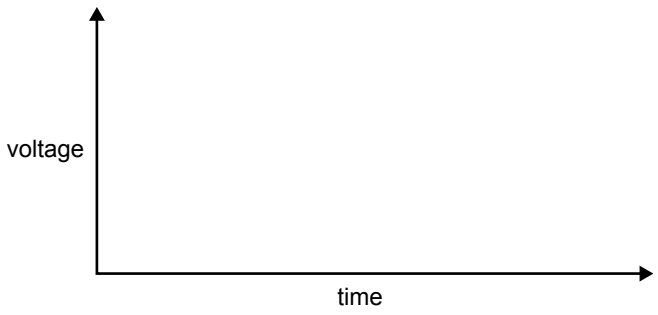
m. Give the resistance between the points **X** and **Y**.

2 marks

n. The alarm speaker is rated at 8 ohms and draws a current of 250 mA. Calculate the voltage across the speaker. Refer to formula on page 19, and show all working.

2 marks

o. The input signal of the alarm is digital. Draw a typical digital signal on the axes below.



1 mark

p. Complete the sentence below.

The relationship between voltage, current and resistance is known as _____.

1 mark

Total 28 marks

Question 6

The pool owner sets up a pool filter system to clean the pool. He needs to test the pump of the pool filter system to see if it is operating efficiently. To clean the pool efficiently, 60 litres of water per minute must be pumped.

Two items of test equipment are required to conduct a mechanical test to check the performance of the pump.

One item of equipment is a **20 litre** bucket.

a. Name the other item of test equipment that is required.

_____

1 mark

b. Explain in detail how you would carry out a mechanical test using the 20 litre bucket and the other item of equipment named in part **a.** and give the expected results.

_____

_____

_____

_____

2 marks

The pump is found to deliver less than the required amount of water. The pump is rated to draw 4 amps of current from a 12 volt DC battery supply. An electrical test is needed to test that the battery is delivering the correct voltage and current.

The following diagram (Figure 10) shows the 12 volt DC pump motor and an ammeter and voltmeter and a 12 volt DC battery supply.

c. Using the components shown below, draw the circuit connections that show the ammeter and voltmeter correctly connected to the motor and battery. Both meters are analogue meters.

Ammeters are connected in series and voltmeters are connected in parallel.

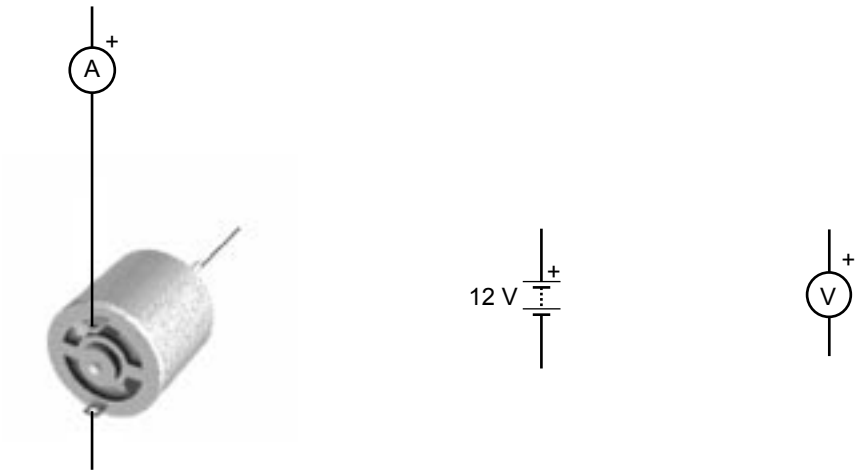


Figure 10

2 marks

When the correct battery polarity is connected to both meters in Figure 10 the meter needle will move from left to right.

d. What will happen to the meter needle if the battery polarities are reversed?

_____

1 mark

Total 6 marks

Question 7

The following two diagrams (Figure 11 and Figure 12) illustrate two methods of solar heating a swimming pool.

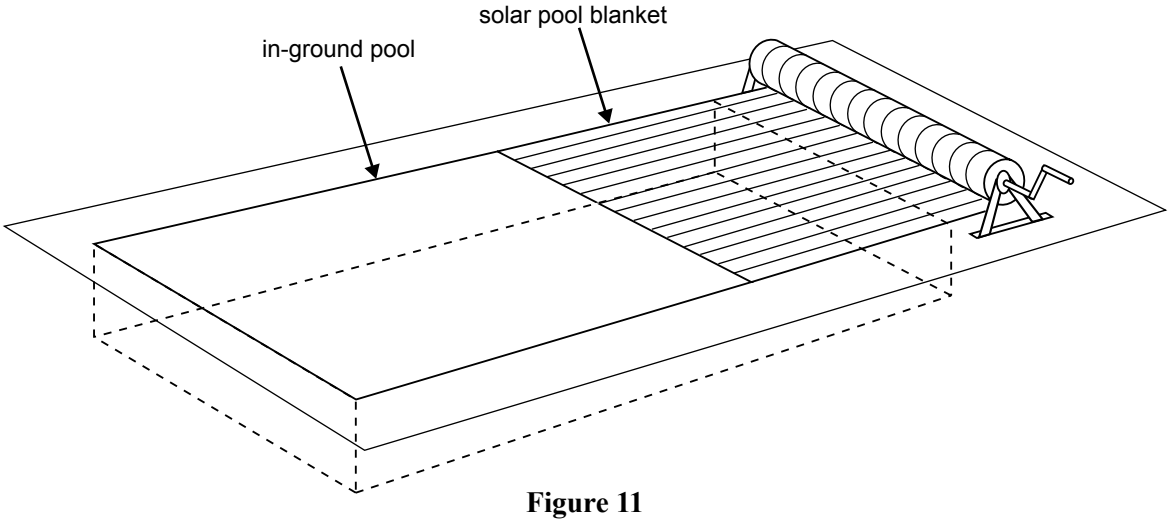


Figure 11

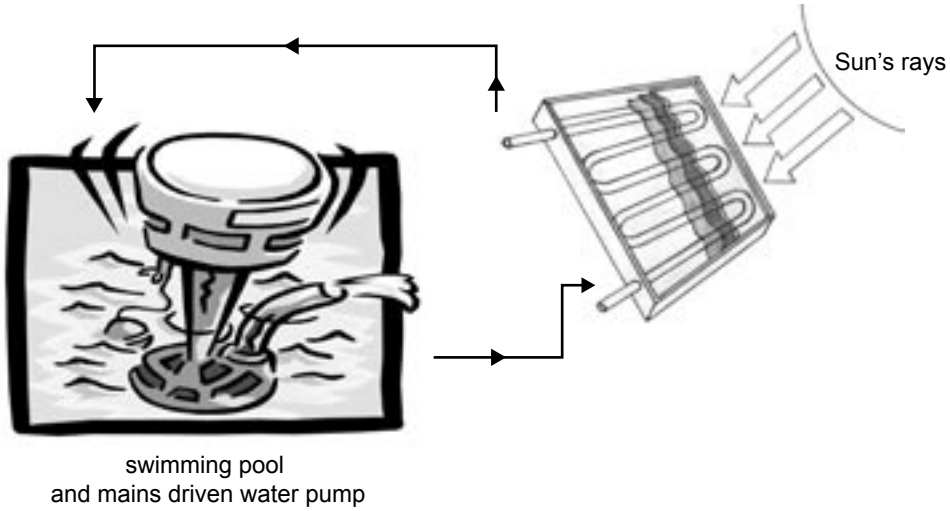


Figure 12

Figure 11 illustrates a passive heating system and Figure 12 an active heating system.

a. Explain briefly why the operation of the heating system shown in Figure 11 is more environmentally friendly than the example shown in Figure 12.

1 mark

b. Explain why the heating system shown in Figure 11 is inefficient in its operation.

2 marks

c. State the major negative environmental effect of the **operation** of the system illustrated in Figure 12.

1 mark

d. Explain why the heating system illustrated in Figure 12 is more efficient in its operation than the system shown in Figure 11.

2 marks

Total 6 marks

Formulas

$$\text{number of revolutions} = \frac{\text{distance moved}}{\text{circumference of roll drum}}$$

$$\text{gear ratio} = \frac{\text{driven gear}}{\text{driving gear}}$$

$$\text{torque} = \text{force} \times \text{distance}$$

$$V = I \times R \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

$$Rt = R_1 + R_2$$

END OF QUESTION AND ANSWER BOOK