Secondary School Leaving Examination

2013

557-410 **APPLIED SCIENCE AND TECHNOLOGY** **JUNE**

WRITTEN EXAMINATION

STUDENT BOOKLET

INSTRUCTIONS

1. Verify the information indicated in Sections 1 and 2 of the machine-scored answer sheet.
2. Detach the *Answer Booklet* located in the middle of this booklet.
3. Stick the self-adhesive label or fill in the required information on the cover page of the *Answer Booklet*.
4. Answer the questions in Part A on the machine-scored answer sheet provided.
5. Write your answers to the questions in Parts B and C in the *Answer Booklet*, showing all your work.
6. You may use a calculator (with or without a graphic display) and a ruler.
7. Reference materials are not permitted, except for the sheet of formulas and quantities as well as Appendixes I, II and III included in this booklet.
8. At the end of the examination, hand in this booklet, the *Answer Booklet* and the machine-scored answer sheet.

Note: Each question is worth four marks.

All the data and programs stored in your calculator's memory must be **erased** before the examination.

TIME: 3 hours

Québec

FORMULAS AND QUANTITIES

Applied Science and Technology

FORMULAS

$V = RI$ — V : potential difference, R : resistance, I : electric current intensity

$F_g = mg$ — F_g : gravitational force, m : mass, g : intensity of the gravitational field

$E = P\Delta t$ — E : energy consumed, P : electrical power, Δt : time difference

$v = \frac{d}{\Delta t}$ — v : average speed, d : distance, Δt : time difference

$P = VI$ — P : electrical power, V : potential difference, I : electric current intensity

$$\text{Energy efficiency} = \frac{\text{Amount of useful energy}}{\text{Amount of energy consumed}} \times 100$$

QUANTITY

NAME	SYMBOL	VALUE
ısity of the gravitational field on Earth	g	9.8 m/s^2 or 9.8 N/kg

PART A

MULTIPLE-CHOICE QUESTIONS

INSTRUCTIONS

This part of the examination consists of Questions 1 to 15.

Answer these 15 questions on the machine-scored answer sheet provided.
For each question, use an HB pencil to fill in the circle
around the letter that corresponds to your answer.

1. Different types of electric power plants are listed in the table below.

Types of Power Plants
Wind
Geothermal
Hydroelectric
Tidal

Ch6+7

Which statement is TRUE about all these types of power plants?

A) They produce few air pollutants. ✓

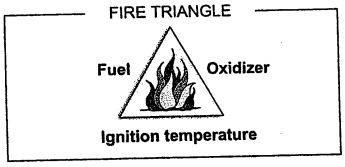
B) They can be set up anywhere in Québec. x tidal

C) They all use water as the primary source of energy. x wind

D) They use non-renewable energy resources. x all are renewable

2. Each of the three statements listed below can be matched with a fire triangle component.

Ch4



Statement 1 One way of fighting forest fires is to remove all the vegetation from certain areas. fuel

Statement 2 Most laboratories have a blanket that can be wrapped around a person whose clothes are on fire. oxygen

Statement 3 Buildings adjacent to the one on fire can be sprayed with water to prevent a fire from spreading in a city. temperature

Which of the following choices shows the correct match between the three statements above and the fire triangle components?

A)	Statement 1 – fuel	Statement 2 – oxidizer	Statement 3 – ignition temperature
B)	Statement 1 – ignition temperature	Statement 2 – fuel	Statement 3 – oxidizer
C)	Statement 1 – fuel	Statement 2 – ignition temperature	Statement 3 – oxidizer
D)	Statement 1 – oxidizer	Statement 2 – ignition temperature	Statement 3 – fuel

3. After being rubbed on hair, a rubber balloon acquires an electrical charge. When a piece of positively charged cotton is brought close to the balloon, the two objects will attract each other. ballon → (−)

Ch5

What will happen to this balloon if it is brought close to a negatively charged plastic rod, and why? (−) + (−) = repel

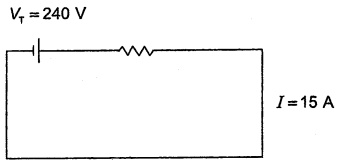
A) The balloon will be repelled because it is positively charged.

B) The balloon will be repelled because it is negatively charged.

C) The balloon will be attracted because it is positively charged.

D) The balloon will be neither attracted nor repelled because it is neutral.

4. The electrical circuit shown below consists of a power source, V_T, and a resistor. The voltage across the terminals of the power source is 240 V, and the current intensity, I, is 15 A.



Ch5

What is the value of this resistor?

$V = IR$

$240 = 15R$

$\frac{240}{15} = R$

$R = 16\,\Omega$

A) 0.06 Ω

B) 16 Ω

C) 255 Ω

D) 3600 Ω

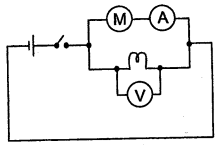
5. Listed below are the characteristics of an electrical circuit consisting of a power source, a light bulb, a switch and a motor (represented by the symbol —(M)— in the diagrams below).

- The circuit has a device for measuring the potential difference across the light bulb. x Voltmeter
- The circuit has another device for measuring the current intensity in the motor.
- Only the motor is controlled by a switch. ↑A

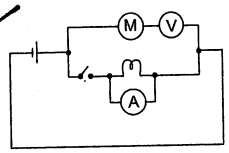
Which of the following diagrams correctly represents this electrical circuit?

Ch14

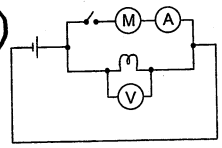
A)



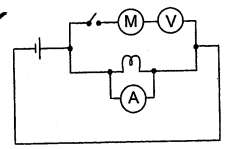
B)

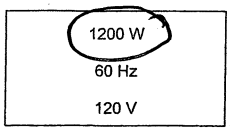


C)



D)





$E = Pt$

$= 1200 \times 55$

$E = 66\,000$

$\%E = \frac{45000}{66000} \times 100 = 68\%$

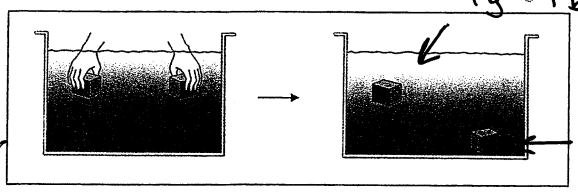
Ch5

You heated water in this oven for 55 seconds and calculated that the amount of useful energy for heating the water is 45 000 Joules.

What is the energy efficiency of this microwave oven?

A) 0.6% B) 15% C) 68% D) 147%

7. Two objects are held under water. When the objects are released, one of them sinks to the bottom, while the other remains suspended in the water. This is illustrated below.



Ch3

Which of the following statements correctly explains why this happened, according to Archimedes' principle?

A) The weight of the object that sinks to the bottom is less than the buoyant force. X

B) The weight of the object that sinks to the bottom is equal to the buoyant force. X

C) The weight of the object suspended in the water is less than the buoyant force. X

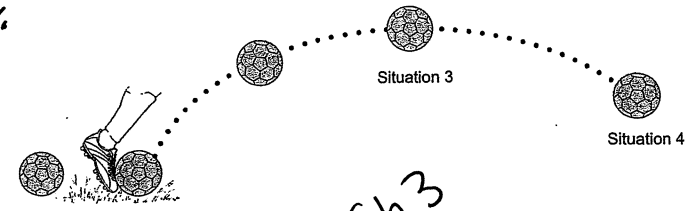
D) The weight of the object suspended in the water is equal to the buoyant force. ✓

Situation 1 – The ball before it is kicked

Situation 2 – The ball as it is kicked

Situation 3 – The ball at the maximum height of its trajectory

Situation 4 – The ball before it hits the ground



Ch3

In which situation does the ball undergo a deformation and a change in direction?

A) Situation 1

B) Situation 2

C) Situation 3

D) Situation 4

9. An electric food mixer consumes 34 200 J of energy when used for 2 minutes. $2 \times 60 = 120s$

What is the power of this food mixer? $E = P\Delta t$

A) 17.1 W

B) 28.5 W

C) 285 W

D) 17 100 W

$34\,200 = P(120)$

$\frac{34\,200}{120} = P$

$285W = P$

Ch5

10. Alexandra leaves for work every morning at 7:00 a.m. She can get to work by bus, metro, commuter train or bicycle.

The following table gives information about the route she takes with each method of transportation.

DISTANCE TRAVELLED AND AVERAGE SPEED WITH EACH METHOD OF TRANSPORTATION USED

	Distance Travelled	Average Speed
Bus	16.8 km	43.2 km/h
Metro	14 000 m 14km	50 km/h
Commuter Train	11.7 km	48 km/h
Bicycle	8 000 m 8km	23 km/h

Ch3

hours

0.38

0.28

0.24 *

0.35

Which method of transportation allows Alexandra to get to work the earliest?

A) Bus

B) Metro

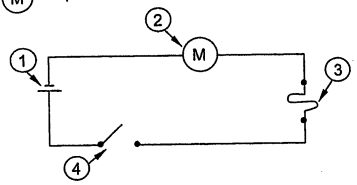
C) Commuter train

D) Bicycle

$V = \frac{d}{t}$

$t = \frac{d}{V}$ do fo each

11. The diagram below shows different components of an electrical circuit.
The symbol —(M)— represents a motor.

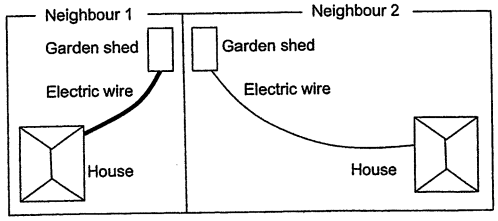


Ch14

Which of the following shows the correct match between each numbered electrical component and its function?

A)	1– Power supply	2– Transformation	3– Control	4– Protection
B)	1– Power supply	2– Transformation	3– Protection	4– Control
C)	1– Transformation	2– Power supply	3– Control	4– Protection
D)	1– Transformation	2– Power supply	3– Protection	4– Control

12. Two neighbours installed a back-up electric heating system in their respective garden sheds. The two systems are identical, and each is connected to its owner's house by an electric wire as illustrated below.



Ch5 Short Cct.

Which of these neighbours does not have the optimal set-up for his heating system and why?

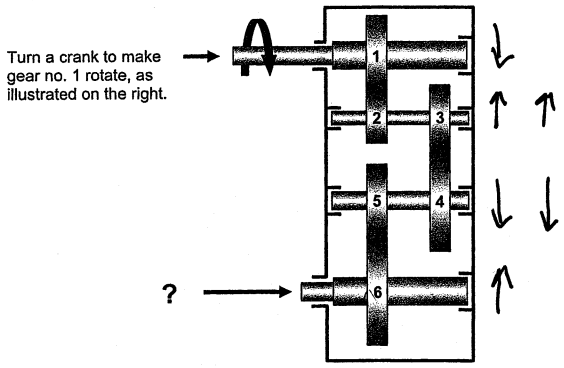
A) Neighbour 1, because his garden shed is better insulated.

B) Neighbour 1, because the diameter of his electric wire is greater than that of neighbour 2.

C) Neighbour 2, because his electric wire is longer than that of neighbour 1.

D) Neighbour 2, because his electric wire is made of copper. X copper is good

13. The diagram below shows a motion transmission system in which each numbered rectangle represents a gear.



Which of the following correctly describes the speed and direction of rotation of gear no. 6 in this system?

A) Gear no. 6 will rotate faster than gear no. 1 and in the same direction.

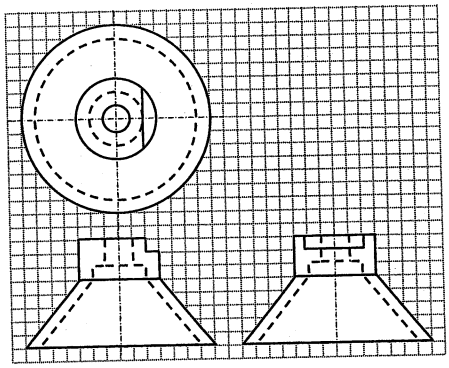
B) Gear no. 6 will rotate faster than gear no. 1 and in the opposite direction.

C) Gear no. 6 will rotate more slowly than gear no. 1 and in the same direction.

D) Gear no. 6 will rotate more slowly than gear no. 1 and in the opposite direction.

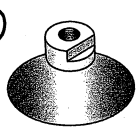
because it is longer.

14. The following diagram shows the orthogonal projection of an object.

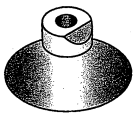


To which one of the following objects does this orthogonal projection correspond?

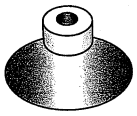
A)



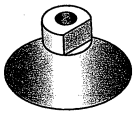
B)



C)

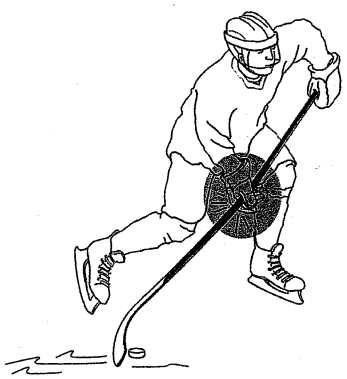


D)



15. New hockey sticks made of composite materials are lighter, but they break more often.

The illustration below shows a hockey stick breaking.



Which of the following constraints causes the hockey stick to break in this way?

A) Shearing

B) Compression

C) Deflection

D) Tension

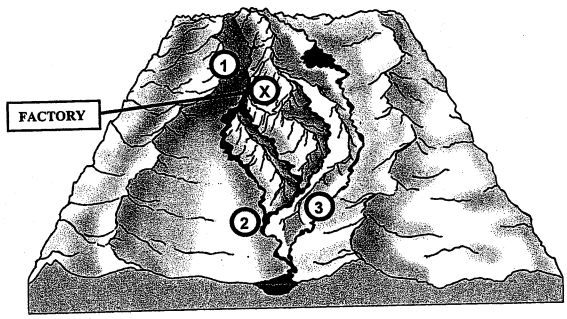
PART B

CONSTRUCTED-RESPONSE QUESTIONS

INSTRUCTIONS

Answer Questions 16 to 19 in your *Answer Booklet*, showing all your work.

16. A pharmaceutical company is planning to build a factory where indicated by the letter X on the map below.



Residents of towns 1, 2 and 3 indicated on the map are concerned about the quality of their water in the event of a toxic spill.

Which one of the **three towns** has reason to be concerned about the quality of its water? Explain your choice and also mention **why the other towns** have no reason to be concerned.

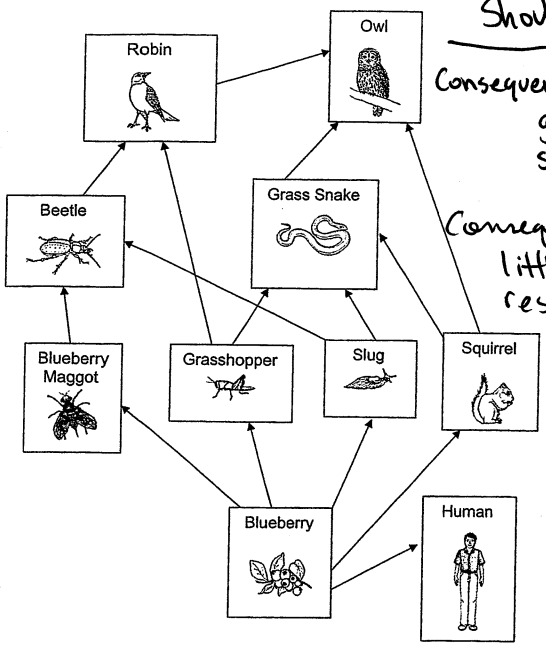
① Town 2

③ reasons Town 1 - is in the same drainage basin, but is higher up. No concern

Town 2 - Concerned. Spill will drain down to the town

Town 3 - No concern, different drainage basi

things, it shows the trophic relationships of the blueberry maggot and the slug, which are two pests that harm blueberry fields.



Should use B

Consequence of B: maggots population will go down. Beetle will eat more slugs ∴ (2 pests gone)

Consequence of A: dec. in slugs will have little effect on the rest.

A farmer has two methods for getting rid of these two pests, but he can only afford to use one of these methods.

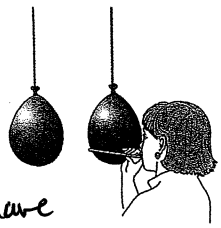
A) Using anti-slug granules that will also kill beetles

OR

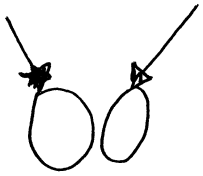
B) Using a fungus that specifically attacks blueberry maggots

Given the trophic relationships shown in the diagram above, which method (A or B) should the farmer use? Justify your choice by indicating the consequences **of each** method for this part of the blueberry field's trophic network.

two suspended balloons, as illustrated below.



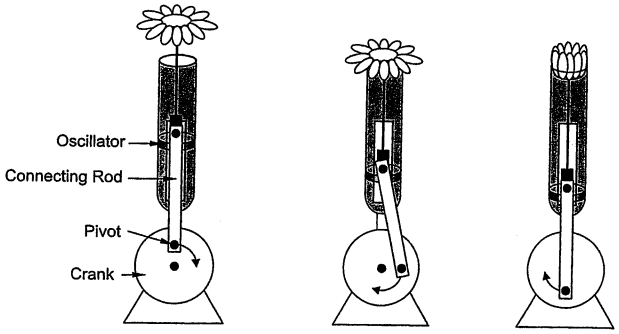
In your *Answer Booklet*, **draw a diagram** showing the behaviour of the two balloons and **explain** this behaviour using Bernoulli's principle.



as the air speed increases, the air pressure between the two decreases.

The air pressure on the other sid is higher. Forcing the ballons toget

19. The mechanism illustrated below moves a paper flower in and out of a container.



a) Is this a motion transmission or motion transformation mechanism? (1)

b) Explain why this mechanism is reversible. (1)

Because you can push the flower up + down to turn the crank.

c) From the list of changes suggested below, choose the combination of **two changes** that should be made to the mechanism so that the flower can come farther out of the container.

Change 1 – Increase the diameter of the crank.

Change 2 – Decrease the diameter of the crank.

Change 3 – Move the connecting rod pivot away from the centre of the crank.

Change 4 – Move the connecting rod pivot closer to the centre of the crank.

1 & 3 (2).

PART C

TECHNOLOGICAL ANALYSIS QUESTIONS

INSTRUCTIONS

Answer Questions 20 to 25 in your *Answer Booklet*, showing all your work.

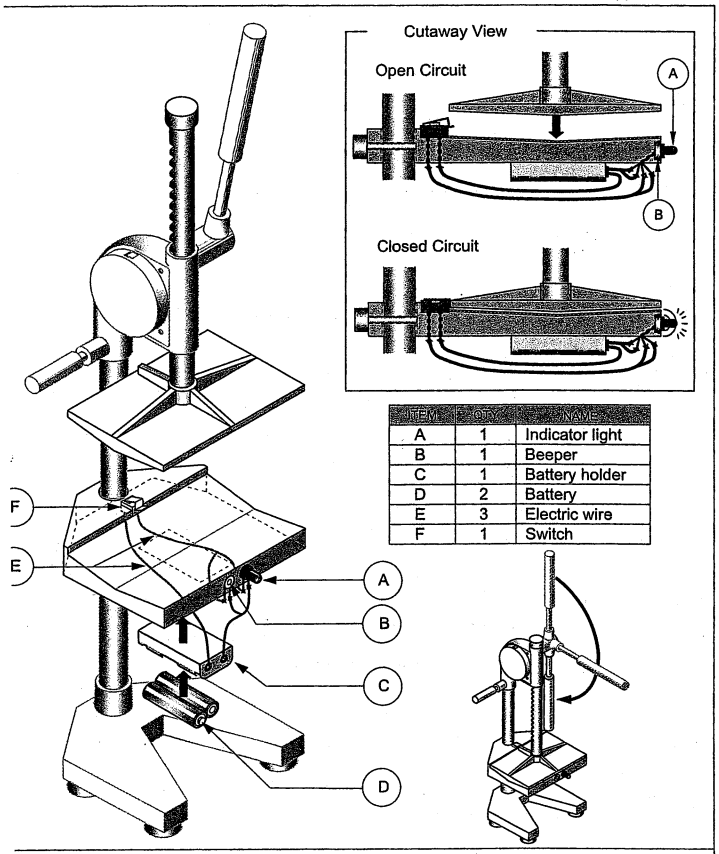
Some students in your school are analyzing a container crusher to understand how it works.

Overall Function

To crush household containers to reduce their volume.

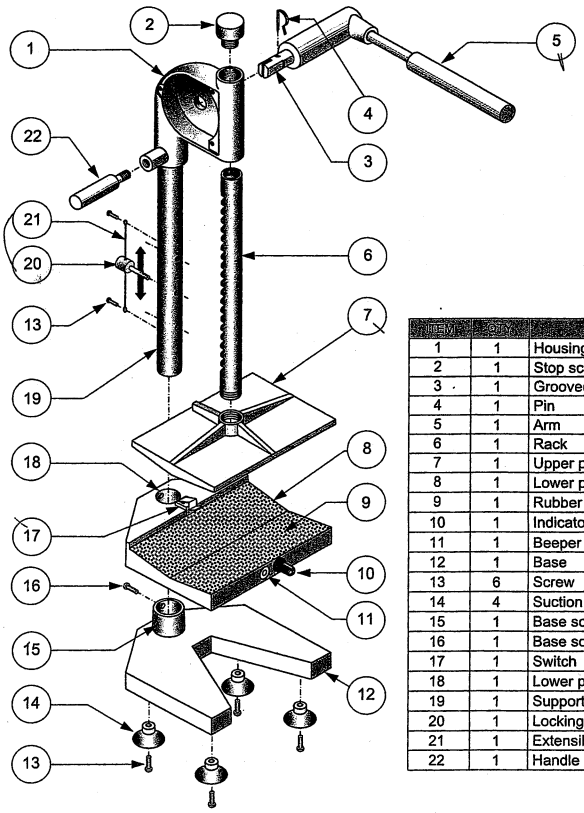
You must analyze the container crusher.

The information in the animated DVD presentation, as well as in Appendixes I, II and III on pages 21, 22 and 23, is needed to answer Questions 20 to 25.



ITEM	QTY.	NAME
A	1	Indicator light
B	1	Beeper
C	1	Battery holder
D	2	Battery
E	3	Electric wire
F	1	Switch

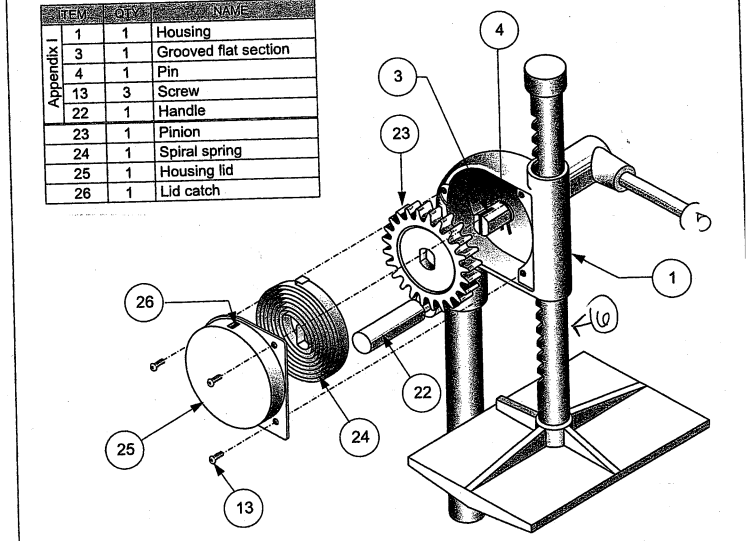
Container Crusher
Electrical Circuit, Names of Parts and Cutaway View

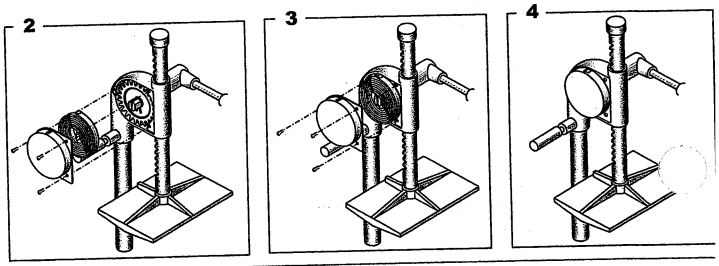


ITEM	QTY.	NAME
1	1	Housing
2	1	Stop screw
3	1	Grooved flat section
4	1	Pin
5	1	Arm
6	1	Rack
7	1	Upper plate
8	1	Lower plate
9	1	Rubber covering
10	1	Indicator light
11	1	Beeper
12	1	Base
13	6	Screw
14	4	Suction cup
15	1	Base socket
16	1	Base screw
17	1	Switch
18	1	Lower plate hole
19	1	Support rod
20	1	Locking pin
21	1	Extensible string
22	1	Handle

Container Crusher
Exploded View and Names of Parts

Appendix I	ITEM	QTY.	NAME
	1	1	Housing
	3	1	Grooved flat section
	4	1	Pin
	13	3	Screw
	22	1	Handle
	23	1	Pinion
	24	1	Spiral spring
	25	1	Housing lid
	26	1	Lid catch





Container Crusher
Housing (Item no. 1) Exploded View, Assembly and Names of Parts