
XV. Technology/Engineering, Grade 9/10 □

Grade 9/10 Technology/Engineering □

Pilot Test □

The spring 2005 Grade 9/10 MCAS Technology/Engineering Test was based on learning standards in the Technology/Engineering content strand of the Massachusetts *Science and Technology/Engineering Curriculum Framework* (2001). These learning standards appear on pages 82–86 of the *Framework*.

The *Science and Technology/Engineering Curriculum Framework* is available on the Department Web site at www.doe.mass.edu/frameworks/scitech/2001/0501.pdf.

Because the Grade 9/10 Technology/Engineering Test was administered as a pilot test this year, the reporting of results is limited to *Test Item Analysis Reports*. No scaled score or performance level results are available.

Test Sessions and Content Overview

The MCAS Grade 9/10 Technology/Engineering Test included two separate test sessions. Each session included multiple-choice and open-response questions.

Reference Materials and Tools

Each student taking the Grade 9/10 Technology/Engineering Test was provided with a plastic ruler. An image of the ruler is not reproduced in this publication.

Each student also had sole access to a calculator with at least four functions and a square root key. No other reference tools or materials were allowed.

The use of bilingual word-to-word dictionaries was allowed for limited English proficient students only, during both test sessions.

Cross-Reference Information

The table at the conclusion of this chapter indicates the *Framework* learning standard that each item assesses. The correct answers for multiple-choice questions are also displayed in the table.

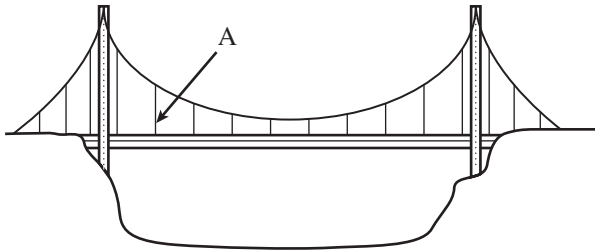
Technology/Engineering □

SESSION 1

DIRECTIONS

This session contains ten multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

- 1 The figure below shows a pictorial model of a highway bridge.



What is the primary structural action of member A?

- A. compression
- B. shear
- C. tension
- D. torsion

- 2 Foam weather stripping is often placed in the frames of doors and windows in a home. What is the purpose of this weather stripping?

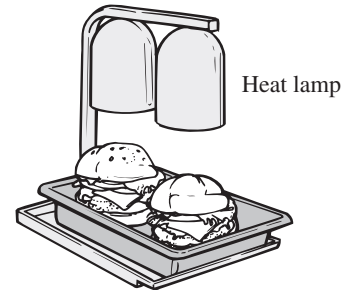
- A. The weather stripping increases heat transfer by radiation.
- B. Heat is conducted quickly through the weather stripping.
- C. The weather stripping reduces heat loss due to convection.
- D. Heat can transfer through the weather stripping due to reflection.

3 Before concrete has hardened, it exhibits plasticity. This is an advantage because it allows the concrete to

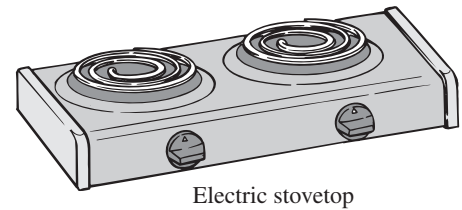
- A. become strong as it cures.
- B. withstand compression.
- C. remain pliable after hardening.
- D. be molded into almost any shape.

4 Which of the following objects transfers its energy **primarily** by radiation?

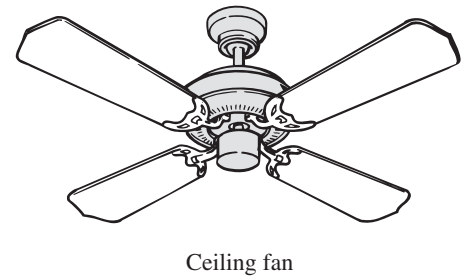
A.



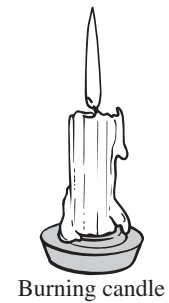
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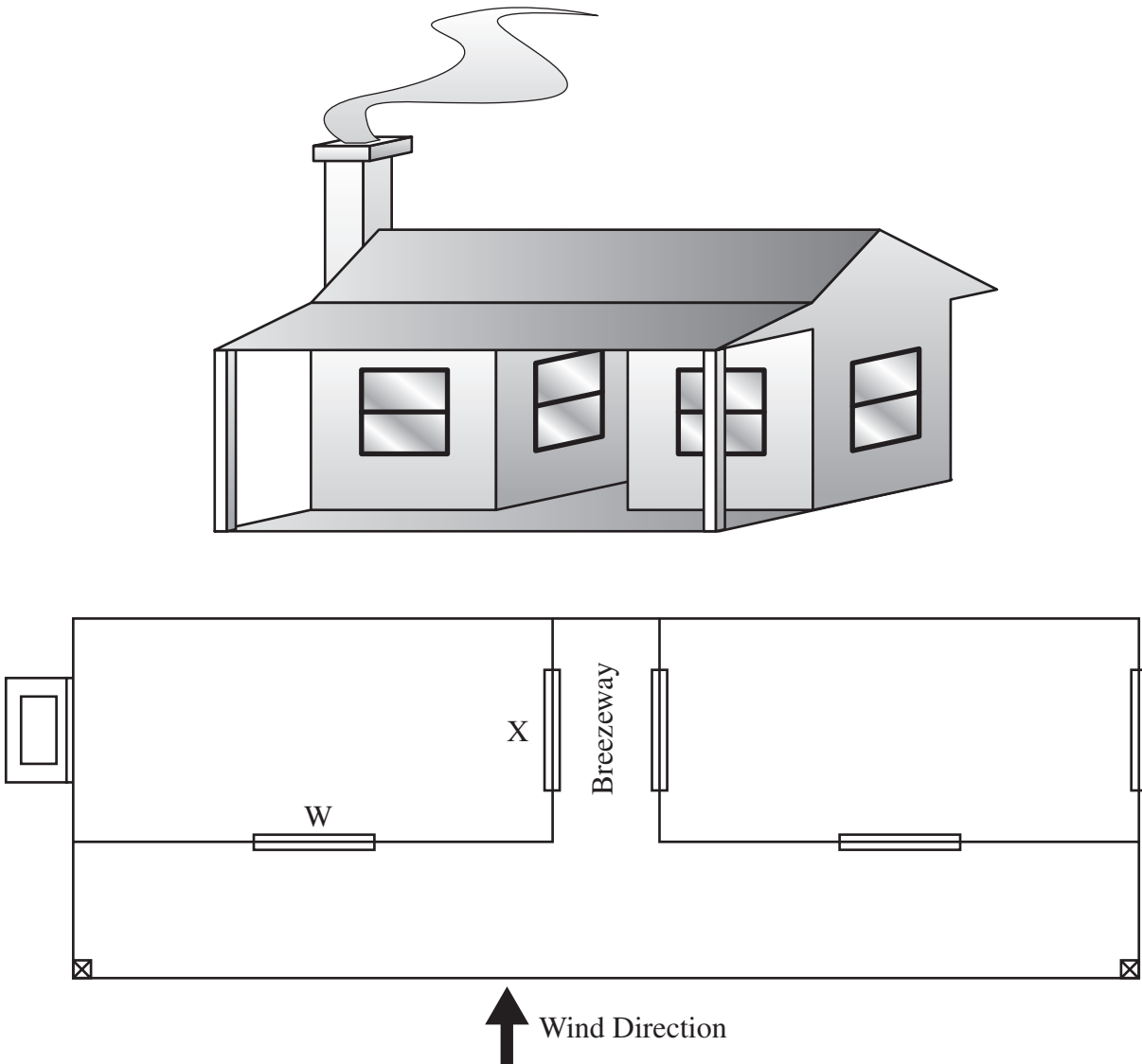
C.



D.



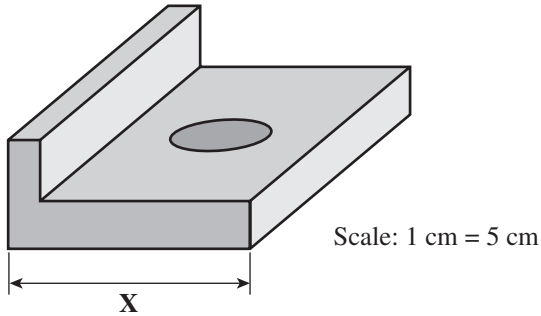
- 5 The diagram below shows a house and its floor plan.



Settlers' homes in the Southwestern United States were often built with a porch facing the prevailing breeze and with two rooms separated by a breezeway. The funneling effects of the porch and front building walls could significantly accelerate the wind. Considering the effects of Bernoulli's principle, what air flow should be expected for windows X and W?

- A. in W and out X
- B. in W and in X
- C. out W and in X
- D. out W and out X

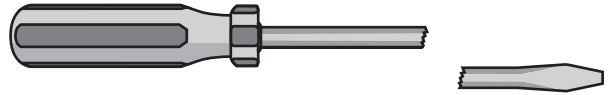
- 6 A scale drawing of a machined part is shown below.



What would be the actual dimension X of this part when it is built?

- A. 1.3 cm
- B. 3.20 cm
- C. 10.3 cm
- D. 16.0 cm

- 7 The figure below shows a screwdriver that broke while being used as a pry bar.



What does the break indicate about the material in the shaft of the screwdriver?

- A. It was too ductile.
- B. It was too brittle.
- C. It was too elastic.
- D. It was too dense.

Question 8 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

Write your answer to question 8 in the space provided in your Student Answer Booklet.

- 8 Susan has installed a wireless doorbell for her apartment. When a person presses the button on the doorframe, it sets off an electronic buzzer inside the apartment.
- a. Explain how the terms “encoder” and “decoder” apply to this communications system.

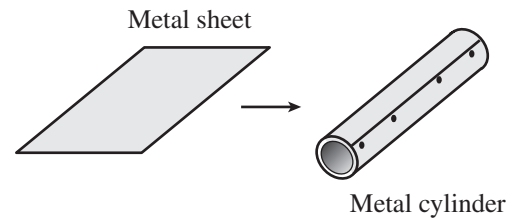
 - b. Describe how the system would fail if the encoder were broken.

 - c. Describe how the system would fail if the decoder were broken.

Mark your answers to multiple-choice questions 9 through 11 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 9 One method of heat distribution is a baseboard forced hot water system. A baseboard system carries hot water through a pipe that passes through many small, flat plates called fins. What is the purpose of these fins?
- A. to dissipate the heat of the hot water flowing through the pipe
 - B. to prevent the baseboard from coming in contact with hot surfaces
 - C. to replace the heated air leaving the system with cold air
 - D. to prevent dust and other particles from entering the baseboard

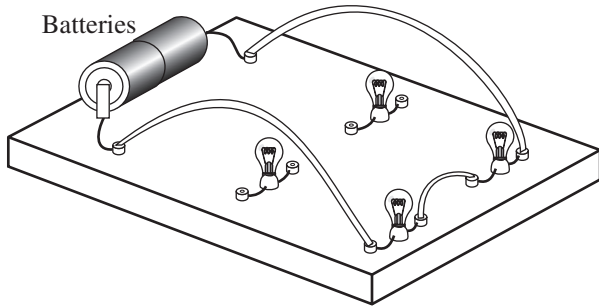
- 10 The diagram below shows a thin sheet of metal that has been rolled and fastened to make a cylinder.



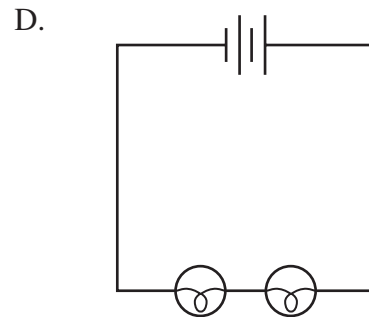
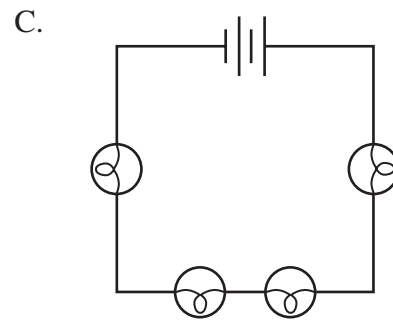
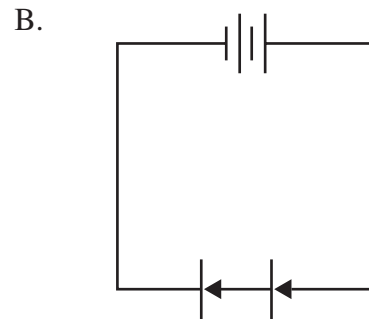
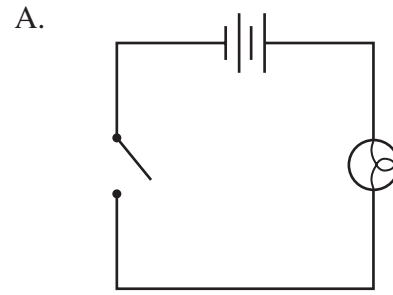
Which manufacturing process was used to create the cylinder?

- A. conditioning
- B. finishing
- C. forming
- D. molding

- 11 A circuit constructed on a circuit board is shown below.



Which of the following schematic circuits correctly represents the circuit shown?



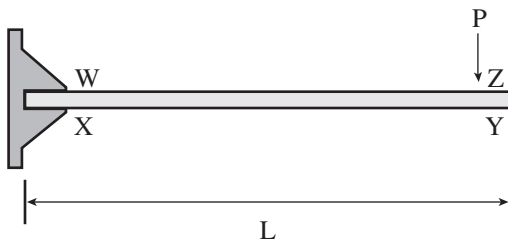
Technology/Engineering □

SESSION 2

DIRECTIONS

This session contains ten multiple-choice questions and one open-response question. Mark your answers to these questions in the spaces provided in your Student Answer Booklet. You may work out solutions to multiple-choice questions in the test booklet.

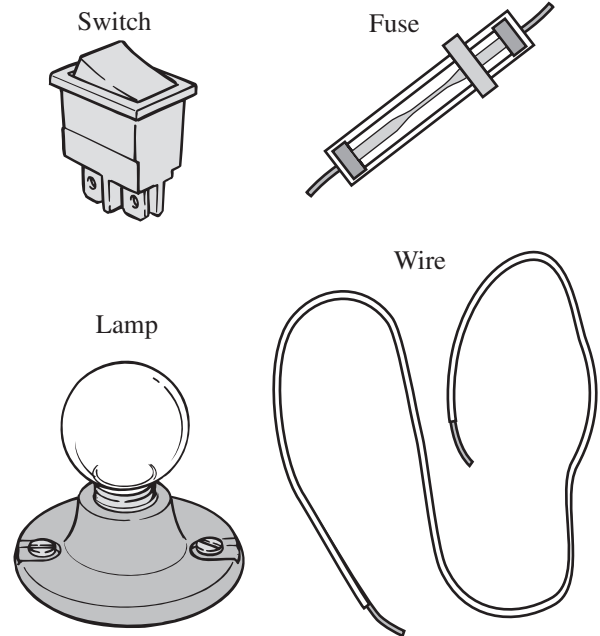
- 12 The diagram below shows a cantilever beam with a force (P) applied.



For the cantilever beam shown, where is the maximum tensile stress when force P is applied?

- A. W
- B. X
- C. Y
- D. Z

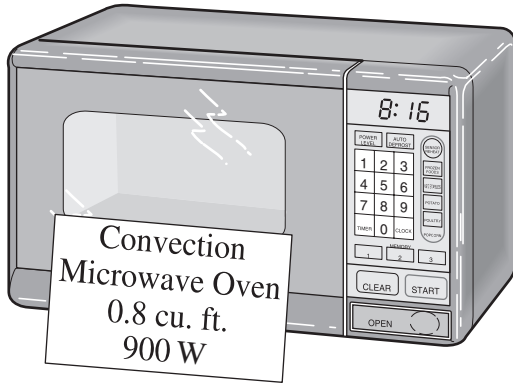
- 13 Several electrical components are drawn below.



Which of the following is needed to make an electrical circuit using these components?

- A. load
- B. resistor
- C. source
- D. transistor

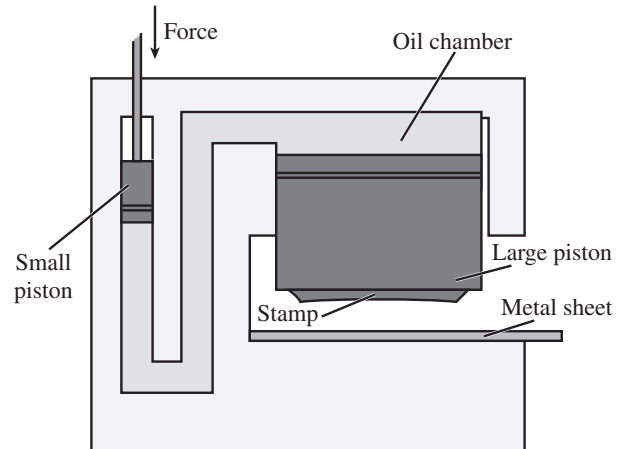
- 14 The picture below shows a microwave oven.



This microwave is labeled “Convection Microwave Oven.” According to this label, what is one way heat is transferred in this oven?

- A. by the movement of air inside the oven
- B. by standing waves in air outside the oven
- C. by electrostatic charges on atoms in the food
- D. by direct contact between the oven and the food

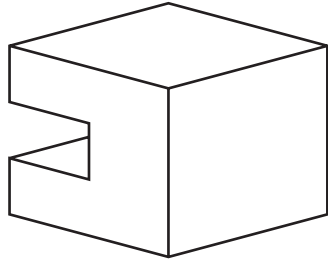
- 15 The diagram below shows a machine used in a factory.



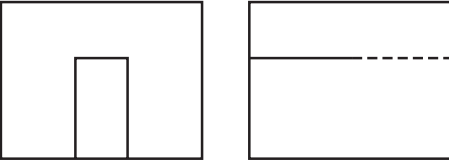
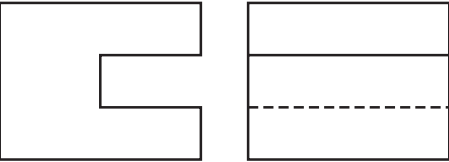
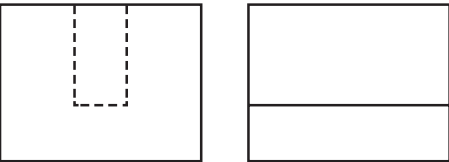
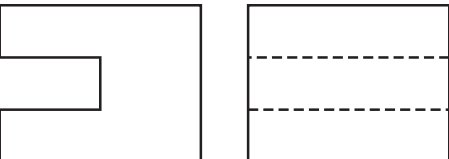
In this machine, fluid pressure is used to stamp sheets of metal with a large piston. Which type of system is illustrated?

- A. hydraulic lift
- B. hydraulic press
- C. pneumatic lift
- D. pneumatic press

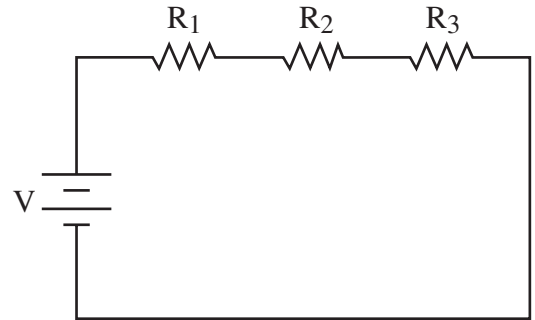
- 16 The drawing below shows a block with a groove along one side.



Which of the following sets of views could be the front and right-side views of this block?

- A. 
- B. 
- C. 
- D. 

- 17 The diagram below shows a circuit.



<p>Ohm's Law</p> $V = IR$ $I = \frac{V}{R}$ $R = \frac{V}{I}$
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The current in this circuit is 3 A. The resistance of R_1 is 2Ω . R_2 and R_3 each have a resistance of 4Ω . What is the voltage for this circuit?

- A. 6 V
- B. 10 V
- C. 30 V
- D. 90 V

Question 18 is an open-response question.

- **BE SURE TO ANSWER AND LABEL ALL PARTS OF THE QUESTION.**
- **Show all your work (diagrams, tables, or computations) in your Student Answer Booklet.**
- **If you do the work in your head, explain in writing how you did the work.**

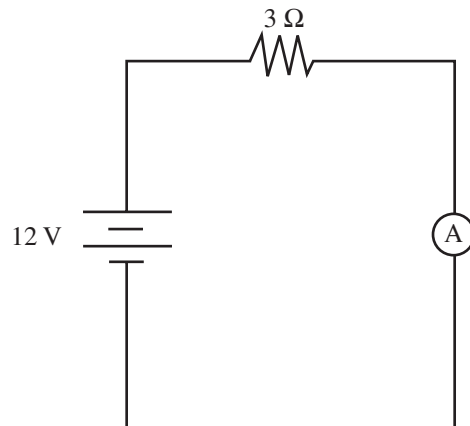
Write your answer to question 18 in the space provided in your Student Answer Booklet.

- 18** A group of students is doing a semester project to determine the best material for textbook covers. During the project, they will conduct a one-month pilot study in which a class of students will try out different types of textbook covers.
- Identify **one** step in the engineering design process that the students should do before starting the pilot study.
 - Explain in detail **one** step that the students should do after the pilot study.
 - Explain in detail why **both** of these steps are important.

Mark your answers to multiple-choice questions 19 through 22 in the spaces provided in your Student Answer Booklet. Do not write your answers in this test booklet, but you may work out solutions to multiple-choice questions in the test booklet.

- 19 Which of the following is the primary way that evergreen trees planted on the north and west sides of residences in Massachusetts help reduce winter heating costs?
- A. They insulate against cold air.
 - B. They optimize solar heating.
 - C. They reduce radiant cooling.
 - D. They act as a windbreak.

- 20 The diagram below shows a circuit.



Ohm's Law

$$V = IR$$

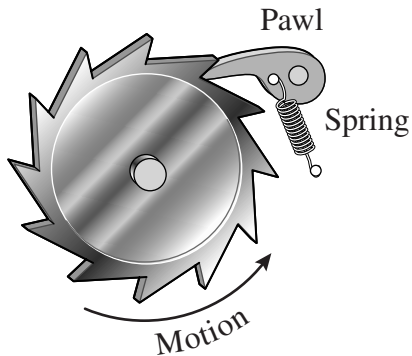
$$I = \frac{V}{R}$$

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

If the resistance in this circuit is 3Ω and the voltage is 12 V , what is the expected current in this circuit?

- A. 4 A
- B. 9 A
- C. 15 A
- D. 36 A

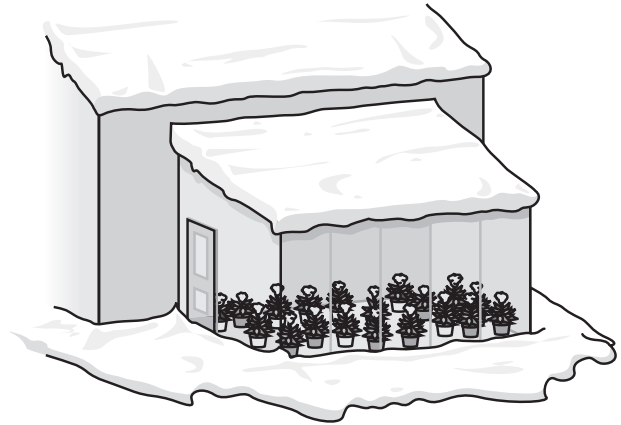
- 21 The drawing below shows a ratchet, which is a mechanical device.



Which of the following is the correct interpretation of this drawing?

- A. It shows the size of the finished device.
- B. It shows how a ratchet can be manufactured.
- C. It shows the operation of a ratchet mechanism.
- D. It shows the necessary materials for the device.

- 22 The figure below shows a snow-covered greenhouse.



The snow on the greenhouse has a density of 100 kg/m^3 and is 0.1 m deep. The roof is 5 m wide and 8 m long. What is the load of snow on the roof?

- A. 40 kg
- B. 400 kg
- C. $4,000 \text{ kg}$
- D. $40,000 \text{ kg}$

Grade 9/10 Technology/Engineering □

Spring 2005 Released Items: □

Standards and Correct Answers □

Item No.	Page No.	Standard	Correct Answer (MC)*
1	324	2.1	C
2	324	4.2	C
3	325	7.1	D
4	325	4.1	A
5	326	3.3	A
6	327	1.4	D
7	327	2.4	B
8	328	6.4	
9	329	4.2	A
10	329	7.1	C
11	330	5.2	D
12	331	2.1	A
13	331	5.2	C
14	332	4.1	A
15	332	3.4	B
16	333	1.2	D
17	333	5.4	C
18	334	1.1	
19	335	4.4	D
20	335	5.3	A
21	336	1.5	C
22	336	2.6	B

* Answers are provided here for multiple-choice items only. Sample responses and scoring guidelines for open-response items, which are indicated by shaded cells, will be posted to the Department's Web site later this year.