

CAPT Science Performance Task

Cold Packs

Certain chemicals when dissolved in water give off heat, while others become cold. These chemicals can be used in hot or cold packs. Cold packs can be used to reduce swelling from a bruise or injury.

A company is trying to develop a new cold pack. The cold pack will contain one chemical mixed with 50 mL of water. The company would like your help in determining which of the following chemicals is best for use in a cold pack and how much should be used.

Ammonium chloride (NH_4Cl)

Calcium chloride (CaCl_2)

Sodium chloride (NaCl)

Your Task

Part I: You and your partner will design and conduct an experiment to determine which of the three chemicals is best for use in a cold pack.

Part II: You and your partner will design and conduct an experiment to determine if the amount of the best chemical from Part I affects its use in the cold pack.

During this activity you will work with a partner (or possibly two partners). However, you must keep your own individual lab notes because after you finish you will work independently to write a report about your investigation.

You have been provided with the following materials and equipment. It may not be necessary to use all of the equipment that has been provided. You may use additional materials and equipment if they are available.

Note: You have been given 1 scoopful of each chemical. Use this amount for Part I and Part II.

1 scoopful ammonium chloride (NH_4Cl)

1 scoopful calcium chloride (CaCl_2)

1 scoopful sodium chloride (NaCl)

10 small plastic cups

Access to water

Access to a balance

Access to a watch or clock with a second hand

Splash-proof safety goggles and apron for each student

3 teaspoons

3 stirrers

1 graduated cylinder

1 thermometer

Labeling dots

1 pair of vinyl gloves

Paper towels for cleanup

CAPT Science Performance Task

Steps to Follow

1. **In your own words, clearly state the problems you are going to investigate for both Part I and Part II.** Include a clear identification of the independent and dependent variables that will be studied. Write a statement of the problems on pages 4 and 5.
2. **Design a separate experiment to solve each problem.** Use the amount of chemical you have been given for both Part I and Part II. Your experimental design should match the statement of the problem, should control for variables, and should be clearly described so that someone else could easily replicate your experiment. Include a control if appropriate.

Caution: Do not mix the chemicals together.

Write your experimental designs on pages 4 and 5. Show your designs to your teacher before you begin your experiments.

3. **After receiving approval from your teacher, work with your partner to carry out your experiments.** Your teacher's approval does not necessarily mean that your teacher thinks your experiments are well designed. It simply means that in your teacher's judgement your experiments are not dangerous or likely to cause an unnecessary mess.
4. **While conducting your experiments, take notes on the attached pages.** Include the results of your experiments. All data should be organized in tables, charts and graphs, which should be properly labeled. Space for your data has been provided on page 9.

Your notes will not be scored, but they will be helpful to you later as you work independently to write about your experiments and results. You must keep your own notes because you will not work with your partner when you write your lab report.

When you have finished your experiments, your teacher will give you instructions for clean up procedures, including proper disposal of all materials.

CAPT Experimentation Open-Ended Questions: *Cold Packs*

Cold Packs

Students in a science class carried out the *Cold Packs* performance task.

Group A carried out the following experiment.

1. We tried to find out which chemical would be best for lowering the temperature of water.
2. We poured 50 mL of water into each of four plastic cups and measured the temperature of the water in each cup.
3. We then added NH_4Cl to one cup, CaCl_2 to another cup, NaCl to the third cup, and nothing to the fourth cup and measured the temperature of each cup.

Our results are shown below.

Cup	Chemical Used	Beginning Temperature	Ending Temperature
A	NH_4Cl	25°C	18°C
B	CaCl_2	23°C	28°C
C	NaCl	22°C	20°C
D	None	22°C	22°C

1. What was the purpose of Cup D? Explain your answer fully.
2. Can a valid conclusion be drawn from group A's experiment and results? Explain your answer fully.

Cold Packs (continued)

Group B carried out the following experiment.

1. We were conducting an experiment to see which chemical is best for use in a cold pack.
2. We filled 3 plastic cups with 50 mL of water and measured the mass.
3. We measured the temperature of the water in each cup, added NH_4Cl to one cup, CaCl_2 and NaCl to the second and third cups, respectively and measured the mass of each cup.
4. We stirred the contents of each cup and measured the temperature again.
5. We then added more of the chemical to each cup, stirred and measured the temperature again.

Our results are shown below.

Cup	Chemical	Mass of Cup with Water	Mass of Cup with Water and Chemicals	Temperature Before Chemical Added	Temperature After Chemical Added	Temperature After More Chemical Added
A	NH_4Cl	52.1g	54.8g	23°C	18°C	17°C
B	CaCl_2	52.1g	53.7g	23°C	21°C	26°C
C	NaCl	52.2g	57.0g	23°C	21°C	20°C

3. Do you have enough information to replicate group B's experiment? If you think you do, tell what information you have. If you think you do not, tell what other information you would need.

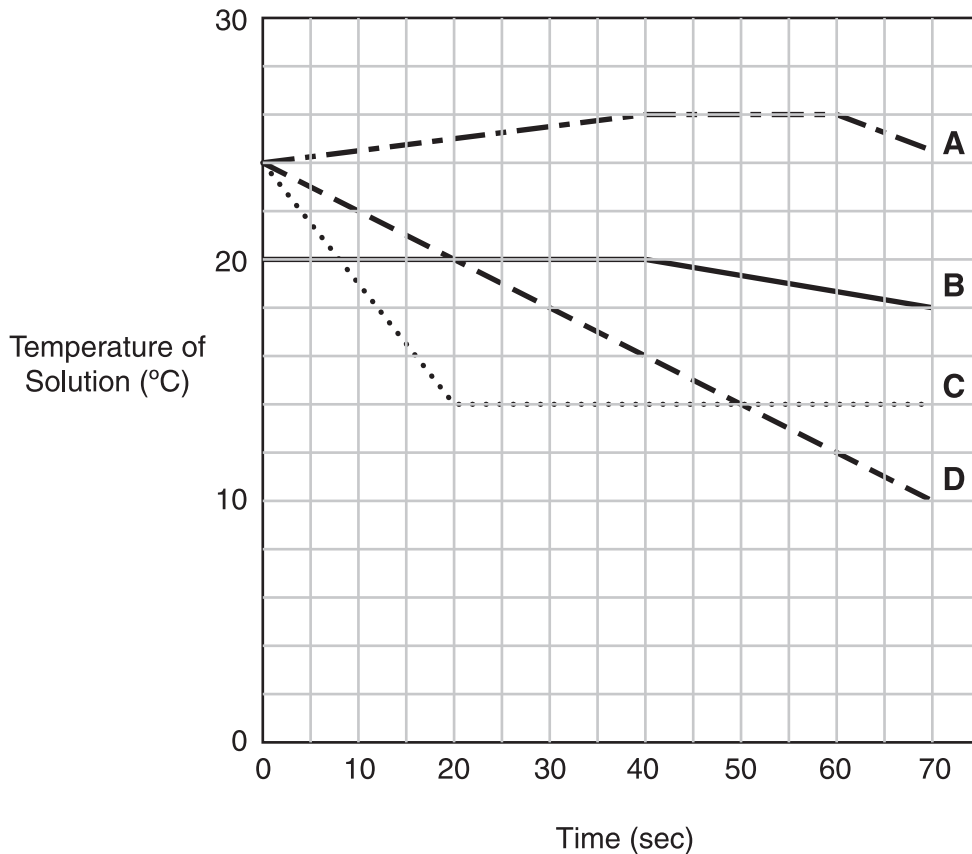
Cold Packs (continued)

Group D carried out the following experiment:

1. We compared four chemicals to find out which would be best in a cold pack.
2. We added 50 mL of water to each of four cups and measured the temperature.
3. We then added 8g of chemical A to cup 1, 8g of chemical B to cup 2, 8g of chemical C to cup 3, and 8g of chemical D to cup 4.
4. We measured the temperature of the water in each cup every ten seconds for 70 seconds.

Our results are shown in the graph below:

Effect of Four Chemicals on Temperature of Water Over Time



4. According to group D's results, which chemical would be best for use in a cold pack? Explain your answer fully.

CAPT Experimentation Multiple-Choice Questions: *Cold Packs*

Cold Packs

Students in a science class carried out the *Cold Packs* experiment.

Group X carried out the following experiment.

1. The problem we investigated was which chemical makes the best cold pack.
2. We poured 50 mL of water into each of three cups.
3. We then added one teaspoon of NaCl to one cup, one teaspoon of CaCl₂ to another cup, and one teaspoon of NH₄Cl to the third cup and measured the temperature of the water in each cup.

Our results are shown below.

Cup	Amount of Chemical	Chemical Used	Temperature
A	1 teaspoon	NaCl	23°C
B	1 teaspoon	CaCl ₂	28°C
C	1 teaspoon	NH ₄ Cl	20°C

5. Which of the following **best** identifies the independent variable in Group X's experiment?
 - a. the size of the cup
 - b. the type of chemical used ⊗
 - c. the temperature of the water
 - d. the amount of each chemical used
6. Which of the following is **not** necessary to improve Group X's experiment?
 - f. Add a Cup D with 50 mL of water only as a control.
 - g. Measure the beginning temperature.
 - h. Use two teaspoons of chemicals instead of one. ⊗
 - j. Do more trials.

CAPT Experimentation Multiple-Choice Questions: *Cold Packs (continued)*

Group Y carried out the following experiment:

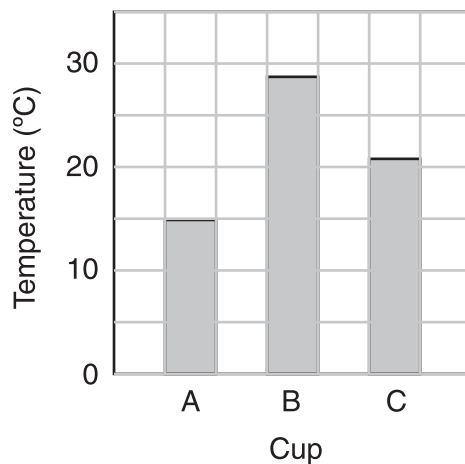
1. We compared chemicals to determine which changed the temperature of water the most.
2. We poured 50 mL of water into each of three small plastic cups and measured the temperature of the water in each cup.
3. We then added one teaspoon of NH_4Cl to one cup, one teaspoon of CaCl_2 to another cup, and one teaspoon of NaCl to the third cup and measured the temperature of the solution in each cup.
4. We added one more teaspoon of chemical to each cup and measured the temperature again.

Our results are shown below.

Cup	Chemical	Temperature Before Chemical Added	Temperature After One Teaspoon of Chemical Added	Temperature After Two Teaspoons of Chemical Added
A	NH_4Cl	22°C	17°C	15°C
B	CaCl_2	22°C	25°C	28°C
C	NaCl	22°C	22°C	21°C

CAPT Experimentation Multiple-Choice Questions: *Cold Packs (continued)*

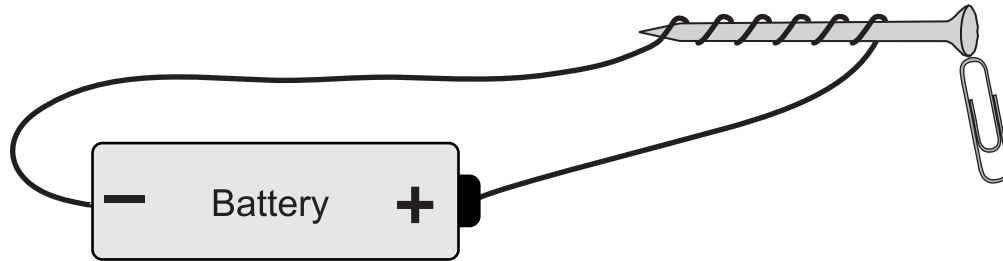
Results after 2 Teaspoons of Chemical Added



7. Group Y made the graph shown above of their data. Which of the following conclusions is **best** supported by their graph?
- Increasing the amount of chemical lowers the temperature.
 - The chemicals have no effect on the temperature.
 - Cup A has the lowest ending temperature. ⓧ
 - The beginning temperature is the same for each cup.
8. Which of the following would **most** improve Group Y's experiment?
- Use a fourth chemical
 - Use a cup with water only ⓧ
 - Add the chemical all at once
 - Use 100 mL of water instead of 50 mL

CAPT Physical Science Open-Ended Question:
Lifting a Paper Clip

Lifting a Paper Clip

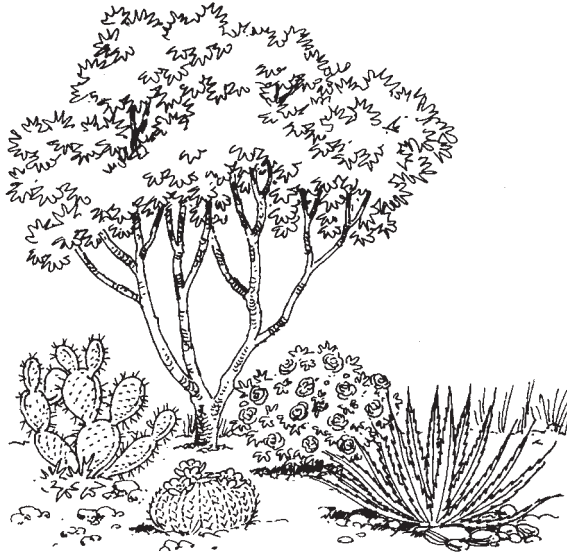


The diagram above shows a wire connected to a battery. The wire is wrapped around an iron nail. This setup can be used to lift a metal paper clip as shown.

Explain how the nail is able to lift the paper clip. Also describe how the setup could be altered in order to lift a heavier metal object.

CAPT Life Science Open-Ended Question:
Plant Survival

Plant Survival



Plants often exhibit adaptations that protect them from predators. Name several features of plants that protect the plant against predation and explain fully how each provides that protection.

CAPT Earth Science Open-Ended Question:
Crop Rotation

Crop Rotation



Crop rotation involves planting different types of crops on a piece of land on a yearly basis. For example, a farmer might plant corn one year and peanuts the next year. Explain why crop rotation on a farm is important.

CAPT Physical Science Multiple-Choice Questions: *The Structure & Properties of the Elements*

The Structure and Properties of the Elements

Atoms can be considered the basic building blocks of matter.

Atom X has 9 protons, 10 neutrons and 9 electrons
Atom Y has 9 protons, 9 neutrons and 9 electrons

1. Which of the following statements **best** describes how Atom X and Atom Y are related?
- X and Y are isotopes of the same element. ⊛
 - X is an ion and Y is a neutral atom.
 - X and Y are different elements.
 - X is neon and Y is fluorine.

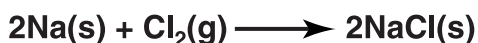
Periodic Table of the Elements

	I											XVIII					
	1		II									XIII	XIV	XV	XVI	XVII	
	2																
	3			III	IV	V	VI	VII	VIII	IX	X	XI	XII				
Period	4																
	5																
	6																
	7																

2. Different elements are **most likely** to react in similar ways when they _____.
- are members of the same period
 - are members of the same group ⊛
 - have nearly the same atomic mass
 - have the same number of neutrons

CAPT Physical Science Multiple-Choice Questions: *The Structure & Properties of the Elements*

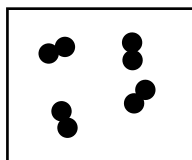
3. Which of the properties of gold would be **most** useful to test if an object is made of pure gold, without damaging it?
- Gold's melting point is 1065° C.
 - Gold is an excellent conductor of electricity.
 - Gold is one of the few metals that is colored.
 - Gold's density is 19.3 grams per cubic centimeter. ⊛



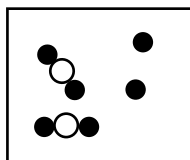
s = solid
g = gas

4. The equation represents a chemical change because _____.
- it is balanced
 - the product is solid
 - a new substance is produced ⊛
 - there are two substances on the reactant side

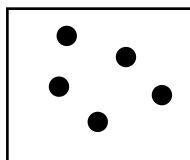
The circles and dots in the boxes below represent atoms of two different elements. Atoms touching each other are considered bonded to each other.



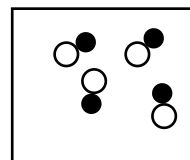
A



B



C



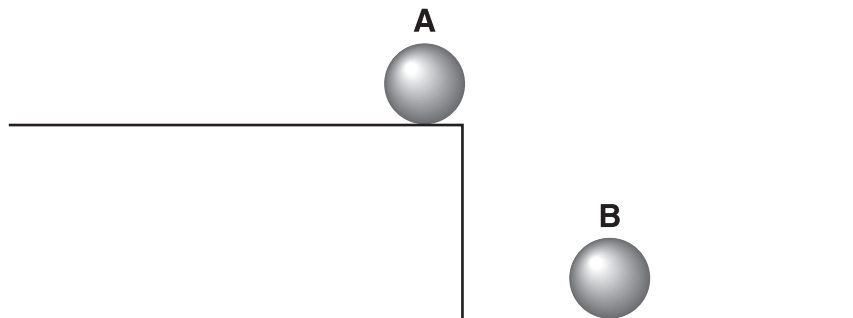
D

5. Which box contains a mixture?
- A
 - B ⊛
 - C
 - D

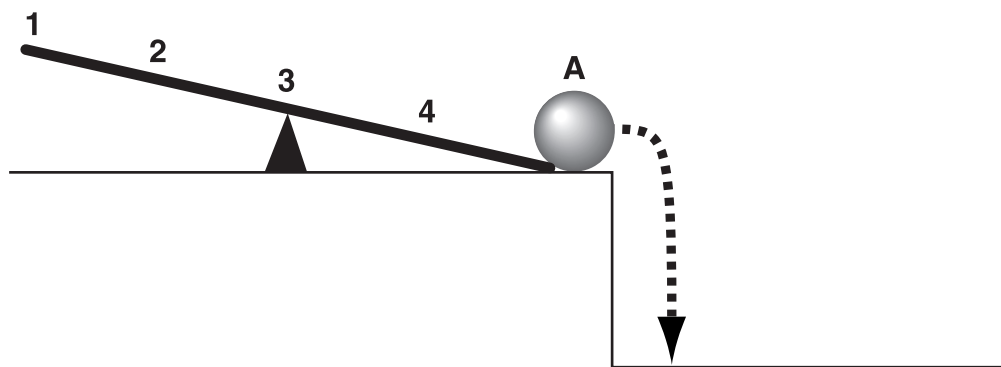
CAPT Physical Science Multiple-Choice Questions: *Bowling Balls*

Bowling Balls

The diagram shows two bowling balls of equal mass. Ball A is resting near the edge of a shelf. Ball B is resting on the ground below.



1. Which of these statements **best** describes the diagram above?
 - a. Ball A has more kinetic energy than Ball B.
 - b. Ball B has more kinetic energy than Ball A.
 - c. Ball A has more potential energy than Ball B. ⓧ
 - d. Ball B has more potential energy than Ball A.



2. The lever shown above can be used to move the bowling ball off the shelf. Pushing down at what point on the lever would require you to apply the least amount of force to move the ball?
 - f. 1 ⓧ
 - g. 2
 - h. 3
 - j. 4

CAPT Physical Science Multiple-Choice Questions: *Bowling Balls (continued)*

3. A student picked up Ball A off a shelf and threw it. Which of the following would show the flow of energy from its source?
- a. Light energy from the sun → chemical energy in food → chemical energy in the student → mechanical energy in the ball ⊗
 - b. Light energy from the sun → chemical energy in the student → chemical energy in food → mechanical energy in the ball
 - c. Chemical energy in the student → mechanical energy in the ball → chemical energy in food → light energy from the sun
 - d. Chemical energy in the student → chemical energy in food → mechanical energy in the ball → light energy from the sun

CAPT Life Science Multiple-Choice Questions: *Genes and Traits*

Genes and Traits

In human beings, earlobes can be free or attached. Some people can roll their tongues while others cannot.

The genotype and phenotype of two parents are shown below.

	Male	Female
Genotype	FFTt	Ffft
Phenotype	Free earlobes, Can roll tongue	Free earlobes, Cannot roll tongue

KEY:
 F = Free earlobe
 f = Attached earlobe
 T = Can roll tongue
 t = Cannot roll tongue

1. Which trait **cannot** be transferred by this mother?
 - a. Free earlobes
 - b. Attached earlobes
 - c. Cannot roll tongue
 - d. Can roll tongue ☒

2. Which trait will all of the offspring of the cross shown above exhibit?
 - f. Can roll tongue
 - g. Cannot roll tongue
 - h. Attached earlobes
 - j. Free earlobes ☒

3. Children would **not** be able to roll their tongues if they inherited a _____.
 - a. t allele from both parents ☒
 - b. T allele from both parents
 - c. T allele from the mother and the t allele from the father
 - d. t allele from the mother and the T from the father

CAPT Earth Science Multiple-Choice Questions: *Rocks and Weathering*

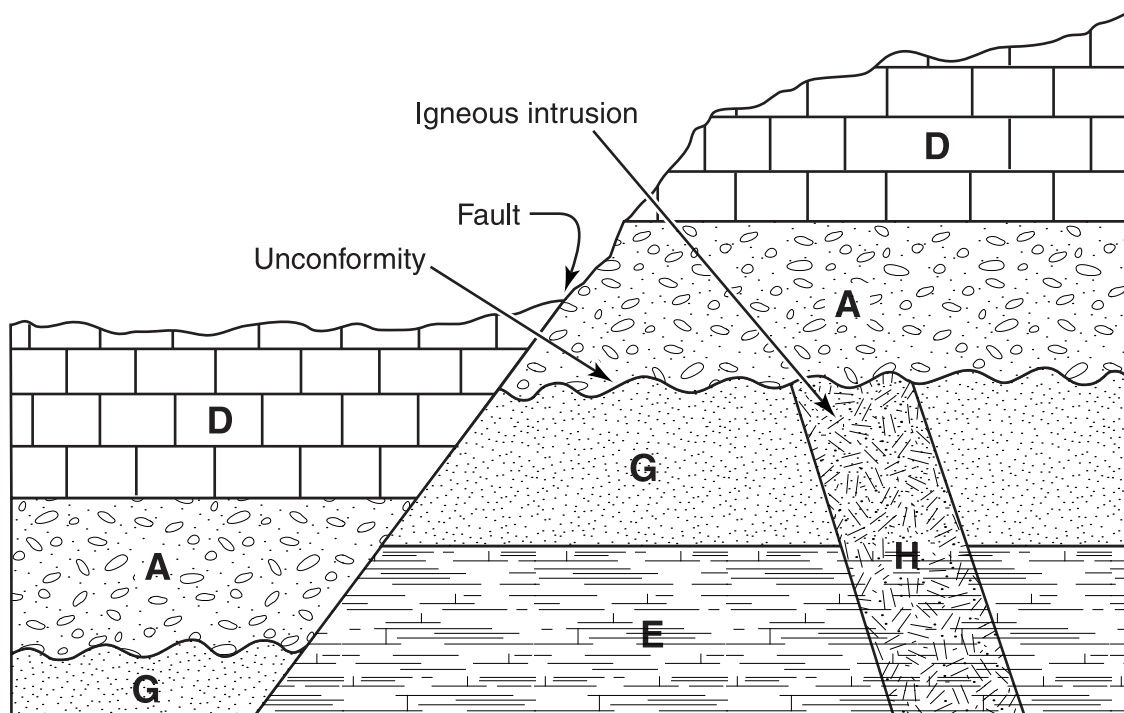
Rocks and Weathering

Earth scientists use theories and principles to help determine the relative age and formation of rocks and landforms.

Superposition Younger sedimentary rock layers are generally found on top of older rock layers.

Cross-cutting Faults and igneous intrusions are younger than the rock they cut through.

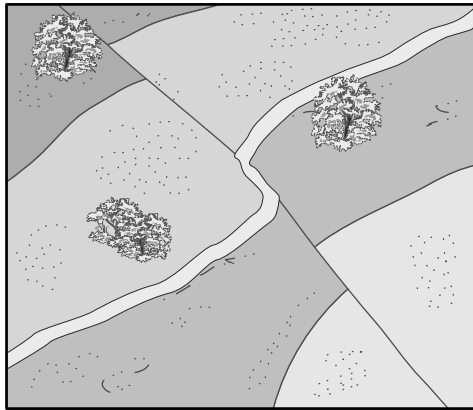
Unconformities An eroded surface that separates older rocks below from younger rocks above.



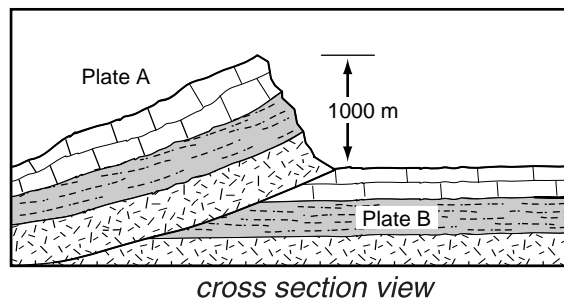
1. Which rock layer is the oldest?
 - a. A
 - b. D
 - c. E ⊕
 - d. G

CAPT Earth Science Multiple-Choice Questions: *Rocks and Weathering (continued)*

2. Which statement about the formation of rocks is true?
- f. Heat and pressure can change igneous rock to sedimentary rock.
 - g. Weathering and erosion can change sedimentary rock into sediment. ☉
 - h. Heat and pressure cause metamorphic rock to weather and erode.
 - j. Weathering and erosion prevent magma from changing into igneous rock.



3. This area of land with a variety of surface features is viewed from **above**. What caused the shift of the surface features?
- a. A fault ☉
 - b. A road
 - c. A flowing stream
 - d. A volcanic intrusion



4. How was the mountain shown above **most likely** formed?
- f. Plates A and B are moving towards each other. ☉
 - g. Plates A and B are moving apart from each other.
 - h. Plate A is moving away and Plate B is stationary.
 - j. Plate A is stationary and Plate B is moving away.