The ACT

Science Practice Test

Questions and Answers

Passage I

Unmanned spacecraft taking images of Jupiter's moon Europa have found its surface to be very smooth with few meteorite craters. Europa's surface ice shows evidence of being continually resmoothed and reshaped. Cracks, dark bands, and pressure ridges (created when water or slush is squeezed up between 2 slabs of ice) are commonly seen in images of the surface. Two scientists express their views as to whether the presence of a deep ocean beneath the surface is responsible for Europa's surface features.

Scientist 1

A deep ocean of liquid water exists on Europa. Jupiter's gravitational field produces tides within Europa that can cause heating of the subsurface to a point where liquid water can exist. The numerous cracks and dark bands in the surface ice closely resemble the appearance of thawing ice covering the polar oceans on Earth. Only a substantial amount of circulating liquid water can crack and rotate such large slabs of ice. The few meteorite craters that exist are shallow and have been smoothed by liquid water that oozed up into the crater from the subsurface and then quickly froze.

Jupiter's magnetic field, sweeping past Europa, would interact with the salty, deep ocean and produce a second magnetic field around Europa. The spacecraft has found evidence of this second magnetic field.

Scientist 2

No deep, liquid water ocean exists on Europa. The heat generated by gravitational tides is quickly lost to space because of Europa's small size, as shown by its very low surface temperature (–160°C). Many of the features on Europa's surface resemble features created by flowing glaciers on Earth. Large amounts of liquid water are not required for the creation of these features. If a thin layer of ice below the surface is much warmer than the surface ice, it may be able to flow and cause cracking and movement of the surface ice. Few meteorite craters are observed because of Europa's very thin atmosphere; surface ice continually sublimes (changes from solid to gas) into this atmosphere, quickly eroding and removing any craters that may have formed.

1. **Which of the following best describes how the 2 scientists explain how craters are removed from Europa's surface?**

A. ○ Scientist 1:Sublimation
Scientist 2: Filled in by water

B. ◉ Scientist 1: Filled in by water
Scientist 2: Sublimation

C. ○ Scientist 1: Worn smooth by wind
Scientist 2: Sublimation

D. ○ Scientist 1: Worn smooth by wind
Scientist 2: Filled in by water

CORRECT RESPONSE ^

B is the best answer. Scientist 1 says that the craters are smoothed by liquid water that oozes up into the craters from the subsurface and then quickly freezes. Scientist 2 says that when ice sublimates, the craters are eroded and smoothed.

2. **According to the information provided, which of the following descriptions of Europa would be accepted by both scientists?**

E. ○ Europa has a larger diameter than does Jupiter.

F. ○ Europa has a surface made of rocky material.

G. ○ Europa has a surface temperature of 20°C.

H. ◉ Europa is completely covered by a layer of ice.

CORRECT RESPONSE ^

H is the best answer. Both scientists indicate that ice covers large portions of the surface and neither discusses the presence of any other surface material. So, both scientists would likely agree that Europa is completely covered by a layer of ice.

3. **With which of the following statements about the conditions on Europa or the evolution of Europa's surface would both Scientist 1 and Scientist 2 most likely agree? The surface of Europa:**

A. ◉ is being shaped by the movement of ice.

B. ○ is covered with millions of meteorite craters.

C. ○ is the same temperature as the surface of the Arctic Ocean on Earth.

D. ○ has remained unchanged for millions of years.

CORRECT RESPONSE ^

A is the best answer. Scientist 1 states that Europa's surface is partially composed of large slabs of ice that rotate. Scientist 2 states that many of the features on Europa's surface resemble features created by flowing glaciers on Earth. Thus, both would likely agree that Europa's surface is being shaped by the movement of ice.

4. **Which of the following statements about meteorite craters on Europa would be most consistent with both scientists' views?**

E. ○ No meteorites have struck Europa for millions of years.

F. ◉ Meteorite craters, once formed, are then smoothed or removed by Europa's surface processes.

G. ○ Meteorite craters, once formed on Europa, remain unchanged for billions of years.

H. ○ Meteorites frequently strike Europa's surface but do not leave any craters.

CORRECT RESPONSE ^

F is the best answer. Both scientists describe surface processes that smooth or remove meteorite craters. Scientist 1 says that the craters become smooth when liquid water oozes into the craters and then quickly freezes. Scientist 2 says the process is the result of the sublimation of ice.

5. **Scientist 2 explains that ice sublimes to water vapor and enters Europa's atmosphere. If ultraviolet light then broke those water vapor molecules apart, which of the following gases would one most likely expect to find in Europa's atmosphere as a result of this process?**

A. ○ Nitrogen

B. ○ Methane

C. ○ Chlorine

D. ◉ Oxygen

CORRECT RESPONSE ^

D is the best answer. Water vapor molecules are composed of hydrogen and oxygen. The breakdown of these molecules would lead to the production of oxygen (O_2) in the atmosphere.

6. **Based on the information in Scientist 1's view, which of the following materials must be present on Europa if a magnetic field is to be generated on Europa?**

E. ○ Frozen nitrogen

F. ○ Water ice

G. ◉ Dissolved salts

H. ○ Molten magma

CORRECT RESPONSE ^

G is the best answer. Scientist 1 states that a second magnetic field exists around Europa and that this magnetic field is caused by an interaction between Jupiter's magnetic field and the deep, salty ocean. So, Scientist 1 believes that the second magnetic field exists because of the presence of dissolved salts.

7. **Assume Scientist 2's view about the similarities between Europa's surface features and flowing glaciers on Earth is correct. Based on this assumption and the information provided, Earth's glaciers would be *least* likely to exhibit which of the following features?**

A. ○ Pressure ridges

B. ○ Cracks

C. ◉ Meteorite craters

D. ○ Dark bands

CORRECT RESPONSE ^

C is the best answer. Scientist 2 states that many of the features on Europa's surface resemble features created by flowing glaciers on Earth. These features include cracks, dark bands, and pressure ridges. So, Earth's glaciers might exhibit these features. However, Scientist 2 does not indicate that Earth's glaciers might exhibit meteorite craters.

DIRECTIONS: The passage in this test is followed by several questions. After reading the passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passage as often as necessary.

You are NOT permitted to use a calculator on this test.

Passage II

A student studying how gases diffuse derived the following formula:

$$\frac{\text{distance Gas A travels}}{\text{distance Gas B travels}} = \frac{\sqrt{\text{molecular weight of Gas B}}}{\sqrt{\text{molecular weight of Gas A}}}$$

The following experiments were conducted to test her formula and to study factors affecting the rate at which gases diffuse.

Experiment 1

When hydrogen chloride (HCl) and ammonia (NH3) vapors react, they form solid ammonium chloride (NH4Cl):

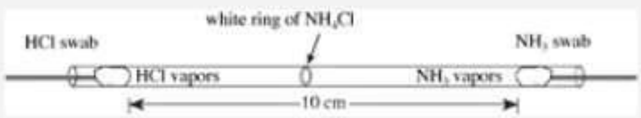
$$HCl(g) + NH_3(g) \rightarrow NH_4Cl(s)$$

A swab soaked with HCl solution was inserted into one end of a glass tube (1 cm diameter), and, simultaneously, a swab soaked with NH3 solution was inserted into the other end, so that the swabs were 10 cm apart. The distance that each vapor traveled could be determined because, at the point they made contact, a white ring of NH4Cl formed (see Figure 1). The reaction was done at different temperatures. The time it took for the ring to start to form and its distance from the HCl swab were measured for each trial (see Table 1).

Table 1

Trial	Temperature (°C)	Time (sec)	Distance of ring from HCl swab (cm)
1	20	33	4.0
2	30	30	4.1
3	40	26	4.1
4	50	23	4.0

Using the formula, the student predicted that the distance of the ring from the HCl swab would be 4.06 cm, so the student concluded that her formula was correct.



Experiment 2

Experiment 1 was repeated, but the temperature was held constant at 20°C and the diameter of the tube was varied for each trial (see Table 2).

Table 2

Trial	Tube diameter (cm)	Time (sec)	Distance of ring from HCl swab (cm)
5	1.0	33	4.0
6	1.2	33	4.0
7	1.4	33	4.1
8	1.6	33	4.0

Experiment 3

Experiment 2 was repeated, but the diameter of the tube was kept constant at 1 cm and longer tubes were used so that the distance between the swabs could be varied for each trial (see Table 3).

Table 3

Trial	Distance between swabs (cm)	Time (sec)	Distance of ring from HCl swab (cm)
9	10	33	4.0
10	20	67	8.1
11	30	101	12.2
12	40	133	16.2

1. **Which of the following best describes the difference between the procedures used in Experiments 1 and 2 ? In Experiment 1, the:**

A. ◉ temperature was varied; in Experiment 2, the diameter of the tube was varied.

B. ○ diameter of the tube was varied; in Experiment 2, the temperature was varied.

C. ○ distance between the swabs was varied; in Experiment 2, the temperature was varied.

D. ○ temperature was varied; in Experiment 2, the distance between the swabs was varied.

CORRECT RESPONSE ^

A is the best answer. Table 1 shows that in Experiment 1, 4 different temperatures were used: 20°C, 30°C, 40°C, and 50°C. Table 2 shows that in Experiment 2, 4 different tube diameters were used: 1.0 cm, 1.2 cm, 1.4 cm, and 1.6. So, in Experiment 1, temperature was varied. In Experiment 2, tube diameter was varied.

2. **Which of the following sets of trials in Experiments 1, 2, and 3 were conducted with identical sets of conditions?**

E. ○ Trials 2, 3, and 4

F. ◉ Trials 1, 5, and 9

G. ○ Trials 4, 7, and 9

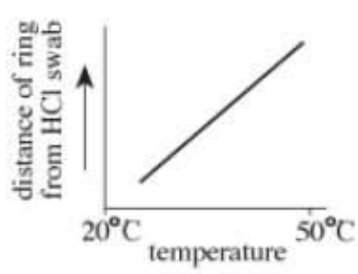
H. ○ Trials 10, 11, and 12

CORRECT RESPONSE ^

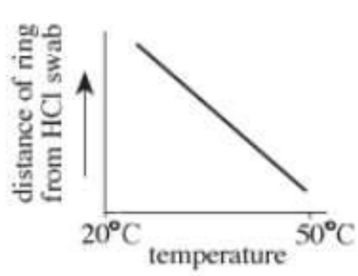
F is the best answer. In Experiments 2 and 3, all of the trials were performed at 20˚C. In Experiment 1, only Trial 1 was performed at this temperature. So, Trial 1 must be part of the answer. Trial 5, in Experiment 2, used the same set of conditions as did Trial 1: temperature = 20˚C; tube diameter = 1.0 cm; swab distance = 10 cm. Trial 9, in Experiment 3, used the same set of conditions as did Trial 1: temperature = 20˚C; tube diameter = 1.0 cm; swab distance = 10 cm.

3. **Based on the results of Experiment 1, which of the following graphs best shows the relationship between the temperature and the distance of the ring from the HCl swab?**

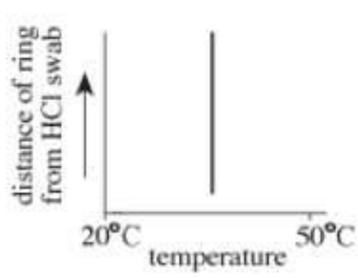
A. ○



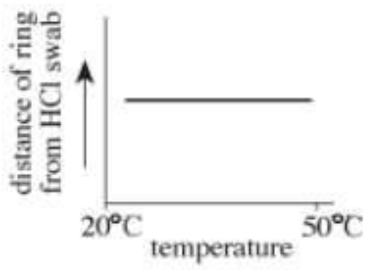
B. ○



C. ○



D. ◉



CORRECT RESPONSE

D is the best answer. This graph indicates that as temperature increased, the distance of the ring from the HCl swab remained constant. The data in Table 1 also show that as temperature increased, the distance of the ring from the HCl swab remained nearly constant.

4. **If a trial in Experiment 3 had been performed with the swabs 25 cm apart, the distance from the HCl swab to the ring would most likely have been closest to:**

E. ○ 8 cm

F. ◉ 10 cm

G. ○ 12 cm

H. ○ 14 cm

CORRECT RESPONSE

F is the best answer. In Experiment 3, as the distance between the swabs increased, the distance of the ring from the HCl swab increased. When the swabs were 20 cm apart, the distance between the ring and the HCl swab was 8.1 cm. When the swabs were 30 cm apart, the distance between the ring and the HCl swab was 12.2 cm. So, if the swabs had been 25 cm apart, the distance between the ring and the HCl swab would have been about 10 cm—halfway between 8.1 cm and 12.2 cm.

5. **If another student wanted to test a factor that was not studied in Experiments 1–3, which of the following should he do next? He should test how the diffusion rates of gases are affected by:**

A. ◉ atmospheric pressure.

B. ○ tube length.

C. ○ temperature.

D. ○ tube diameter.

CORRECT RESPONSE ^

A is the best answer. In Experiment 1, temperature was studied. In Experiment 2, tube diameter was studied. In Experiment 3, tube length was studied. So these three factors were studied in Experiments 1–3. Atmospheric pressure was not studied in any of the 3 experiments.

6. **The student concluded that NH_3 diffuses at a greater rate than HCl. Do the results of Experiments 1–3 support her conclusion?**

F. ○ No; in Trials 1–9 the HCl vapors traveled farther than the NH_3 vapors.

F. ○ No; in Trials 1–9 the NH_3 vapors traveled farther than the HCl vapors.

G. ○ Yes; in Trials 1–9 the HCl vapors traveled farther than the NH_3 vapors.

H. ◉ Yes; in Trials 1–9 the NH_3 vapors traveled farther than the HCl vapors.

CORRECT RESPONSE ^

H is the best answer. In each of the trials, the ring was closer to the HCl swab than to the NH_3 swab. This shows that the HCl vapors traveled a shorter distance than did the NH_3 vapors before the 2 vapors collided and formed the ring. For example, in Trial 1, the vapors collided 4 cm from the HCl swab and 6 cm from the NH_3 swab. So the HCl vapors traveled 4 cm and the NH_3 vapors traveled 6 cm. Thus, the NH_3 vapors traveled farther than did the HCl vapors. This shows that NH_3 diffuses at a greater rate than HCl.

Passage III

A student performed 2 studies to investigate the factors that affect the germination of peony seeds.

Study 1

Peony seeds were placed in dry containers. Some of the containers were stored at 5°C for either 4, 6, 8, or 10 weeks. The temperature and time periods were defined as the *storage temperature* and the *storage period*, respectively.

The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a separate petri dish. Each petri dish was maintained at 1 of 4 temperatures for 30 days. The temperature and time periods were defined as the *germination temperature* and the *germination period*, respectively. Table 1 shows the number of seeds that germinated in each dish.

Table 1

Storage period (weeks)	Number of peony seeds that germinated when maintained at a germination temperature of:			
	13°C	18°C	23°C	28°C
0	0	0	0	0
4	0	2	0	0
6	3	8	6	0
8	7	22	18	0
10	15	24	21	1

Study 2

Peony seeds were placed in dry containers. The containers were stored at various temperatures for 10 weeks.

The peony seeds were divided evenly so that there were 20 sets of 25 seeds. Twenty petri dishes were then prepared. Each contained damp paper. Each set of seeds was placed in a petri dish. The petri dishes were maintained at 1 of 4 temperatures for 30 days. Table 2 shows the number of seeds that germinated in each dish.

Table 2

Storage temperature (°C)	Number of peony seeds that germinated when maintained at a germination temperature of:			
	13°C	18°C	23°C	28°C
0	15	24	21	1
5	16	23	21	1
10	0	6	4	0
15	0	0	0	0
20	0	0	0	0

Tables adapted from Joel Beller, *Experimenting with Plants*. ©1985 by Joel Beller.

1. **In general, the results of Study 1 suggest that peony seeds that are placed in a petri dish containing damp paper are most likely to germinate when they are maintained at which of the following temperatures?**

A. ○ 13˚ C

B. ◉ 18˚ C

C. ○ 23˚C

D. ○ 28˚C

CORRECT RESPONSE

B is the best answer. In Study 1 more seeds germinated when they were maintained at a germination temperature of 18˚C than when they were maintained at any of the other 3 germination temperatures. So the seeds are more likely to germinate when they are maintained at 18˚C than when they are maintained at 13˚C, 23˚C, or 28˚C.

2. **Suppose another set of 25 peony seeds had been included in Study 2 and these seeds had a storage temperature of 25˚C and a germination temperature of 18˚C. Based on the information provided, the number of seeds that would have germinated after being maintained for 30 days would most likely have been closest to:**

E. ◉ 0

F. ○ 8

G. ○ 16

H. ○ 24

CORRECT RESPONSE

E is the best answer. In Study 2, when the storage temperature was equal to or greater than 15˚C, zero seeds germinated. So, the number of seeds that would have germinated after being maintained for 30 days would most likely have been closer to 0 than to any other number.

3. **In Study 2, at the storage temperature of 5°C, as germination temperature increased from 13°C to 28°C, the number of seeds that germinated:**

A. ○ decreased only.

B. ○ increased only.

C. ○ decreased, then increased.

D. ◉ increased, then decreased.

CORRECT RESPONSE ^

D is the best answer. In Study 2, 4 germination temperatures were used: 13°C, 18°C, 23°C, and 28°C. The numbers of seeds that germinated at these 4 temperatures were 16, 23, 21, and 1, respectively. So, as germination temperature increased from 13°C to 28°C, the number of seeds that germinated initially increased (from 16 to 23) and then decreased (from 23 to 21 and from 21 to 1).

4. **Which of the following sets of seeds were exposed to the same conditions prior to being placed in the petri dishes?**

E. ○ The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 5°C

F. ○ The seeds from Study 1 that were stored for 8 weeks and the seeds from Study 2 that were stored at 15°C

G. ◉ The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 5°C

H. ○ The seeds from Study 1 that were stored for 10 weeks and the seeds from Study 2 that were stored at 15°C

CORRECT RESPONSE ^

G is the best answer. In Study 1, all of the seeds were stored at 5°C. In Study 2, all of the seeds were stored for 10 weeks. So, seeds exposed to the same conditions in Studies 1 and 2 must have been stored at 5°C for 10 weeks.

5. **A student stored 100 peony seeds at a constant temperature for 10 weeks. The student then divided the seeds into 4 sets and maintained them as described in Study 2. The results were as follows:**

Germination temperature (°C)	Number of seeds that germinated
13	1
18	6
23	3
28	0

These seeds most likely had a storage temperature of:

A. ○ 0°C

B. ○ 5°C

C. ◉ 10°C

D. ○ 15°C

CORRECT RESPONSE

C is the best answer. The conditions described in the question match the conditions used in Study 2. So, to determine the storage temperature, look at the results from Study 2. In Study 2, at a storage temperature of 10°C and a germination temperature of 13°C, 0 seeds germinated. In Study 2, at a storage temperature of 10°C and a germination temperature of 18°C, 6 seeds germinated. In Study 2, at a storage temperature of 10°C and a germination temperature of 23°C, 4 seeds germinated. In Study 2, at a storage temperature of 10°C and a germination temperature of 28°C, 0 seeds germinated. These results closely match the results given in the question.

6. **The experimental designs of Study 2 and Study 1 differed in that in Study 2:**

E. ○ storage temperature was held constant.

F. ◉ storage time was held constant.

G. ○ germination temperature was varied.

H. ○ germination time was varied.

CORRECT RESPONSE

F is the best answer. In Study 1, 5 storages periods were used: 0, 4, 6, 8, and 10 weeks. In Study 2, 1 storage period was used: 10 weeks. So, in Study 2, storage time was held constant. In Study 1, storage time was varied.

Passage IV

Spent fuel (SF), a radioactive waste, is often buried underground in canisters for disposal. As it decays, SF generates high heat and raises the temperature of the surrounding rock, which may expand and crack, allowing radioactivity to escape into the environment. Scientists wanted to determine which of 4 rock types—rock salt, granite, basalt, or shale—would be least affected by the heat from SF. The thermal conductivity (how well heat is conducted through a material) and heating trends of the 4 rock types were studied.

Study 1

Fifty holes, each 0.5 m across and 20 m deep, were dug into each of the following: a rock salt deposit, granite bedrock, basalt bedrock, and shale bedrock. A stainless steel canister containing 0.4 metric tons of SF was buried in each hole. The rock temperature was measured next to each canister after 1 year had passed. The results are shown in Table 1, along with the typical thermal conductivity of each rock type, in Watts per meter per °C (W/m°C), at 25°C. The higher the thermal conductivity, the more quickly heat is conducted through the rock and away from the canisters.

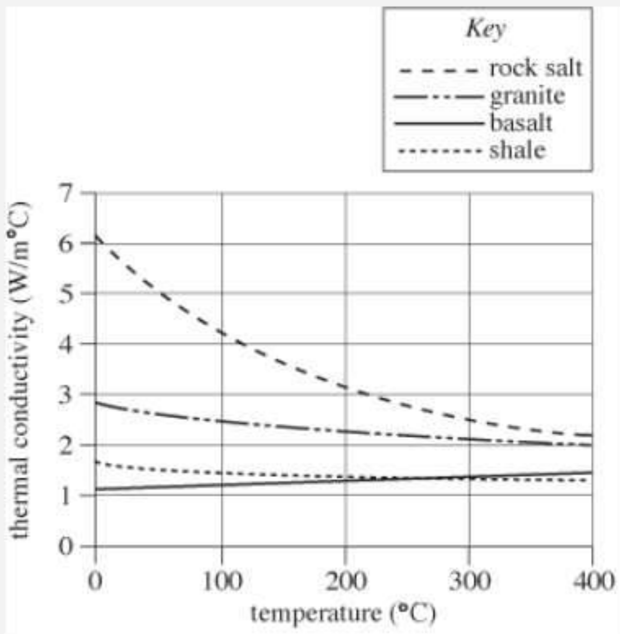
Table 1

Rock	Thermal conductivity (W/m°C)	Rock temperature (°C)*
Rock salt	5.70	110
Granite	2.80	121
Basalt	1.26	165
Shale	1.57	146

*All rock types had an initial temperature of 10°C.

Study 2

The scientists determined the thermal conductivity of the 4 rock types at a number of different temperatures between 0˚C and 400˚C. The results are shown in Figure 1.



Study 3

The scientists calculated the temperature increase that would be expected over a period of 100,000 yr in each rock type at a point within a site holding buried SF. The results are shown in Figure 2.

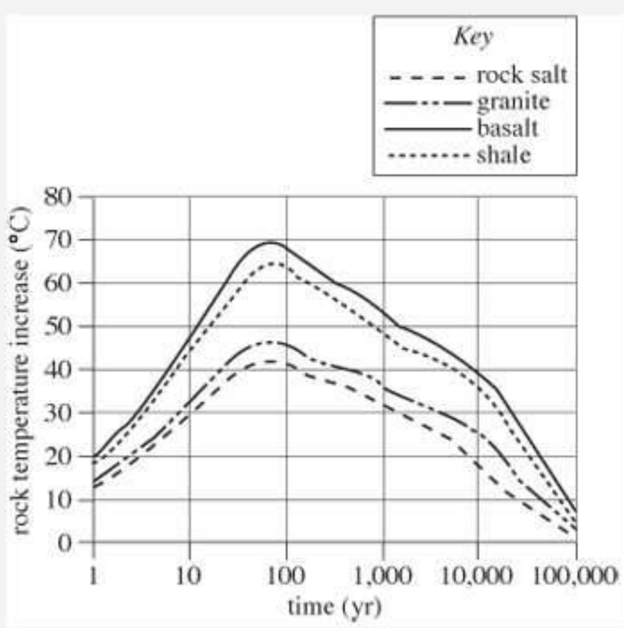


Table and figures adapted from J. S. Y. Wang, D. C. Mangold, and C. F. Tsang, "Thermal Impact of Waste Emplacement and Surface Cooling Associated with Geologic Disposal of High-Level Nuclear Waste." ©1988 by Springer-Verlag New York Inc.

1. **According to Study 2, the thermal conductivity of rock salt measured at a temperature of 500˚C would be closest to which of the following values?**

A. ○ 1.0 W/m˚C

B. ◉ 2.0 W/m˚C

C. ○ 3.5 W/m˚C

D. ○ 4.0 W/m˚C

CORRECT RESPONSE ^

B is the best answer. In Study 2, as temperature increased from 0˚C to 400˚C, thermal conductivity of rock salt decreased from about 6.1 W/m˚C to about 2.2 W/m˚C. In addition, the rate of the decrease slowed as temperature increased. For example, as temperature increased from 300˚C to 400˚C, thermal conductivity decreased by about 0.4 W/m˚C (from about 2.6 W/m˚C to about 2.2 W/m˚C). Based on this trend, thermal conductivity at 500˚C would be about 0.2 W/m˚C less than the thermal conductivity at 400˚C (2.2 W/m˚C). So, the best estimate is 2.0 W/m˚C.

2. **According to Study 3, if another set of temperatures had been calculated for a time 1,000,000 years in the future, the calculated temperature increase in any of the 4 rock types would most likely be closest to:**

E. ◉ 0˚C

F. ○ 10˚C

G. ○ 20˚C

H. ○ 30˚C

CORRECT RESPONSE ^

E is the best answer. In Figure 2, each curve represents 1 of the 4 rock types. Each curve starts to decrease after about 70 yr. To determine the rock temperature increase (˚C) at 1,000,000 yr, extrapolate each curve. Because the x-axis is a semi-log scale, the distance along the x-axis between 10,000 yr and 100,000 yr will equal the distance along the x-axis between 100,000 yr and 1,000,000 yr. So, when time is 1,000,000 yr, each of the curves will be at 0˚C.

3. ***Welded tuff*** **(another rock type) has a thermal conductivity of 1.8 W/m˚C at 25˚C. If measurements of the temperature of this rock type adjacent to SF canisters were taken as in Study 1, the recorded temperature would be closest to:**

A. ○ 100˚C

B. ○ 110˚C

C. ○ 120˚C

D. ◉ 130˚C

CORRECT RESPONSE ^

D is the best answer. Table 1 shows how the recorded rock temperature varied with thermal conductivity. Granite has a thermal conductivity of 2.80 W/m˚C and it had a temperature of 121˚C. Shale has a thermal conductivity of 1.57 W/m˚C and it had a temperature of 146˚C. Since welded tuff has a thermal conductivity (1.8 W/m˚C) between the thermal conductivities of granite and shale, welded tuff will have a temperature between the temperatures observed for granite and shale: 121˚C and 146˚C. 130˚C falls between these 2 values.

4. **According to the results of Study 1, which of the following best describes the relationship between thermal conductivity and rock temperature? As thermal conductivity increases, the rock temperature recorded adjacent to buried SF canisters:**

E. ◉ decreases only.

F. ○ increases only.

G. ○ increases, then decreases.

H. ○ remains the same.

CORRECT RESPONSE ^

E is the best answer. Table 1 shows how the recorded rock temperature varied with thermal conductivity. Higher thermal conductivities are associated with lower rock temperatures. For example, the rock type with the lowest thermal conductivity (basalt) had the highest rock temperature, and the rock type with the highest thermal conductivity (rock salt) had the lowest rock temperature. So as thermal conductivity increases, rock temperature decreases only.

5. **Based only on the information provided, which of the following rock types would be the safest in which to bury SF?**

A. ◉ Rock salt

B. ○ Granite

C. ○ Basalt

D. ○ Shale

CORRECT RESPONSE ^

A is the best answer. The scientists wanted to determine which of the 4 rock types would be least affected by heat from SF. Heating can cause rock to expand and crack. So the rock type that showed the least amount of heating would be the safest rock type in which to bury SF. The studies show that rock salt had the smallest increase in temperature. So rock salt would be the safest rock type to use.

6. **Which of the following procedures, in addition to Studies 1, 2, and 3, would best test whether the amount of heat generated by SF is related to the mass of the SF?**

E. ○ Following the design of Study 1 but using concrete canisters containing 0.4 metric tons of SF

F. ◉ Following the design of Study 1 but using stainless steel canisters containing 0.8 metric tons of SF

G. ○ Following the design of Study 2 but determining the thermal conductivities of twice as much of each rock type

H. ○ Following the design of Study 3 but determining the rock temperatures 0.5 km from the sites of SF burial

CORRECT RESPONSE ^

F is the best answer. To determine whether the amount of heat generated by SF is related to the mass of the SF, the amount of heat generated by SF should be determined as the mass of the SF is varied. To do this, Study 1 should be repeated with a different mass of SF. In Study 1, 0.4 metric tons of SF were tested, so using 0.8 metric tons of SF would provide a comparison to determine how the mass of the SF affects the amount of heat generated by the SF.