TEST 4: SCIENCE TEST

30 Minutes—28 Questions

DIRECTIONS: There are six passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer folder. You may refer to the passages as often as necessary.

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

Passage I

The amount of energy a food provides depends on its chemical composition. The basic chemical components of food are protein, carbohydrate (including *fiber*), fat, and water. Fiber is the indigestible portion of carbohydrate in a food. A chemist analyzed 100 g samples of the edible portions of raw nuts and fruits to determine the energy content, measured in kilocalories (kcal), of each sample. The chemist also determined the percent of each of the basic chemical components (including fiber) that made up the total mass of each 100 g sample. The results are shown in the table below.

Food sample	Energy content (kcal)	Protein (%)	Carbohydrate* (%)	Fiber (%)	Fat (%)	Water (%)
Nuts						
Almonds	578	21	20	12	51	5
Cashews	566	18	27	3	47	5
Macadamias	718	8	14	8	76	1
Pecans	691	9	14	10	72	4
Pistachios	557	21	28	10	44	4
Walnuts	654	15	14	7	65	4
Fruits						
Apples	59	—	15	3	—	84
Bananas	92	1	23	2	—	74
Grapefruits	30	1	7	1	—	92
Peaches	43	1	11	2	—	88
Pineapples	49	—	12	1	—	87
Watermelons	32	1	7	1	—	92

*The percent of carbohydrate includes the percent of fiber.

Note: "—" indicates a value less than 0.5%.

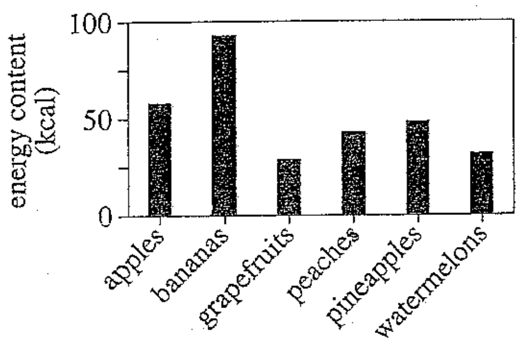
Table adapted from the U.S. Department of Agriculture, *USDA Nutrient Database for Standard Reference, Release 15.* 2002.

1. Which of the food samples listed in the table had the highest energy content?

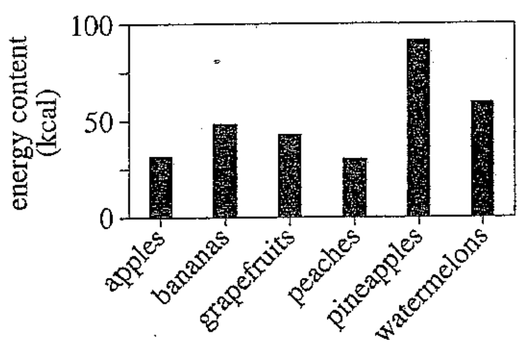
   A. Cashews
   B. Macadamias
   C. Pineapples
   D. Watermelons

2. Which of the following graphs best shows the energy content measured for the fruit samples listed in the table?

F.



G.



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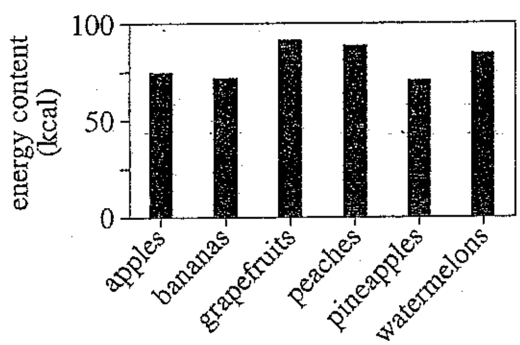
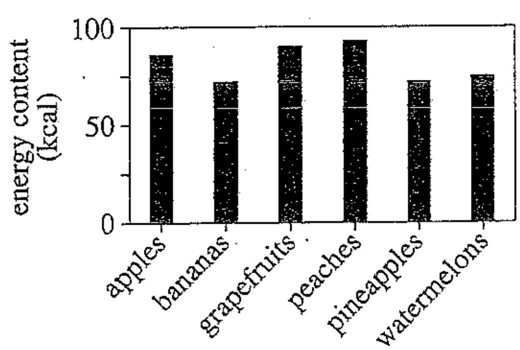


J.



3. A nutritionist wants to design a dessert containing 25 g of nuts and 25 g of fruit. Based on the table, which of the following combinations raw nuts and raw fruits would give the desse the highest percent of carbohydrate?

   A. Cashews and grapefruits
   B. Macadamias and pineapples
   C. Pecans and apples
   D. Pistachios and bananas

4. The chemist also analyzed a 100 g sample of pecans that had been roasted in oil and determined that 75% of the sample's mass was fat and 1% of the sample's mass was water. Based on the table, how does roasting the pecans in oil affect fat content and water content?

	Fat content	Water content
F.	increases	increases
G.	decreases	increases
H.	increases	decreases
J.	decreases	decreases

Passage II

Sunspots appear on the Sun's surface at locations where eruptions of X-rays, gamma radiation, ultraviolet (UV) radiation, and charged particles occur. Some of the radiation and particles travel to Earth and cause *auroras* (the northern and southern lights). A sunspot may appear individually, or as part of a pair or group of sunspots. A sunspot can remain visible for as little as a few hours or for as long as a few months. Sunspots look darker than the rest of the Sun's surface because the material that composes a sunspot is cooler (around 4,000°C) than the surrounding material (around 6,000°C).

Three studies involving sunspots are described below.

Study 1

To study the Sun's rotation, scientists tracked the position of 2 individual sunspots over a 12-day period. One sunspot was located on the Sun's equator, and the other was located halfway between the Sun's equator and one of the Sun's poles (see Figure 1). The sunspots were tracked with a telescope equipped with a solar filter that blocked nearly all UV radiation. The filter also blocked nearly all visible light, but still allowed sunspots to be seen.

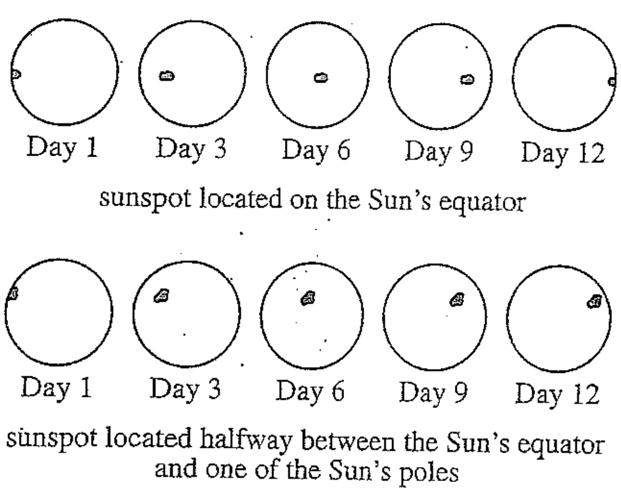


Figure 1

Study 2

Using the telescope and filter from Study 1, scientists determined the average diameter and the *lifetime* (length of time a sunspot exists) of 6 individual sunspots on various parts of the Sun's surface (see Table 1).

Table 1

Sunspot	Average diameter (km)	Lifetime (days)
1	6,000	5
2	15,000	10
3	3,000	2
4	25,000	12
5	7,000	6
6	11,000	8

Study 3

To determine how the number of sunspots changes over time, scientists counted all visible sunspots every day from 1950 to 2005, monitoring which sunspot(s) remained from one day to the next. Figure 2 shows their results for each year of the 56-year period.

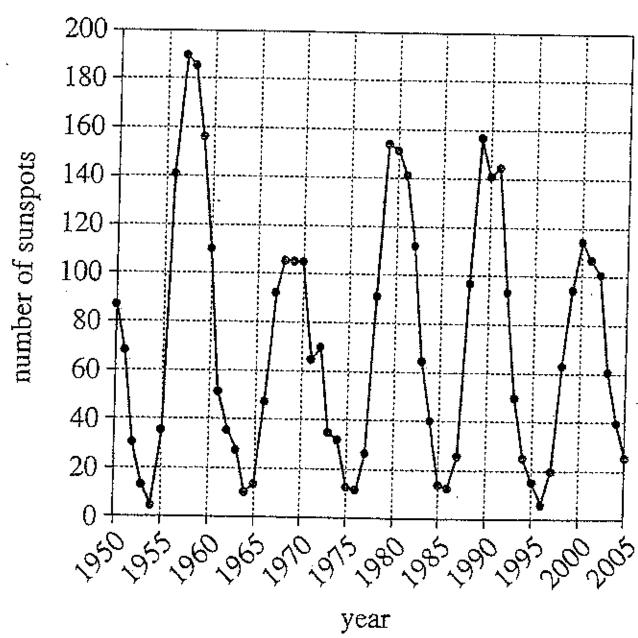


Figure 2

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5. Assume that the greater the number of sunspots visible during a period of time, the greater the Sun's influence on Earth's climate during that period of time. Based on the results of Study 3, during which of the following 11-year periods has Earth's climate been most influenced by the Sun?

   A. 1955–1965
   B. 1965–1975
   C. 1985–1995
   D. 1995–2005

6. Earth's diameter is 12,756 km. Which of the 6 sunspots examined in Study 2 had an average diameter approximately twice as great as Earth's diameter?

   F. Sunspot 1
   G. Sunspot 2
   H. Sunspot 3
   J. Sunspot 4

7. In Study 1, the sunspot on the Sun's equator traveled a distance of about 2,200,000 km over the tracking period. Therefore, the sunspot's average speed along the Sun's equator is given by which of the following expressions?

   A. 2,200,000 km + 6 days
   B. 2,200,000 km − 12 days
   C. 2,200,000 km × 6 days
   D. 2,200,000 km ÷ 12 days

8. According to the results of Study 3, the number of sunspots counted in 1960 was closest to the number of sunspots counted in which of the following years?

   F. 1972
   G. 1978
   H. 1982
   J. 1988

9. Based on the temperature of the material on the Sun's surface that surrounds a sunspot, the temperature at the center of the Sun is most likely:

   A. less than 4,000°C.
   B. between 4,000°C and 5,000°C.
   C. between 5,000°C and 6,000°C.
   D. greater than 6,000°C.

Passage V

Radioactivity can be measured in *counts per minute* (cpm) with an instrument called a *Geiger counter*. Two experiments were done using a Geiger counter and 1 source of radioactivity.

Experiment 1

The radioactive source was placed 2 cm from a Geiger counter's detector. The reading from the Geiger counter was recorded. The radioactive source was then moved various distances from the detector. A measurement from the Geiger counter was recorded for each distance. The results are shown in Table 1.

Table 1

Distance (cm)	Radioactivity (cpm)
2	365
6	300
10	250
14	210
18	175
22	145
26	115
30	90

Experiment 2

The radioactive source was placed 10 cm from the detector. A sheet of cardboard was placed halfway between the radioactive source and the detector, and the measurement from the Geiger counter was recorded (see Figure 1).

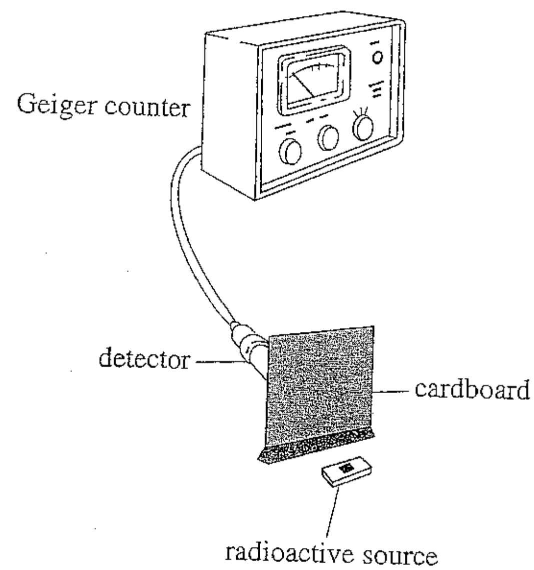

Figure 1

The procedure was repeated, but for each successive trial, an additional sheet of cardboard was added and the sheets were placed together halfway between the radioactive source and the detector. These procedures were repeated using aluminum sheets, then lead sheets. All sheets were identical to each other in length, width, and thickness. The results are shown in Figure 2.

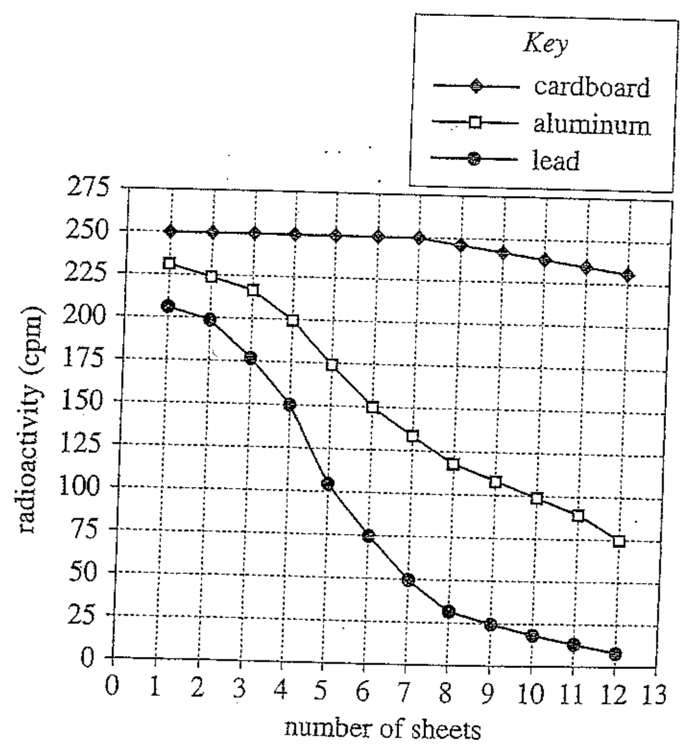

Figure 2

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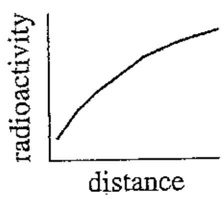
Table and figures adapted from M. Wagner, *Chemistry: The Study of Matter—Laboratory Manual*, 3rd ed. ©1989 by Prentice Hall, Inc.

20. Which of the following graphs best shows the results of Experiment 1 ?

F.


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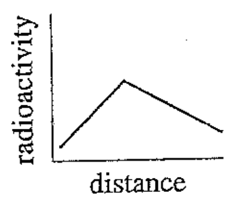

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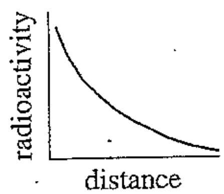
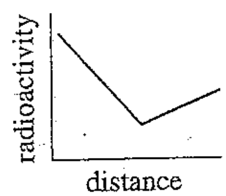


J.


21. In Experiment 2, as the number of sheets of cardboard was increased, the radioactivity:

A. increased only.
B. decreased only.
C. remained constant, then increased.
D. remained constant, then decreased.

22. Suppose a trial had been done in Experiment 2 with 13 sheets of lead. The radioactivity would most likely have been closest to which of the following?

F. 5 cpm
G. 50 cpm
H. 105 cpm
J. 150 cpm

23. In Experiment 2, which of the following *prevented* the most radioactivity from reaching the detector?

A. 1 sheet of aluminum
B. 7 sheets of aluminum
C. 1 sheet of cardboard
D. 10 sheets of cardboard

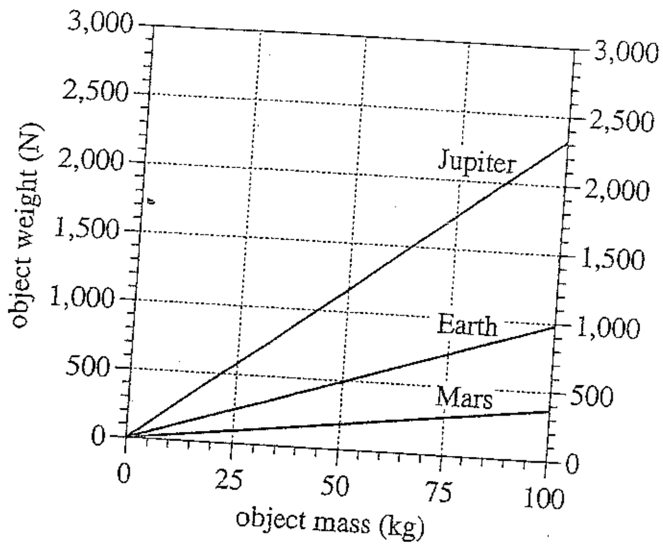
24. Assume the thickness of each of the sheets used in Experiment 2 was 1 mm. For the trial using lead sheets in which 75 cpm was measured, the total thickness of lead between the source and the detector was:

F. 6 mm.
G. 8 mm.
H. 10 mm.
J. 12 mm.

Passage VI

The strength of the gravitational force at a planet's surface depends on the planet's mass and radius. Therefore, as no 2 planets in our solar system have the same mass and radius, an object having a fixed mass will have different weights on different planets.

The figure below shows graphs of weight, in newtons (N), versus mass, in kilograms (kg), for objects on Earth, Mars, and Jupiter.



25. According to the figure, for each planet, as object mass increases, object weight:

A. increases only.
B. decreases only.
C. varies, but with no general trend.
D. remains the same.

26. Consider the weight of a 100 kg object on Earth, on Mars, and on Jupiter. Based on the figure, what is the correct ranking of the 3 planets on the basis of the object's weight, from the planet on which the object would weigh the *most* to the planet on which the object would weigh the *least* ?

F. Mars, Earth, Jupiter
G. Mars, Jupiter, Earth
H. Jupiter, Earth, Mars
J. Jupiter, Mars, Earth

27. Suppose a lead sphere is dropped from a height of 1 m above Earth's surface, and an identical lead sphere is dropped from a height of 1 m above Mars's surface. Based on the figure, would the speed of the Mars sphere immediately before it impacts Mars's surface be greater than or less than the speed of the Earth sphere immediately before it impacts Earth's surface? The speed of the Mars sphere would be:

A. less than the speed of the Earth sphere, because gravity is stronger on Mars than on Earth.
B. less than the speed of the Earth sphere, because gravity is weaker on Mars than on Earth.
C. greater than the speed of the Earth sphere, because gravity is stronger on Mars than on Earth.
D. greater than the speed of the Earth sphere, because gravity is weaker on Mars than on Earth.

28. A particular object weighs 500 N on Jupiter. Approximately how much mass must the object lose or gain to weigh 500 N on Earth?

F. The object must lose approximately 30 kg.
G. The object must lose approximately 50 kg.
H. The object must gain approximately 30 kg.
J. The object must gain approximately 50 kg.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.