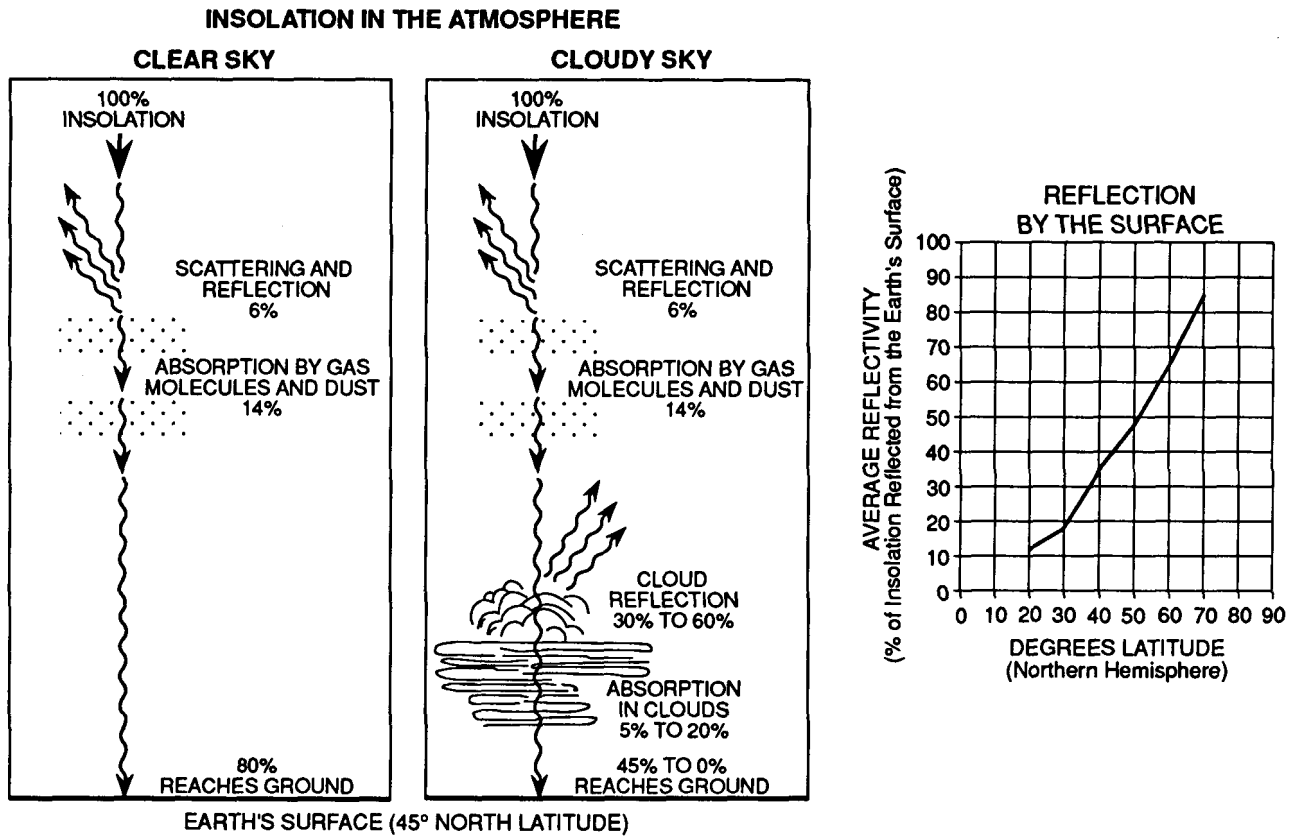


## Topic 6 - Insolation and Seasons

Base your answers to questions 1 through 4 on the diagrams and graphs below. The diagrams show the general effect of the Earth's atmosphere on insolation from the Sun at middle latitudes during both clear-sky and cloudy-sky conditions. The graph shows the percentage of insolation reflected by the Earth's surface at different latitudes in the Northern Hemisphere in winter.



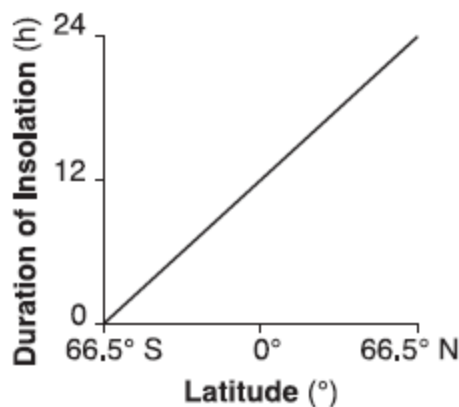
- Which factor keeps the greatest percentage of insolation from reaching the Earth's surface on cloudy days?
  - absorption by cloud droplets
  - reflection by cloud droplets**
  - absorption by clear-air gas molecules
  - reflection by clear-air gas molecules
- Approximately what percentage of the insolation actually reaches the ground at 45° North latitude on a clear day?
  - 100%
  - 80%**
  - 60%
  - 45%
- Which statement best explains why, at high latitudes, reflectivity of insolation is greater in winter than in summer?
  - The North Pole is tilted toward the Sun in winter.
  - Snow and ice reflect almost all insolation.**
  - The colder air holds much more moisture.
  - Dust settles quickly in cold air.
- According to the graph, on a winter day at 70° North latitude, what approximate percentage of the insolation is reflected by the Earth's surface?
  - 50%
  - 65%
  - 85%**
  - 100%

## Topic 6 - Insolation and Seasons

5. Equal areas of which type of surface will reflect the most insolation?

- A) light gray rooftop    B) dark tropical forest  
 C) **snow-covered field**    D) black paved road

6. The graph below shows the general relationship between latitude and the duration of insolation on a particular day of the year.



Which date is represented by the graph?

- A) March 21                      **B) June 21**  
 C) September 21                D) December 21

7. How do clouds affect the temperature at the Earth's surface?

- A) Clouds block sunlight during the day and prevent heat from escaping at night.**  
 B) Clouds block sunlight during the day and allow heat to escape at night.  
 C) Clouds allow sunlight to reach the Earth during the day and prevent heat from escaping at night.  
 D) Clouds allow sunlight to reach the Earth during the day and allow heat to escape at night.

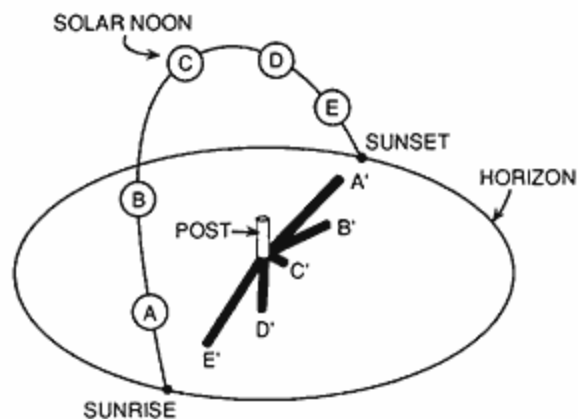
8. In Maine, which day has the shortest duration of insolation?

- A) March 21                      B) June 21  
 C) June 21                        **D) December 21**

9. The intensity of insolation at solar noon from November 1 to February 1 in New York State will

- A) decrease, only  
 B) increase, only  
**C) decrease, then increase**  
 D) increase, then decrease

10. Base your answer to the following question on "the diagram below which shows a post located in the Northern Hemisphere. Five different shadows,  $A'$ ,  $B'$ ,  $C'$ ,  $D'$ , and  $E'$ , are cast on a certain day by the post when the Sun is in positions  $A$ ,  $B$ ,  $C$ ,  $D$ , and  $E$ , respectively.



Which statement would be true if this post were located at the Equator on March 21?

- A) There would be no shadows at sunrise or sunset.  
**B) There would be no shadow at solar noon.**  
 C) Shadow  $C'$  would point north at solar noon.  
 D) Shadow  $C'$  would point south at solar noon.

11. In New York State, the number of hours of daylight each day increases continuously from

- A) March 1 to May 1**  
 B) June 1 to August 1  
 C) September 1 to November 1  
 D) December 1 to February 1

12. Which gas absorbs some of the harmful insolation in Earth's upper atmosphere before that insolation reaches Earth's surface?

- A) nitrogen                      **B) ozone**  
 C) oxygen                        D) hydrogen

## Topic 6 - Insolation and Seasons

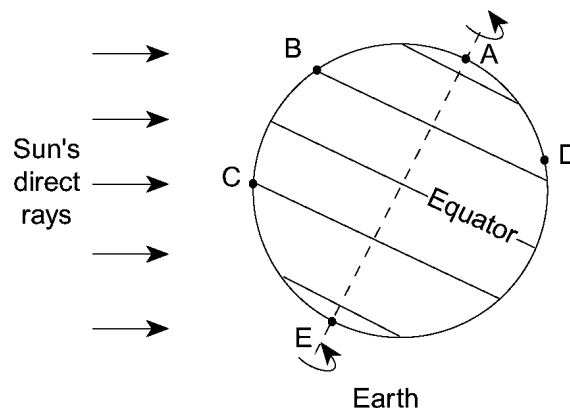
13. The table below shows the duration of insolation at different latitudes for three different days during the year.

Latitude	Day 1 Duration of Insolation (hours)	Day 2 Duration of Insolation (hours)	Day 3 Duration of Insolation (hours)
90° N	24	12	0
80° N	24	12	0
70° N	24	12	0
60° N	$18\frac{1}{2}$	12	$5\frac{1}{2}$
50° N	$16\frac{1}{4}$	12	$7\frac{3}{4}$
40° N	15	12	9
30° N	14	12	10
20° N	$13\frac{1}{4}$	12	$10\frac{3}{4}$
10° N	$12\frac{1}{2}$	12	$11\frac{1}{2}$
0°	12	12	12

Which dates are represented most correctly by Day 1, Day 2, and Day 3, respectively?

- A) March 21, September 22, December 21    **B) June 21, September 22, December 21**  
 C) September 22, December 21, March 21    D) December 21, March 21, June 21

14. Base your answer to the following question on the diagram below, which shows the tilt of Earth on its axis in relation to the Sun on one particular day. Points *A* through *E* are locations on Earth's surface. Point *D* is located in Virginia. The dashed line represents Earth's axis.

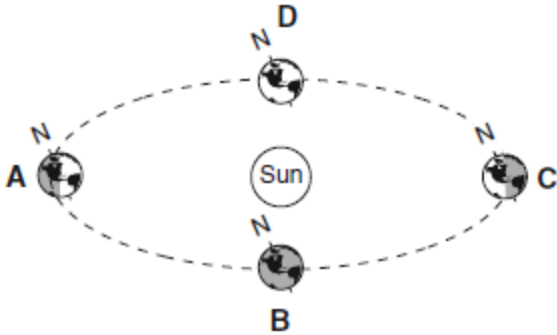


On this day, which location has the greatest number of hours of daylight?

- A) *E*                      B) *B*                      C) *C*                      D) *D*

## Topic 6 - Insolation and Seasons

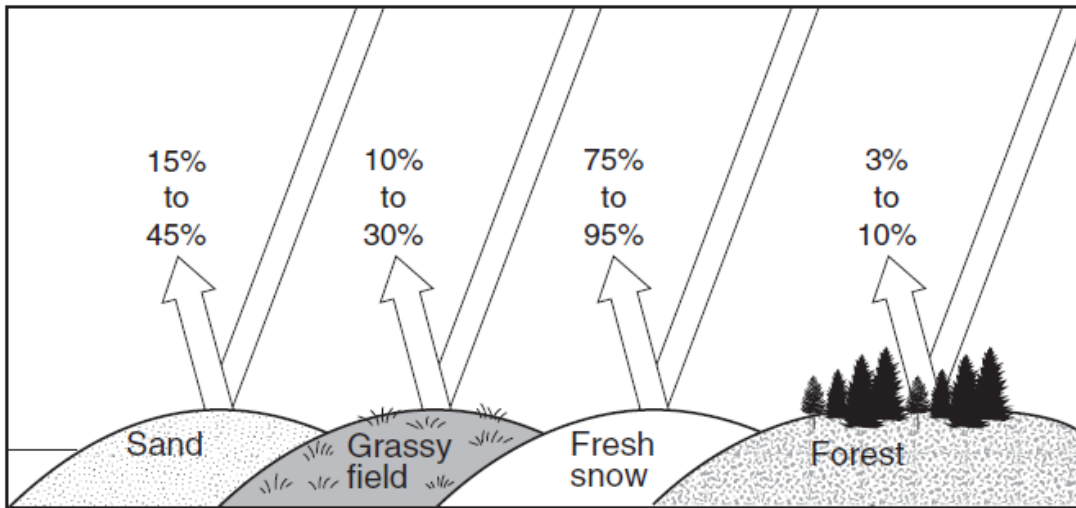
15. Base your answer to the following question on the diagram below, which represents Earth in its orbit around the Sun. The position of Earth on the first day of each season is labeled *A*, *B*, *C*, and *D*.



(Not drawn to scale)

At which location are the Sun's noontime rays perpendicular to Earth's surface at the Tropic of Cancer? ( $23.5^{\circ}$  N)?

- A) *A*                      B) *B*                      C) *C*                      D) *D*
16. The diagram below indicates the amount of solar radiation that is reflected by equal areas of various materials on Earth's surface.



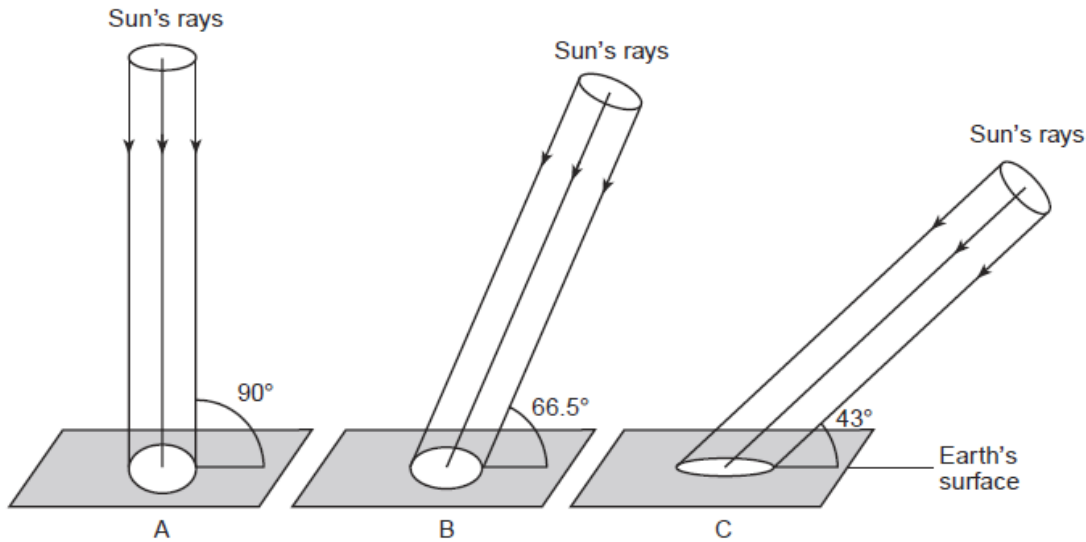
Which material absorbs the most solar radiation?

- A) grassy field      B) fresh snow      C) sand                      D) forest

## Topic 6 - Insolation and Seasons

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17. Base your answer to the following question on the diagrams below and on your knowledge of Earth science. The diagrams, labeled *A*, *B*, and *C*, represent equal-sized portions of the Sun's rays striking Earth's surface at  $23.5^\circ$  N latitude at noon at three different times of the year. The angle at which the Sun's rays hit Earth's surface and the relative areas of Earth's surface receiving the rays at the three different angles of insolation are shown.

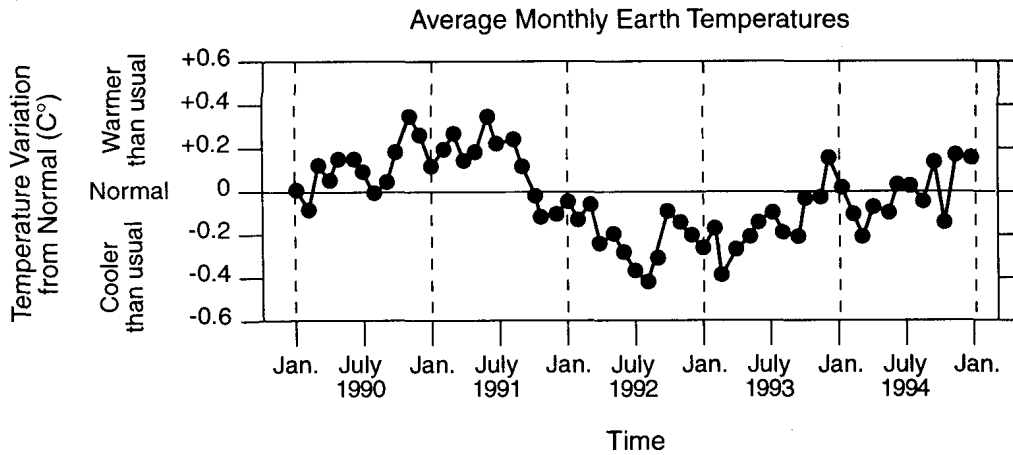


As viewed in sequence from *A* to *B* to *C*, these diagrams represent which months and which change in the intensity of insolation?

- A) December → March → June; and decreasing intensity
- B) December → March → June; and increasing intensity
- C) **June → September → December; and decreasing intensity**
- D) June → September → December; and increasing intensity

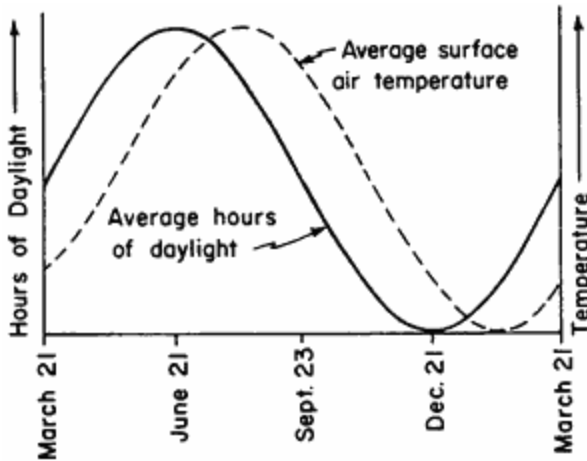
## Topic 6 - Insolation and Seasons

18. Base your answer to the following question on the graph below which shows variations in Earth's monthly temperatures from normal Earth temperatures between January 1990 and January 1995.



The addition of water vapor, carbon dioxide, and methane gas to the atmosphere changes Earth's climate. This change occurs primarily because these gases cause

- A) cooler temperatures by absorbing infrared radiation
  - B) cooler temperatures by absorbing ultraviolet radiation
  - C) warmer temperatures by absorbing ultraviolet radiation
  - D) warmer temperatures by absorbing infrared radiation**
19. The graph below indicates the average number of daylight hours and the average surface air temperature over a 12-month period at a specific location on the Earth.

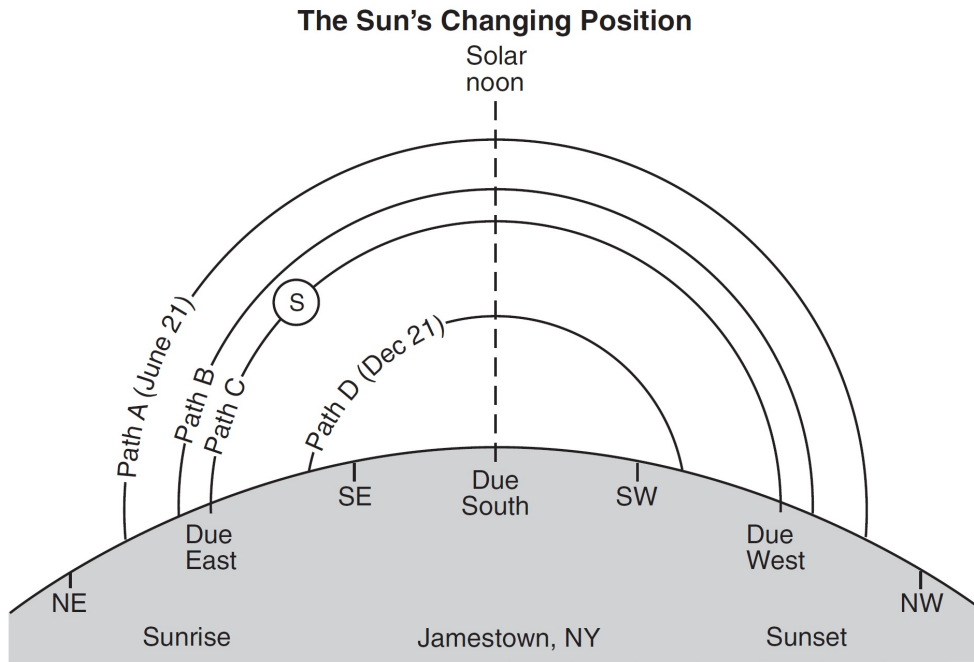


Based on the graph, the highest average surface air temperature occurs

- A) on June 21
- B) between June 21 and September 23**
- C) on December 21
- D) between December 21 and March 21

## Topic 6 - Insolation and Seasons

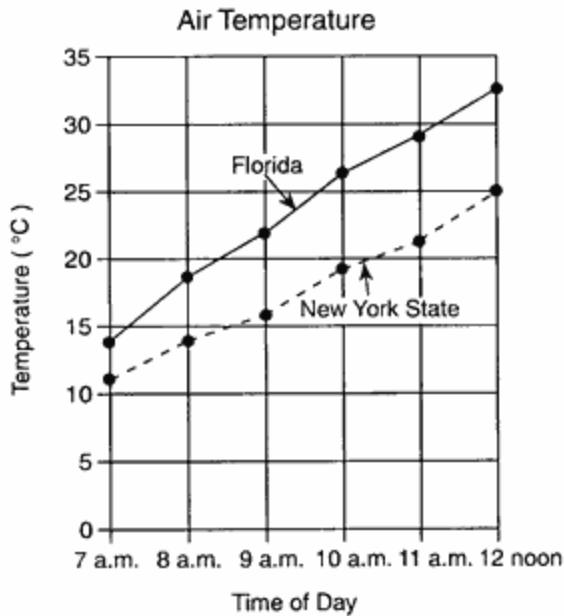
Base your answers to questions **20** through **22** on the diagram below and on your knowledge of Earth science. The diagram represents four apparent paths of the Sun, labeled *A*, *B*, *C*, and *D*, observed in Jamestown, New York. The June 21 and December 21 sunrise and sunset positions are indicated. Letter *S* identifies the Sun's position on path *C* at a specific time of day. Compass directions are indicated along the horizon.



20. When the Sun appears to travel along path *D* at Jamestown, which latitude on Earth receives the most direct rays from the Sun?
- A)  $42^{\circ}$  N      B)  $23.5^{\circ}$  N      C)  $0^{\circ}$       **D)  $23.5^{\circ}$  S**
21. The greatest duration of insolation in Jamestown occurs when the Sun appears to travel along path
- A) *A***      B) *B*      C) *C*      D) *D*
22. At what time of day is the Sun at position *S*?
- A) 6 a.m.      **B) 9 a.m.**      C) 3 p.m.      D) 6 p.m.

## Topic 6 - Insolation and Seasons

23. The graph below shows air temperatures on a clear summer day from 7 a.m. to 12 noon at two locations, one in Florida and one in New York State.



Air temperature rose slightly faster in Florida than in New York State because Florida

- A) has a lower angle of insolation
- B) has a higher angle of insolation**
- C) is closer to the Prime Meridian
- D) is farther from the Prime Meridian

24. Two identical glass containers were placed in direct sunlight. The first container was filled with air and the second container was filled with a mixture of air and additional carbon dioxide. Each container was sealed with a thermometer inside. Temperatures were recorded at 2-minute intervals, as shown in the data table below.

Time (minutes)	Temperature (°C)	
	Container 1 (Air)	Container 2 (Air + CO <sub>2</sub> )
0	24°	24°
2	25°	26°
4	26°	29°
6	27°	32°
8	28°	33°
10	29°	35°

Which statement best explains the results of this activity?

- A) Carbon dioxide is a good absorber of infrared radiation.**
- B) Carbon dioxide causes a random reflection of energy.
- C) Carbon dioxide has no effect on the atmosphere's energy balance.
- D) Carbon dioxide converts some energy into potential energy.



**Answer Key**  
**Topic 6 - Insolation and the Seasons**

1. **B**
  2. **B**
  3. **B**
  4. **C**
  5. **C**
  6. **B**
  7. **A**
  8. **D**
  9. **C**
  10. **B**
  11. **A**
  12. **B**
  13. **B**
  14. **A**
  15. **C**
  16. **D**
  17. **C**
  18. **D**
  19. **B**
  20. **D**
  21. **A**
  22. **B**
  23. **B**
  24. **A**
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