1. Base your answer to the following question on the information and the cross section below. The cross section represents a possible model of the Moon's interior.

Seismographs left on the Moon by astronauts have provided enough data to develop a model of the Moon's interior. Scientists believe that the Moon has a layered interior and that its crustal thickness varies greatly from one side of the Moon to the other.

According to the cross section, which kind of surface bedrock is found in large amounts on the Moon?

A) fossil limestone  
B) volcanic rock  
C) sedimentary conglomerate  
D) nonclastic evaporite
2. Base your answer to the following question on the diagram below, which has lettered arrows showing the motions of Earth and the Moon.

These lettered arrows represent motions that are

A) noncyclic and unpredictable
B) noncyclic and predictable
C) cyclic and unpredictable
D) cyclic and predictable
3. Base your answer to the following question on the graph below, which shows two days of tidal data from a coastal location in the northeastern United States.

![Tidal Changes Graph](image)

The change in the tides as shown on the graph is primarily the result of

A) **Earth's rotation and the Moon's revolution**
B) Earth's rotation and revolution
C) the Moon's rotation and Earth's revolution
D) the Moon's rotation and revolution
4. Base your answer to the following question on the diagram below which represents the Earth, Moon, and Sun on a particular day as viewed from a point in space. Positions A through D are located along the Earth's Equator and E is at the North Pole. Positions F and G are located on the surface of the Moon.

Which statement best explains why an observer on the Moon sees varying amounts of the illuminated side of the Earth (phases of the Earth) during a one-year period?

A) The Earth rotates on its axis.
B) The Sun revolves on its axis.
C) The Moon rotates on its axis.
D) The Moon revolves around the Earth.

5. Which New York State landscape region is best represented by the block diagram below?

A) Appalachian Plateau
B) Adirondack Mountains
C) Atlantic Coastal Lowlands
D) Lake Ontario Lowlands

6. The phases of the Moon are caused by the

A) Earth's revolution around the Sun
B) Moon's revolution around the Earth
C) Moon's varying distance from the Earth
D) Sun's varying distance from the Moon

7. If the distance between the Moon and Earth were double its present distance, the Moon’s cycle of phases would occur

A) in reverse order and more slowly
B) in reverse order and more quickly
C) in the same order but more slowly
D) in the same order but more quickly
8. Base your answer to the following question on the diagram below, which shows the Moon, Earth, and the Sun’s rays as viewed from space. Letter A indicates a certain position of the Moon in its orbit.

Which diagram represents the phase of the Moon, as seen by an observer on Earth, when the Moon is located at position A in its orbit?

A)  
B)  
C)  
D)  

9. The Moon would not be visible from Earth when the Moon is at position

A)  
B)  
C)  
D)  

10. Which diagram best represents the appearance of the Moon to an observer on the Earth when the Moon is at position B?

A)  
B)  
C)  
D)  

11. Why are impact structures more obvious on the Moon than on Earth?

A) The Moon’s gravity is stronger than Earth’s gravity.
B) The Moon has little or no atmosphere.
C) The rocks on the Moon are weaker than those on Earth.
D) The Moon rotates at a slower rate than Earth does.
12. The approximate time required for the Moon to move from position 3 to position 7 is
   A) 1 hour           B) 2 weeks           C) 3 months           D) 4 days

13. Which device when placed on the Moon would provide evidence of Moon rotation?
   A) Foucault pendulum       B) seismograph       
   C) thermometer             D) wind vane
14. Base your answer to the following question on the graph below, which shows the water levels of ocean tides measured in Boston, Massachusetts, for a 2-day period.

The graph shows that high tides at Boston occur approximately every

A) 3.5 hours  B) 6.0 hours  C) **12.5 hours**  D) 16.0 hours
15. Base your answer to the following question on the data table below and on the graph. The data table shows the maximum altitude and phase of the Moon observed above the southern horizon on certain dates during January and February at a New York State location. The line on the graph shows the altitude of the noontime Sun observed during the same time period at the same New York State location.

<table>
<thead>
<tr>
<th>Date</th>
<th>Maximum Altitude of Moon (°)</th>
<th>Phase of Moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 4</td>
<td>26</td>
<td>new</td>
</tr>
<tr>
<td>January 13</td>
<td>63</td>
<td>first quarter</td>
</tr>
<tr>
<td>January 19</td>
<td>72</td>
<td>full</td>
</tr>
<tr>
<td>January 26</td>
<td>35</td>
<td>last quarter</td>
</tr>
<tr>
<td>February 3</td>
<td>34</td>
<td>new</td>
</tr>
<tr>
<td>February 11</td>
<td>70</td>
<td>first quarter</td>
</tr>
<tr>
<td>February 18</td>
<td>60</td>
<td>full</td>
</tr>
<tr>
<td>February 25</td>
<td>27</td>
<td>last quarter</td>
</tr>
</tbody>
</table>

The multiple-exposure photograph below, taken on February 3, shows a total solar eclipse in the middle of the photograph. The maximum altitude of the Sun on this date was 34° above the southern horizon at this New York State location.

Based on the data table, explain why this total solar eclipse occurred on February 3.
What is a Blue Moon?

A Blue Moon is the name given to the second full moon in a calendar month. Because there are roughly 29.5 days between full moons, it is unusual for two full moons to “fit” into a 30 or 31 day month (and impossible to fit into a 28 or 29 day month, so February can never have a Blue Moon). The saying “Once in a Blue Moon” means a rare occurrence, and predates the current astronomical use of the term, which is quite recent. In fact, Blue Moons are not all that rare, on average there will be one Blue Moon every 2.5 years. After 1999, the next Blue Moons will be in November 2001; July 2004; and June 2007. The last one before 1999 was in July 1996.

The term Blue Moon is believed to have originated in 1883 after the eruption of Krakatoa. The volcano put so much dust in the atmosphere that the Moon actually looked blue in color. This was so unusual that the term “once in a Blue Moon” was coined.

“The Blue Moon”
David R. Williams
nssdc.gsfc.nasa.gov/planetary/lunar/blue_moon.html

16. Explain why a Blue Moon never occurs during the month of February.

17. What is the greatest number of full-Moon phases, visible from Earth, that are possible in a span of 1 year?

18. Base your answer to the following question on the diagram in your answer booklet, which shows the Moon's orbit around Earth.

Explain why lunar eclipses only occur when the Moon and the Sun are on opposite sides of Earth.
Base your answers to questions 19 through 21 on the passage below.

The Moon Is Moving Away While Earth's Rotation Slows

Tides on Earth are primarily caused by the gravitational force of the Moon acting on Earth's surface. The Moon causes two tidal bulges to occur on Earth: the direct tidal bulge occurs on the side facing the Moon, and the indirect tidal bulge occurs on the opposite side of Earth. Since Earth rotates, the bulges are swept forward along Earth's surface. This advancing bulge helps pull the Moon forward in its orbit, resulting in a larger orbital radius. The Moon is actually getting farther away from Earth, at a rate of approximately 3.8 centimeters per year.

The Moon's gravity is also pulling on the direct tidal bulge. This pulling on the bulge causes friction of ocean water against the ocean floor, slowing the rotation of Earth at a rate of 0.002 second per 100 years.

19. Explain why the force of gravity between the Moon and Earth will decrease over time.

20. In 100,000 years, the rotation of Earth will be slower by how many seconds?

21. Explain why the Moon has a greater influence than the Sun on Earth's tides.
1. B
2. D
3. A
4. D
5. A
6. B
7. C
8. A
9. A
10. B
11. B
12. B
13. A
14. C
15. Examples: — The Sun and the Moon were at the same altitude on February 3. — The Sun and the Moon were aligned with Earth. — This solar eclipse occurred at the new Moon phase. — The apparent paths of the Sun and the Moon crossed.
16. February has only 28 or 29 days and a complete cycle of the Moon phases takes 29.5 days.
17. 13
18. — During a lunar eclipse, Earth blocks the sunlight from reaching the Moon. — Earth’s shadow must fall on the Moon. — The Moon must move into Earth’s shadow.
19. The Moon gets farther away from Earth. As distance between objects increases, the gravitational attraction decreases.
20. 2 seconds
21. The Moon is closer to Earth than the Sun. The Moon's gravitational attraction to Earth is greater than the Sun's.