Base your answers to questions 1 and 2 on the diagram below, which shows Earth in orbit around the Sun, and the Moon in orbit around Earth. \( M_1, M_2, M_3, \) and \( M_4 \) indicate positions of the Moon in its orbit. Letter \( A \) indicates a location on Earth’s surface.

1. At which Moon position could a solar eclipse be seen from Earth?
   A) \( M_1 \)   B) \( M_2 \)   C) \( M_3 \)   D) \( M_4 \)

2. An observer at location \( A \) noticed that the apparent size of the Moon varied slightly from month to month when the Moon was at position \( M_4 \) in its orbit. Which statement best explains this variation in the apparent size of the Moon?
   A) The Moon expands in summer and contracts in winter.
   B) The Moon shows complete cycles of phases throughout the year.
   C) The Moon’s period of rotation is equal to its period of revolution.
   D) The Moon’s distance from Earth varies in a cyclic manner.
3. Which two motions cause the Moon to show a complete cycle of phases each month when viewed from New York State?

A) the Moon’s rotation and Earth’s rotation
B) **the Moon’s revolution and Earth’s rotation**
C) the Moon’s rotation and the Sun’s rotation
D) the Moon’s revolution and the Sun’s rotation

4. A solar eclipse might be observed from Earth when the Moon is at which position?

A) the Sun
B) Venus
C) the Moon
D) Mars

5. Which object is closest to Earth?

A) the Sun
B) Venus
C) **the Moon**
D) Mars

6. Ocean tides observed at coastal locations each day are primarily caused by

A) Earth's revolution around the Sun
B) the changing phases of the Moon
C) the **gravitational attraction between the Moon and Earth**
D) seasonal changes in the compass location of sunrise
7. The next first-quarter Moon after November 17 occurred closest to
   A) December 9      B) December 14    C) December 17    D) December 24

8. The tidal range on November 8 was approximately
   A) 11 m          B) 2 m            C) 13 m          D) 15 m
9. The diagram below shows the Moon orbiting Earth, as viewed from space above Earth's North Pole. The Moon is shown at eight positions in its orbit.

Spring ocean tides occur when the difference in height between high tide and low tide is greatest. At which two positions of the Moon will spring tides occur on Earth?

A) 1 and 5  
B) 2 and 6
C) 3 and 7  
D) 4 and 8
10. Base your answer to the following question on the graph below. The graph shows the recorded change in water level (ocean tides) at a coastal city in the northeastern United States during 1 day.

According to the pattern shown on the graph, the next high tide will occur on the following day at approximately

A) 12:30 a.m.  B) **2:00 a.m.**  C) 3:15 a.m.  D) 4:00 a.m.
11. The photographs below show the same coastal location at two different times during the same day.

![People on Beach 12:40 p.m.](image1)

![People Boating 6:52 p.m.](image2)

Source: thehopemanbricks.ca (adapted)

Which statement best explains the cause for the higher water level at 6:52 p.m.?

A) The Moon rotates on its axis at the same rate that it revolves around Earth.

B) **The Moon exerts a gravitational pull on a rotating Earth.**

C) Earth's rotation causes a deflection of surface ocean currents.

D) Earth's tilted axis causes different amounts of insolation throughout the day.
12. Base your answer to the following question on the graph below, which shows the maximum altitude of the Moon, measured by an observer located at a latitude of 43° N during June in a particular year. The names and appearance of the four major Moon phases are shown at the top of the graph, directly above the date on which the phase occurred.

Which terms describe both the changes in the maximum altitude of the Moon and the changes in the Moon’s phases over a period of several years?

A) cyclic and predictable  B) cyclic and unpredictable
C) noncyclic and predictable  D) noncyclic and unpredictable
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
14. The diagram below shows the relative positions of the Sun, the Moon, and Earth when an eclipse was observed from Earth. Positions A and B are locations on Earth's surface.

Which statement correctly describes the type of eclipse that was occurring and the position on Earth where this eclipse was observed?

A) A lunar eclipse was observed from position A.
B) A lunar eclipse was observed from position B.
C) A solar eclipse was observed from position A.
D) A solar eclipse was observed from position B.

Base your answers to questions 15 and 16 on the diagram below, which shows the Moon at position 1 in its orbit around Earth. Numbers 2 through 8 represent other positions in the Moon's orbit.

15. Identify one numbered orbital position where the gravitational attraction of the Moon and the Sun cause Earth to experience the highest high tides.

16. A solar eclipse could occur when the Moon is located at which numbered position?
17. Base your answer to the following question on the calendar below, which shows the month of July of a recent year. The dates of major Moon phases, as seen in New York State, are shown.

![Calendar for July with Moon phases]

The diagram below represents the phase of the Moon observed from New York State one night during the month of July.

Eclipses do *not* occur every month because the Moon’s

A) rate of rotation is 15° each hour  
**B) orbit is inclined to Earth’s orbit**  
C) period of revolution is 27.3 days  
D) period of rotation and period of revolution are the same
18. The graph below shows ocean water levels for a shoreline location on Long Island, New York. The graph also indicated the dates and times of high and low tides.

Based on the data, the next high tide occurred at approximately

A) 4 p.m. on July 13  B) 10 p.m. on July 13  C) 4 p.m. on July 14  D) 10 p.m. on July 14

19. The diagram below represents a total solar eclipse as seen from Earth.

Which diagram correctly represents the relative positions of the Sun (S), Earth (E), and the Moon (M) in space during a total solar eclipse? [The diagrams are not drawn to scale.]
20. The table below shows the times of ocean high tides and low tides on a certain date at a New York State location.

<table>
<thead>
<tr>
<th>Type of Tide</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>4:45 a.m.</td>
</tr>
<tr>
<td>low</td>
<td>10:58 a.m.</td>
</tr>
<tr>
<td>high</td>
<td>5:15 p.m.</td>
</tr>
<tr>
<td>low</td>
<td>11:22 p.m.</td>
</tr>
</tbody>
</table>

At approximately what time on the following day did the next high tide occur at this location?

A) 4:40 a.m.  B) 5:40 a.m.
C) 4:40 p.m.  D) 5:40 p.m.

21. Which arrangement of the Sun, the Moon, and Earth results in the highest high tides, and the lowest low tides on Earth? (Diagrams are not drawn to scale.)

A) The Moon is closer to the Sun.
B) The Moon is closer to Earth.
C) The Moon, the Sun, and Earth are aligned.
D) The Moon is in the same phase at both locations.

22. The diagram below represents eight positions of the Moon in its orbit.

Why are high tides on Earth greatest when the Moon is in position A and in position E?

A) The Moon is closer to the Sun.
B) The Moon is closer to Earth.
C) The Moon, the Sun, and Earth are aligned.
D) The Moon is in the same phase at both locations.

23. The diagrams below represent Earth's ocean tides at four different positions of the Moon. Which diagram shows the Moon position that will produce the highest high tides and the lowest low tides? (The diagrams are not drawn to scale.)

<table>
<thead>
<tr>
<th>Key</th>
</tr>
</thead>
<tbody>
<tr>
<td>E = Earth</td>
</tr>
<tr>
<td>H = High tide</td>
</tr>
<tr>
<td>M = Moon</td>
</tr>
<tr>
<td>L = Low tide</td>
</tr>
</tbody>
</table>

A)  B)  C)  D)
24. A graph of tidal sea-level changes at a coastal city is shown below.

The number of hours from one high tide to the next high tide is approximately

A) 4 h  
B) 8 h  
C) 12 h  
D) 24 h
25. The diagram below shows the relative positions of Earth and Mars in their orbits on a particular date during the winter of 2007.

Which diagram correctly shows the locations of Earth and Mars on the same date during the winter of 2008?

A)  

B)  

C)  

D)
26. Base your answer to the following question on the passage below.

**A Newly Discovered Planet**

Scientists studying a Sun-like star named Ogle-Tr-3 discovered a planet that is, on the average, 3.5 million kilometers away from the star’s surface. The planet was discovered as a result of observing a cyclic decrease in the brightness of Ogle-Tr-3 every 28.5 hours. The changing brightness is the result of the planet blocking some of the starlight when it is between Ogle-Tr-3 and Earth. This observation allowed scientists to find not only the planet, but also to determine the planet’s mass and density. The mass has been calculated to be approximately 159 times the mass of Earth. The planet is only 20% as dense as Jupiter. Scientists think that this low density is the result of being very close to Ogle-Tr-3.

The planet was discovered when it passed between Earth and the star Ogle-Tr-3. Which event in our solar system results from a similar type of alignment of the Moon between Earth and the Sun?

A) summer solstice  
B) winter solstice  
C) solar eclipse  
D) lunar eclipse
27. Base your answer to the following question on the diagram below, which has lettered arrows showing the motions of Earth and the Moon.

Which lettered arrow represents the motion that causes the Moon to show phases when viewed from Earth?

A) A  B) B  C) C  D) D
Base your answers to questions 28 through 30 on the world map below, which shows regions of Earth where a solar eclipse was visible on May 20, 1947. Location A, B, C, and D are on Earth’s surface.

![Solar Eclipse Map](image)

28. Which diagram best represents the positions of Earth (E), the Sun, and the Moon that created the solar eclipse? (Diagrams are not drawn to scale.)

A) ![Diagram A]  
B) ![Diagram B]  
C) ![Diagram C]  
D) ![Diagram D]

29. At which location could an observer have viewed this total solar eclipse if the skies were clear?

A) A  
B) B  
C) C  
D) D

30. Which statement best describes the visibility of this eclipse from locations in New York State?

A) A total eclipse was visible all day.  
B) A total eclipse was visible only from noon until sunset.  
C) A partial eclipse was visible only from noon until sunset.  
D) Neither a partial nor a total eclipse was visible.
31. What is represented by the diagram below?

![Diagram of solar eclipses](image)

<table>
<thead>
<tr>
<th>Key</th>
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<tbody>
<tr>
<td>☀</td>
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<td>Ⓣ</td>
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</tbody>
</table>

A) changing phases of the Sun  
B) changing phases of the Moon  
C) stages in an eclipse of the Sun  
D) stages in an eclipse of the Moon

32. The diagram below shows Earth's orbit around the Sun and different positions of the Moon as it travels around Earth. Letters A through D represent four different positions of the Moon.

![Diagram of solar eclipses](image)

(Not drawn to scale)

An eclipse of the Moon is most likely to occur when the Moon is at position

A) A  B) B  C) C  D) D
33. The diagram below shows the position of the Sun, the Moon, and Earth during a solar eclipse. The full shadow (umbra) and partial shadow (penumbra) of the Moon and Earth are shown.

Which diagram best represents the appearance of the Sun and the Moon to an observer located within the umbra of the Moon's shadow on Earth's surface?

A) Sun behind Moon
B) Moon behind Sun
C) Moon
D) Sun

34. A high tide occurred at 6:00 a.m. at a beach on Long Island. The next high tide at this same beach would occur at approximately

A) 12:15 p.m. on the same day
B) 6:30 p.m. on the same day
C) 12:45 p.m. on the following day
D) 7:00 a.m. on the following day
35. Base your answer to the following question on the diagram below, which shows Earth and the Moon in relation to the Sun. Positions A, B, C, and D show the Moon at specific locations in its orbit. Point X is a location on Earth's surface.

A solar eclipse might occur when the Moon is at location

A) A  B) B  C) C  D) D
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>1.</td>
<td>A</td>
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<tr>
<td>2.</td>
<td>D</td>
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<tr>
<td>3.</td>
<td>B</td>
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<tr>
<td>4.</td>
<td>A</td>
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<td>5.</td>
<td>C</td>
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<td>6.</td>
<td>C</td>
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<td>7.</td>
<td>C</td>
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<td>8.</td>
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<td>9.</td>
<td>A</td>
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<td>10.</td>
<td>B</td>
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<td>11.</td>
<td>B</td>
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<tr>
<td>12.</td>
<td>A</td>
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<td>13.</td>
<td>A</td>
</tr>
<tr>
<td>14.</td>
<td>C</td>
</tr>
<tr>
<td>15.</td>
<td>4 or 8</td>
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<tr>
<td>16.</td>
<td>8</td>
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<td>17.</td>
<td>B</td>
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<td>18.</td>
<td>B</td>
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<td>19.</td>
<td>D</td>
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<td>21.</td>
<td>C</td>
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<td>22.</td>
<td>C</td>
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<td>23.</td>
<td>A</td>
</tr>
<tr>
<td>24.</td>
<td>C</td>
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<td>25.</td>
<td>B</td>
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<td>26.</td>
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<td>31.</td>
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<tr>
<td>32.</td>
<td>B</td>
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<tr>
<td>33.</td>
<td>A</td>
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<tr>
<td>34.</td>
<td>B</td>
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<td>35.</td>
<td>C</td>
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