Earth Science Regents Review #2

Astronomy

Topics Reviewed:

Organization of the Universe

Origin of the Universe

Galaxies & Stars

Solar System

Orbits

The Moon

Earth's Motions

Seasonal Changes & Path of the Sun

PLUS 39 Practice Regents Questions with Answers!

REGENTS REVIEW #2
ASTRONOMY

7) **ORGANIZATION OF THE UNIVERSE**

Largest ----------> Smallest

Universe, Galaxy, Solar System, Sun, Planet, Moons/Asteroids/Meteoroids/Comets

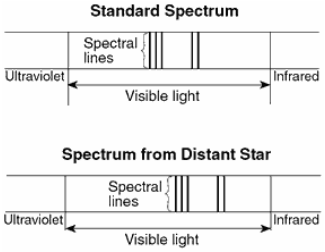
8) **UNIVERSE**

a) The **universe** began with a big explosion--**"The Big Bang"—**13.7 billion years ago.

b) Evidence of the big bang:

i) **Cosmic microwave background radiation**

ii) **Red shift** of light from distant galaxies (indicates galaxies are moving away & universe is expanding)



9) **GALAXIES AND STARS**

a) **Galaxies** are groups of hundreds of billions of stars.

b) Our solar system is located on one of the outer arms of our **spiral Milky Way Galaxy**.

c) Our Sun and all stars produce light energy by **nuclear fusion** of hydrogen.

d) All stars have life cycles **(see ESRT p.15).** Our sun is a **main sequence star**.

e) All stars are classified based upon their **size/luminosity** and **temperature/color**. (see **ESRT p.15**) Our sun is average sized and average temperature (yellow color).

10) **SOLAR SYSTEM**

a) Our solar system (**sun, planets, asteroids, comets, meteors**) formed **4.6 billion years ago** when a cloud of gas and dust was pulled together due to **gravity**.

b) **Terrestrial planets** (inner four) are rocky and small. **Jovian planets** (outer four) are gaseous and large. See **ESRT p.15** for planetary data.

c) Venus is the hottest planet in our solar system due to the **runaway greenhouse effect**. Venus' atmosphere is 95% **carbon dioxide** (**greenhouse gas**) which allows light to pass through, but traps heat near the surface.

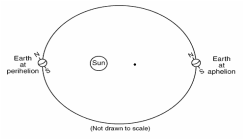
11) **ORBITS**

a) Planets revolve around the Sun in an **elliptical orbit** with the sun at one **focus**.

b) **Aphelion**: the point on an orbit farthest from the sun (July).

c) **Perihelion**: the point on an orbit closest to the sun (January).

d) **Eccentricity** can be calculated (**ESRT p.1 for equation**). The closer the value is to 1, the more elliptical the orbit.



e) Eccentricity data form planets in our solar system can be found on ESRT page 15.

f) The closer a planet is to the sun, the greater its **gravitational attraction**, the greater its **orbital velocity** (the faster it orbits), and the shorter its **period of revolution**.

12)**THE MOON**

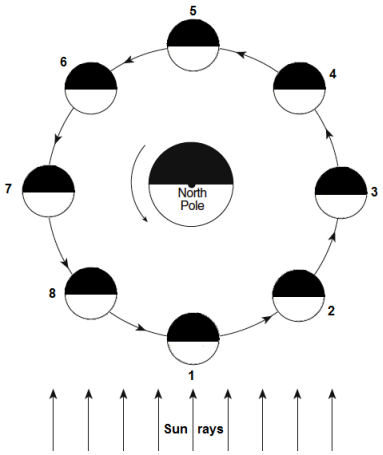
a) Phases & Motions of the Moon

i) Moon phases are **cyclic** and **predictable**.

ii) We only see the same side of the moon because the Moon's period of rotation (27.3 days) equals the Moon's period of revolution around Earth (27.3 days). **(ESRT p. 15)**

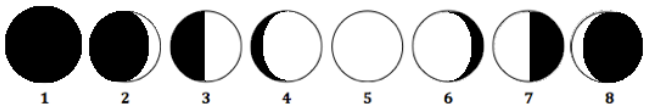
iii) **Moon phases** are caused by the Moon's revolution of Earth. We see a full cycle of Moon phases every 29.5 days.

iv) Know how to determine Moon phase as seen from Earth using a diagram of the Moon's orbit:



Steps to determine the Phase of the Moon:

1. Draw an arrow from the observer to the selected position.
2. Turn your paper so that the arrow is pointed directly away from you.
3. Block the far half of the moon.
4. Draw the amount of light and dark you see on the same side as you view it.



b) Ocean Tides

i) **Tides** are the **cyclic** & **predictable** rise and fall of ocean waters**.**

(1) Tides are caused by the gravitational pull of the Sun and the Moon.

(2) The Moon has more influence over the tides because it is closer to Earth.

ii) Time from high tide to high tide (or low tide to low tide) = 12 hours 26 minutes

iii) **Spring tides**: Extreme tidal change (highest high tides/lowest low tides) = Full or New Moon

iv) **Neap tides**: Minimal tidal change (lowest high tides/highest low tides) = 1st or 3rd Quarter Moon

c) Eclipses

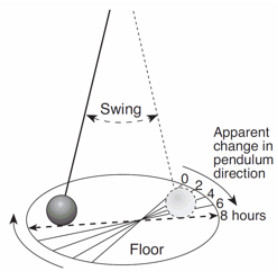
i) **Solar eclipse**: Sun is blocked by the Moon. Only occurs during New Moon.

ii) **Lunar eclipse**: Moon moves into Earth's shadow. Only occurs during Full Moon.

iii) Eclipses are rare because the Moon orbits Earth on a 5˚ incline.

13)**EARTH'S MOTIONS**

a) **Earth Rotates** on axis **DAILY.** Evidence:



i) All celestial objects appear to rise in the east and move west. (apparent motion)

ii) **Coriolis Effect** (deflects winds to right in the Northern Hemisphere) – see ESRT p 14

iii) **Foucault Pendulum** (appearance of change in swing direction)

iv) **Star Trails** (Stars appear to rotate 15˚/hour with Polaris at center)

b) **Earth Revolves** around the Sun **YEARLY.** Evidence:

i) **Constellations** are change throughout the year

ii) **Seasons**

14)**SEASONAL CHANGES**

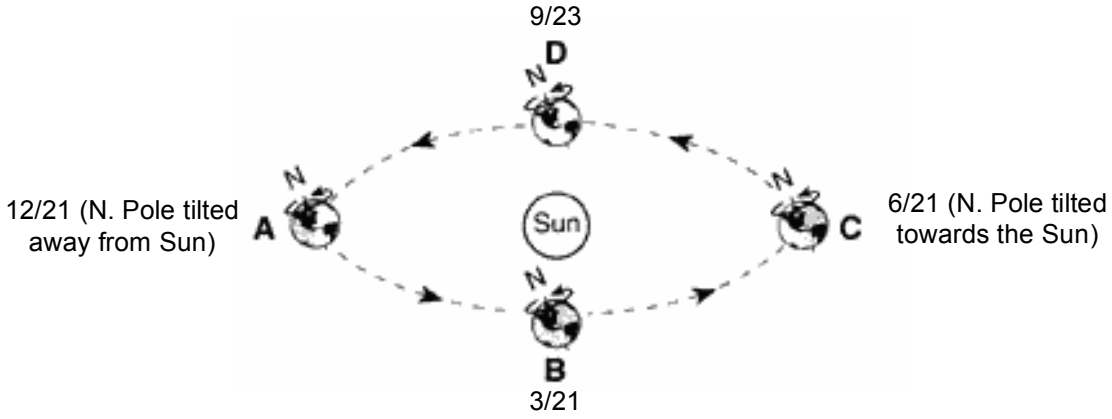
a) Seasonal changes are caused by:

i) Earth's revolution around the Sun

ii) Earth's axis is tilted at 23.5˚ with North Pole aligned with Polaris (**parallelism**).

b) Seasons in Southern Hemisphere are opposite.

c) Diagram of Seasons as seen from space:



d) **Duration of Insolation**: length of daylight period

i) Equator always has 12 hours of daylight.

e) **Angle of Insolation**: how high the sun is in the sky (between 0 and 90 degrees)

i) The greater the angle of insolation, the greater the intensity of insolation and the warmer the temperature.

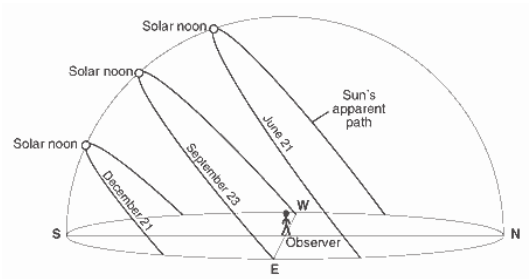
ii) **Vertical rays**: locations that receive sunlight directly overhead (90 degrees above the observer)

(1) NEW YORK STATE NEVER RECEIVES VERTICAL RAYS!

15)**PATH OF THE SUN:** The path the Sun takes changes with latitude and season.

Season Start in N. Hemisphere	Date	Location of Vertical Rays	Direction of Sun rise & Sun set	Length of Day in N.Hemisphere
Winter Solstice	12/21	23.5˚S	Southeast & Southwest	Shortest (9 hours in NY)
Equinoxes	3/21 & 9/23	0˚ (Equator)	Due East & Due West	12 hours all over world
Summer Solstice	6/21	23.5˚N	Northeast & Northwest	Longest (15 hours in NY)

a) Sun's apparent path in **New York State**:



b) **Solar Time**: the time of day can be estimated using the Sun's location on its path through the sky.

i) **Solar noon***:* halfway through the daylight period. Represented by the location where the Sun's path intersects the arc of the diagram.

ii) **Sunrise:** where the sun intersects the eastern horizon

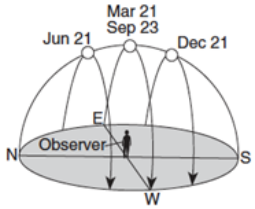
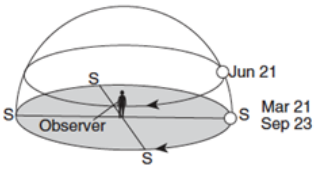
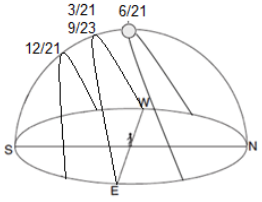
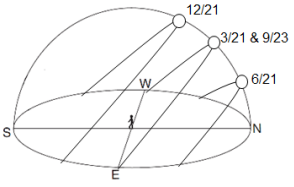
iii) **Sunset:** where the sun intersects the western horizon

c) **Shadows** always point in the opposite direction from the light.

i) The lower the altitude of the Sun, the longer the shadow. (winter, sunrise, sunset)

ii) The higher the altitude of the Sun, the shorter the shadow. (summer & solar noon)

d) Sun's apparent path changes with latitude:

Equator	North Pole	Tropic of Cancer	Southern Hemisphere
			
Sun reaches zenith on equinox at solar noon.	All directions are South. Sun's path is a ring parallel to horizon.	Sun reaches zenith on June 21 at solar noon	Sun is in Northern sky each day.

REGENTS REVIEW #2
ASTRONOMY

PRACTICE REGENTS QUESTIONS

1. List the following astronomical features, in order of relative size, from smallest to largest.

   Sun
   Jupiter
   Milky Way Galaxy
   Universe
   Our solar system

2. Which evidence best supports the Big Bang theory?
   (1) rate of rotation of the Sun
   (2) existence of cosmic background radiation
   (3) uniform radioactive decay of uranium-238
   (4) separation of Earth's interior into different layers

3. Galaxies are classified based on their shape. What is the shape of the Milky Way Galaxy when viewed from directly above?

4. Which process combines lighter elements into heavier elements and produces energy within the Sun and other stars?
   (1) fusion (2) insolation (3) conduction (4) radioactive decay

5. Which star has a surface temperature most similar to the surface temperature of Alpha Centauri?
   (1) Polaris (2) Betelgeuse (3) Procyon B (4) Sirius

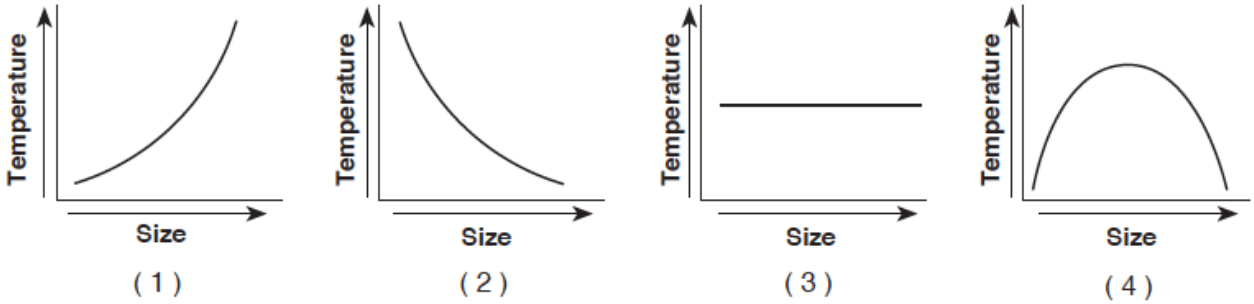
Base your answers to questions 6 through 8 on the passage below and on your knowledge of Earth science.

Cosmic Microwave Background Radiation

In the 1920s, Edwin Hubble's discovery of a pattern in the red shift of light from galaxies moving away from Earth led to the theory of an expanding universe. This expansion implies that the universe was smaller, denser, and hotter in the past. In the 1940s, scientists predicted that heat (identified as cosmic microwave background radiation) left over from the Big Bang would fill the universe. In the 1960s, satellite probes found that cosmic microwave background radiation fills the universe uniformly in every direction, and indicated a temperature of about 3 kelvins (K). This radiationhas been cooling as the universe has been expanding.

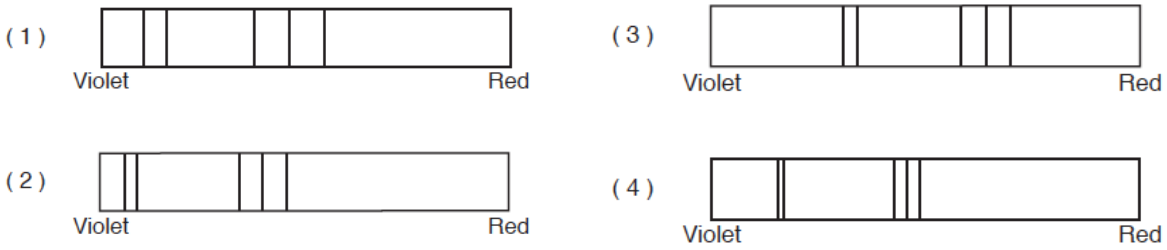
6. Scientists infer that the universe began approximately
   (1) 1.0 billion years ago
   (2) 3.3 billion years ago
   (3) 8.2 billion years ago
   (4) 13.7 billion years ago

7. Which graph best shows the relationship of the size of the universe to the temperature indicated by the cosmic microwave background radiation?



8. The diagram below represents the spectral lines from the light of an element in a laboratory on Earth.

Which diagram below best represents the pattern of spectral lines from the same element when it was observed by Edwin Hubble in the light of one of the distant galaxies?



9. Which event occurred approximately 4.6 billion years ago?
   (1) evolution of the earliest fish
   (2) evolution of stromatolites
   (3) formation of the oldest known Earth rocks
   (4) formation of Earth and our solar system

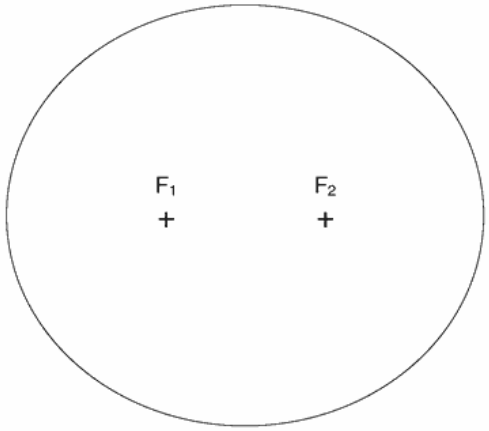
10. Which two characteristics do all Jovian planets have in common?
   (1) small diameters and low densities (3) large diameters and low densities
   (2) small diameters and high densities (4) large diameters and high densities

11. Which planet takes more time to complete one rotation on its axis than to complete one revolution around the Sun?
   (1) Mercury (2) Venus (3) Mars (4) Jupiter

12. Approximately 97% of Venus's atmosphere is carbon dioxide. Describe how carbon dioxide contributes to the unusually high average surface temperature of Venus.

13. During which Northern Hemisphere season is Earth closest to the Sun?
   (1) spring (2) summer (3) autumn (4) winter

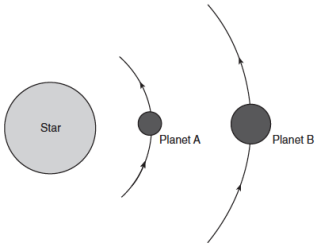
14. Base your answer to the following question on the diagram of the ellipse below.



   a. Calculate the eccentricity of the ellipse to the nearest thousandth.

   b. State how the eccentricity of the given ellipse compares to the eccentricity of the orbit of Mars.

15. The diagram below represents planets A and B, of equal mass, revolving around a star.



Compared to planet A, planet B has a

(1) weaker gravitational attraction to the star and a shorter period of revolution
(2) weaker gravitational attraction to the star and a longer period of revolution
(3) stronger gravitational attraction to the star and a shorter period of revolution
(4) stronger gravitational attraction to the star and a longer period of revolution

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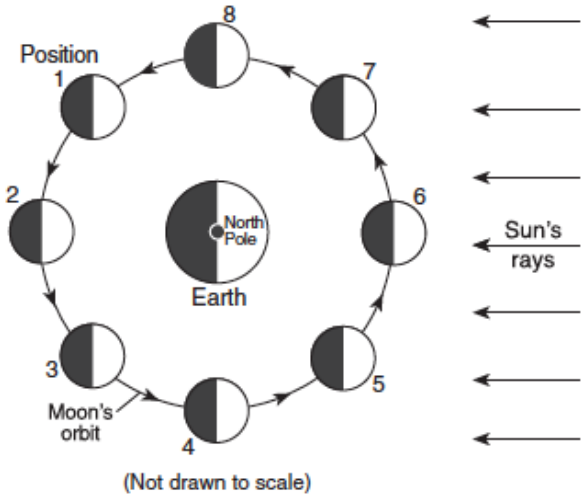
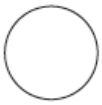
Base your answers to questions 16 through 20 on the diagram below, which represents eight positions of the Moon in its orbit around Earth.



(Not drawn to scale)

16. On the diagram above, circle the position of the Moon where a solar eclipse is possible.

17. On the diagram below, shade the portion of the Moon that is in darkness to show the phase of the Moon at position 3, as viewed from New York State.



18. Using the terms rotation and revolution, explain why the same side of the Moon always faces Earth.

19. State the number of days the Moon takes to go through one complete cycle of Moon phases from full Moon to full Moon as viewed from Earth.

20. Explain why the Moon's gravity has a greater effect on Earth's ocean tides than the Sun's gravity.

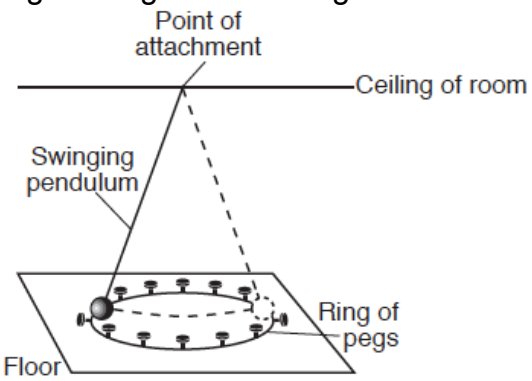
21. The table below shows times of ocean tides on March 4 for a city on the Atlantic coast of the United States.

Ocean Tides on March 4

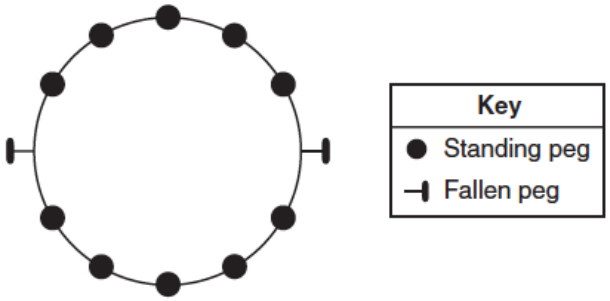
Tide	Time
high	12:00 a.m.
low	6:13 a.m.
high	12:26 p.m.

Determine the time when the next low tide occurred. Include a.m. or p.m. in your answer, if needed.

22. The diagram below represents a swinging pendulum located in Earth's Northern Hemisphere. The pendulum knocked over two pegs during its first swing.



The diagram below represents a top view of the same pegs. Circle the next two pegs that would fall as the pendulum appears to change its direction of swing in the Northern Hemisphere.

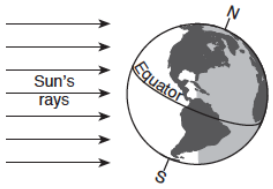


23. What causes many surface winds to deflect to the right in the Northern Hemisphere?
    (1) rotation of Earth on its axis
    (2) unequal heating of Earth's surface
    (3) gravitational force of the Moon
    (4) gravitational force of the Sun

24. Which statement best explains why some constellations are not seen during all four seasons?
    (1) Earth revolves around the Sun.
    (2) Constellations revolve around the Sun.
    (3) The Moon revolves around Earth.
    (4) The Sun revolves around the center of the Milky Way.

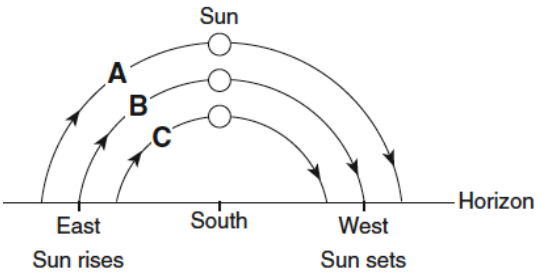
25. Evidence that Earth revolves around the Sun is provided by the
    (1) apparent rising and setting of the Sun during one day
    (2) apparent rising and setting of Polaris during one day
    (3) seasonal changes in the apparent positions of constellations
    (4) hourly changes in the apparent direction of the swing of a Foucault pendulum

26. The diagram below represents Earth in space on the first day of a season.



Which season is beginning in New York State on the day represented in the diagram?
(1) winter (2) spring (3) summer (4) fall

27. The diagram below represents the horizon and the Sun's apparent paths, A, B, and C, on three different dates, as viewed from the same location in New York State.



Which table correctly shows the dates on which the apparent paths of the Sun were observed?

Path of Sun	Date
A	December 21
B	September 23
C	March 21

(1)

Path of Sun	Date
A	March 21
B	September 23
C	June 21

(3)

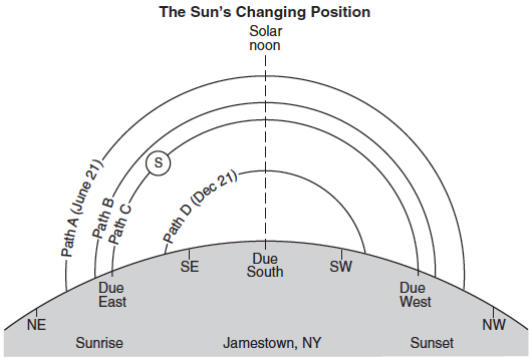
Path of Sun	Date
A	December 21
B	March 21
C	June 21

(2)

Path of Sun	Date
A	June 21
B	March 21
C	December 21

(4)

Base your answers to questions 28 through 30 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.

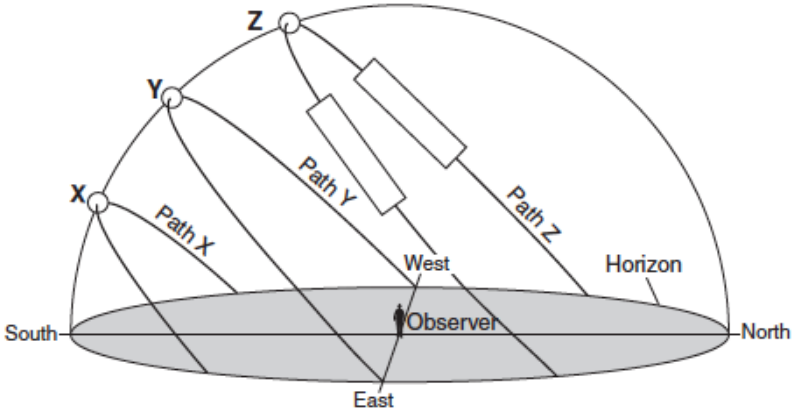


28. The greatest duration of insolation in Jamestown occurs when the Sun appears to travel along path
    (1) A (2) B (3) C (4) D

29. At what time of day is the Sun at position S?
    (1) 6 a.m. (2) 9 a.m. (3) 3 p.m. (4) 6 p.m.

30. When the Sun appears to travel along path D at Jamestown, which latitude on Earth receives the most direct rays from the Sun?
    (1) 42° N (2) 23.5° N (3) 0° (4) 23.5° S

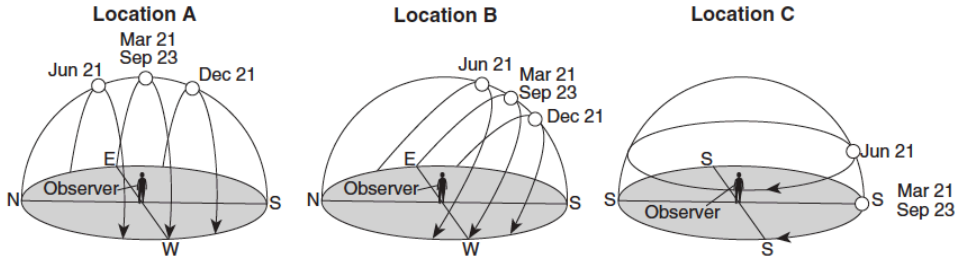
Base your answers to questions 31 and 32 on the diagram below and on your knowledge of Earth science. The diagram represents the Sun's apparent path on the equinoxes and the longest and shortest days of the year for a location in New York State. Points X, Y, and Z represent the solar noon positions along daily Sun paths X, Y, and Z.



31. On the diagram above, draw one arrow in each box on path Z to indicate the Sun's apparent direction of movement along path Z.

32. State one possible date of the year represented by each apparent path of the Sun.
    - Path X: _____
    - Path Y: _____
    - Path Z: _____

Base your answers to questions 33 through 39 on the diagrams below, which show the apparent path and solar noon positions of the Sun on specific dates at three different locations on Earth.



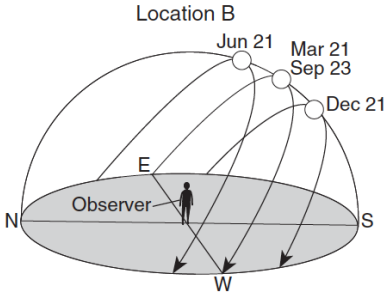
33. What evidence indicates that the observer at location A is at the equator?

34. How many hours of daylight are seen by the observer at location A on the equinox dates?

35. Explain why the observer's shadow at location B will always point northward at solar noon.

36. What evidence indicates that the observer at location B is in the Northern Hemisphere?

37. On the diagram below, draw a line representing the apparent path of the Sun at location B on August 21.



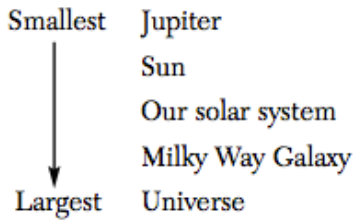
38. What is the latitude of the observer at location C? How do you know?

39. How many hours of daylight are seen by the observer at location C on June 21?

REGENTS REVIEW #2
ASTRONOMY

PRACTICE REGENTS QUESTIONS

1. *(See Fact 7)*

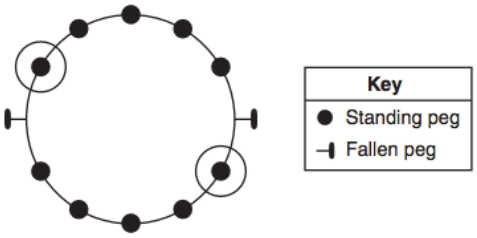


2. 2 *(See Fact 8b)*
3. Spiral galaxy *(See Fact 9b)*
4. 1 *(See Fact 9c)*
5. 1 *(See Fact 9e & ESRT p15)*
6. 4 *(See Fact 8a)*
7. 2 *(Answer is in the reading)*
8. 3 *(See Fact 8b)*
9. 4 *(See Fact 10a)*
10. 3 *(See Fact 10b & ESRT p15)*
11. 2 *(See Fact 10b & ESRT p15)*
12. Carbon dioxide is a greenhouse gas – it allows visible light to pass through but it traps infrared heat near Venus' surface. *(See Fact 10c)*
13. 4 *(See Fact 11c)*
14. a. 0.333 *(See Fact 11d)*

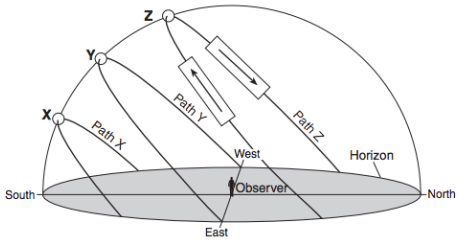
    b. The eccentricity of the given ellipse is more elliptical than the orbit of Mars. *(See Fact 11d)*
15. 2 *(See Fact 11f)*
16. Position 6 must be circled on the diagram. *(See Fact 12c,i)*
17. *(See Fact 12a,iv)*

18. The period of rotation of the Moon is equal to the period of revolution of the Moon. *(See Fact 12a,ii)*
19. 29.5 days *(See Fact 12a,iii)*
20. The Moon is closer to the Earth than the Sun is. *(See Fact 12b,i,2)*
21. 6:39 p.m. *(See Fact 12b,ii)*

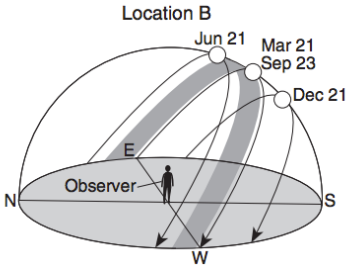
22. *(See Fact 13a,iii)*



23. 1 *(See Fact 13a,ii)*
24. 1 *(See Fact 13b,i)*
25. 3 *(See Fact 13b)*
26. 1 *(See Fact 14c)*
27. 4 *(See Fact 15)*
28. 1 *(See Fact 15)*
29. 2 *(See Fact 15b)*
30. 4 *(See Fact 15)*
31. *(See Fact 13a,i)*



32. X: December 21; Y = March 21/September 23; Z = June 21 *(See Fact 15a)*
33. Sun reaches the zenith at noon on the equinox *(See Fact 15d)*
34. 12 hours *(See Fact 14d,i)*
35. At solar noon the Sun is always located due south and shadows always point in the opposite direction. *(See Fact 15c)*
36. The Sun is in the Southern Sky. *(See Fact 15)*
37. The line must be drawn in the shaded area, parallel to the existing Sun paths. *(See Fact 15a)*



38. 90˚N (North Pole) because all directions are south *(See Fact 15d)*
39. 24 hours *(See Fact 15d)*