Unit E: Space Exploration

Focusing Questions:

1. How have humans attained a presence in space?
2. What technologies have been developed and on what scientific ideas are they based?
3. How has the development of these technologies contributed to the exploration, use and understanding of space and to benefits on Earth?

Key concepts:

- Technologies for space exploration and observation
- Reference frames for describing position and motion in space
- Satellites and orbits
- Distribution of matter through space
- Composition and characteristics of bodies in space
- Life-support technologies
- Communication technologies

Learning outcomes:

1. Identify different perspectives on the nature of Earth and space.
2. Investigate and illustrate the contributions of technological advances to a scientific understanding of space.
3. Describe the distribution of matter in space.
4. Describe and apply techniques for determining the position and motion of objects in space.
5. Analyze space environments, and identify challenges that must be met in developing life-supporting systems.
6. Describe technologies for space transport, and interpret the scientific principles involved.
7. Describe the development of artificial satellites, and explain the major purposes for which they are used.
8. Explain, in general terms, the operation of optical telescopes, including telescopes that are placed in space environments.
9. Explain the role of radio and optical telescopes in determining the characteristics of stars and star systems.
10. Describe and interpret, in general terms, the technologies used in global positioning systems and in remote sensing.
11. Recognize the risks and dangers associated with space exploration.

12. Describe Canadian contributions to space research and development and to the astronaut program.

13. Identify and analyze factors that are important to decisions regarding space exploration and development.

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**Observing with Eyes**
(pre-history–1600s)

- The stars, Moon, Sun, and planets appear to circle Earth.
- Is the universe Earth-centred or Sun-centred?

**Observing with Simple Telescopes**
(1600s–1700s)

- Galileo's telescopic observations help secure the Sun-centered model of the universe (solar system).

**Observing with Spectroscopes**
(1800s–present)

- The spectroscope helps determine the composition and motion of stars.

**Telescopes Become Bigger and “Smarter”**
(1700s–present)

- With finer measurements, one can determine distances to the stars.
- Our understanding of the size of the universe increases.

**Observing with Radio Telescopes**
(1930s–present)

- Opens the door to observing radio emissions in the universe.

**Using Rockets and Computers**
(1940s–present)

- Rockets provide access to space, enabling observations of the universe without the blanketing effects of Earth's atmosphere.
- Computers play a crucial role in space exploration; imaging, remote sensing, space probe maneuvering.

**Observing with Unmanned Space Probes**
(1970s–present)

- Observing the planets, Sun, and Moon up close shows us that each is unique.

**Manned Space Exploration**
(1950s–present)

- From suborbital flights, to the International Space Station, people learn to work in space.
- Microgravity research benefits people on Earth.
1. Latitude, longitude and altitude are all examples of **frames of reference**. Explain this phrase.

2. Celestial bodies:

   We can see stars and planets because stars _________ light and planets _________ light.

3. Grouping of stars that form patterns such as Orion, the hunter are called _________________.
   Why did ancient people think that the Earth was the centre of the universe?

4. By watching celestial bodies move, ancient people could predict the spring and summer equinox, the summer and winter solstice, and solar and lunar eclipses.
5. The __________ __________ (_____________) can be used to find directions at night because it is a fixed point almost directly above the Earth’s North Pole. The big Dipper appears to move counter-clockwise around it.

6. Angles used to specify the coordinates of a celestial body relative to a fixed Earth are called __________ - __________ __________:

<table>
<thead>
<tr>
<th>Angle name:</th>
<th>Altitude</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain what it is and how to calculate:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Device used to measure:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Zenith is the highest point above the observer, or the maximum altitude of 90°.

7. Complete Practice Problems #1 – 3 on page 359.

#1 = star _____ #2 = star _____ #3 = star _____

8. Because of the Earth’s ________________, the stars and planets appear to circle above the Earth. Therefore, the Earth should not be used as a frame of reference when tracking the actual motion of celestial bodies. Instead, you should use __________ as the frame of reference.
9. How does the Copernicus’ **heliocentric model** of the universe differ from the Aristotle’s **geocentric model**?

![Diagram of heliocentric and geocentric models of the universe]

10. How does the current heliocentric model (Kepler p. 371) differ from Copernicus’ older version?

![Diagram of heliocentric model]

**Topic 2 – Stronger Eyes and Better Numbers**

1. A ___________ is used to magnify objects at great distances. Differentiate between **objective** and **ocular lenses**.

2. ___________ telescopic study of Jupiter and its four orbiting moons supported the ____-centric model of the universe.

3. The ability to distinguish fine detail is referred to as ___________ (resolution) and can be increased by using ___________ diameter objective lenses or by using multiple telescopes (**optical interferometry**).
### Optical Telescopes

<table>
<thead>
<tr>
<th>Refracting Telescopes</th>
<th>Reflecting Telescopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refracting telescopes use ______ that ______ light.</td>
<td>Reflecting telescopes use ______ that ______ light.</td>
</tr>
</tbody>
</table>

**Advantage:**
- Refracting: First telescope used.
- Reflecting: Example: Hubble telescope

You must be able to label each of the following telescopes:
Movie - Understanding the Universe

1. Which planet is closest to the sun and which planet is furthest from the sun?
2. How many light-years away is the nearest star after our sun?
3. Who invented the first telescope?
4. When an object is moving away, its spectrum becomes _______ shifted?
5. Explain the big bang theory.
6. How old is the universe according to this theory?
7. Why do astronomers move to remote areas for observations?
8. What are supernovas?
9. What causes the twinkling (twisting and shimmering) of stars?
10. What was the name of the first telescope place above the Earth’s orbit?
11. The brightest stars in a cluster burn what gas?
12. Scientists owe most of what they know about the universe to a low pitch “hiss” called __________ waves.
13. Is the universe expanding uniformly or not?
14. What is the 90% of the universe that is not visible is called?
15. Theoretically, gravity will cause the end of the universe in an event called the Big __________.
16. The fusion of hydrogen atoms results in __________ atoms.
17. What is a gravitational field so intense that even light cannot escape is called?
18. What are wormholes?
19. According to modern physics, what is the fastest speed attainable?
20. Where do the atoms in your body come from?
Unit E – Topics 1-2 Review

Definitions:
1. altitude

2. frame of reference

3. eyepiece

4. resolving power

5. geocentric

Matching

A
6. Kepler’s discovery — the shape of planetary orbits
7. instrument used to measure azimuth
8. telescope with a mirror for an objective
9. an object seen in the sky beyond Earth
10. a planet turns on its axis

B
rotation
celestial body
reflecting
elliptical
compass

11. While Jack runs past Sally at 15 km/h toward the east, Sam passes Jack at a speed 5 km/h faster than Jack’s speed.
   (a) What is Sam’s speed, including direction, relative to Sally?

   (b) What is Jack’s speed, including direction, relative to Sam?
12. How did the ancient astronomers know that the planets were different from the stars (hint: what do stars do that planets can’t)?

Use this diagram to answer the next question.

13. Write the altitude-azimuth co-ordinates for the Moon and Jupiter in the diagram.

14. How was the model of the universe that Copernicus presented similar to and different from the model used by Ptolemy?

15. When people buy astronomical telescopes, they have an option to buy a set of eyepieces to go with the telescope. If Fred bought a telescope with an objective with a focal length of 2000 mm, and eyepieces with focal lengths of 40 mm, 16 mm, and 8 mm, then what magnifications will Fred expect from his telescope?
16. How did Galileo come to the conclusion that the moon has mountains on its surface?

17. Match the astronomer or scientist in Column A to their theory or invention in Column B. There may be more than one item in Column B that matches the scientists listed.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Galileo Galilei</td>
<td>law of universal gravitation</td>
</tr>
<tr>
<td>2. Hans Lippershey</td>
<td>sun-centred model of the universe</td>
</tr>
<tr>
<td>3. Johannes Kepler</td>
<td>invented the reflecting telescope</td>
</tr>
<tr>
<td>4. Ptolemy</td>
<td>Earth-centred model of the universe</td>
</tr>
<tr>
<td>5. Copernicus</td>
<td>disproved the Earth-centred model of the universe</td>
</tr>
<tr>
<td>6. Issac Newton</td>
<td>invented the telescope in 1608</td>
</tr>
<tr>
<td></td>
<td>theorized that planetary orbits were elliptical</td>
</tr>
<tr>
<td></td>
<td>discovered the shape and scale of the entire known solar system.</td>
</tr>
</tbody>
</table>

18. Use the following diagram to identify the star with each of these coordinates:

<table>
<thead>
<tr>
<th>Star</th>
<th>Altitude</th>
<th>Azimuth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>80º</td>
<td>330º</td>
</tr>
<tr>
<td>B</td>
<td>45º</td>
<td>135º</td>
</tr>
<tr>
<td>C</td>
<td>70º</td>
<td>245º</td>
</tr>
<tr>
<td>D</td>
<td>25º</td>
<td>50º</td>
</tr>
</tbody>
</table>

FERRIGE/SCIENCE 9/Unit E/Space 10
Topic 3 – Spectroscopy

Visible light is often referred to as ___________ ___________. By passing a beam of light through a ____________, Newton discovered that white light is actually a mixture of all the different colours of a rainbow or ________________ (ROY G. BIV). (demo)

A ________________ can be used to produce a “focused” spectrum or spectra. An expensive spectroscope consists of a prism and several lenses, but an inexpensive spectroscope (the one you’ll use) consists of **diffraction gratings** (flat piece of glass/plastic etched with thousands of slits). Studying spectra is a science known as ________________.

Three Types of Spectra:

When an object/element is heated sufficiently it starts to glow and gives off a ________________ ________________, a complete rainbow of colours without any ________________ lines (fine dark lines on a spectrum). (demo)

If there is an unexcited/cool gas between the hot, glowing substance and the spectroscope, the spectrum will have dark spectral lines because the gas absorbs the energy of some of the wavelengths of the light. ________________ ________________ ________________ are known as ________________ spectra.
If the dark line spectrum is viewed at an angle away from the light source, a pattern of bright spectral lines appear. __________ __________ __________ are known as ________________ spectra. (demos)

Note: the bright lines in an emission spectrum occur at exactly the same positions as the dark lines in the absorption spectrum of the same __________.

Every element produces its own unique pattern of absorption or emission spectra. Therefore, we can identify some of the elements present in stars by examining the spectra they produce. This process is referred to as __________ ____________.

Complete Investigation 5-E in the space below:

1.

2.

3.

4.

5.

6.
More Spectral Analysis

Analyze the spectra below in order to answer the following questions.

<table>
<thead>
<tr>
<th></th>
<th>V</th>
<th>B</th>
<th>G</th>
<th>Y</th>
<th>O</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mercury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery Star 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery Star 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery Star 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mystery Star 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions

1. List the chemical elements in:
   (a) Mystery Star 1
   (b) Mystery Star 2
   (c) Mystery Star 3

2. (a) There is something strange about Mystery Star 4’s spectrum. What chemical is in Mystery Star 4?
   (b) What is odd about the spectrum?
What does spectroscopy tell us about the movement of stars?

Think about the sound of an ambulance or police siren as it approaches your car and then passes it. When a sound source is moving towards you, the frequency (pitch) __________. Once a sound source passes by, the pitch ____________. This effect is called the ____________ __________.

Motion has the same effect on light waves. If a star is moving ____________ from an observer, the spectral lines are shifted towards the red end of the spectrum. This is called ____________ ____________.

If a star is moving towards an observer, the spectral lines shift towards the ____________ end of the spectrum. This is called ____________ ____________.

Note: The greater the shift, the faster it is moving.

What three factors can we determine from the spectral analysis of a star?

- 
- 
- 

Complete #2– 4 p. 384

2. 
3. 
4.
Topic 4 – Bigger and Smaller Telescopes

1. Mr. Ferrige desperately wants to explain why the Hubble telescope which is 600 km above the Earth’s surface and other telescopes placed above the atmosphere are better than land-based telescopes so please ask him.

2. Why do astronomers continue to build even larger telescopes?

3. What is adaptive optics? How does this technique work?

4. Two methods can be used to measure distance in space: triangulation and parallax
   a. Define triangulation and explain how it works.
   b. Define parallax (technique) and explain how it works.
5. A group of students went to a park to practice their triangulation skills. They picked an object far away, set up a baseline, and measured the angle to their object at each end of the baseline, (see diagram). Their results are shown here. For each group below, use triangulation to find the distance to the far object.

<table>
<thead>
<tr>
<th>Group</th>
<th>Baseline length (m)</th>
<th>angle X</th>
<th>angle Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>46</td>
<td>75°</td>
<td>78°</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>81°</td>
<td>77°</td>
</tr>
<tr>
<td>C</td>
<td>89</td>
<td>55°</td>
<td>71°</td>
</tr>
</tbody>
</table>

6. The ___________ the baselines, the more accurate the triangulation will be. What do astronomers use as the baseline for triangulating distant stars?

7. Because it takes ____ months to generate this baseline, astronomers use __________ _________ as reference points.

8. Because universal distances are so great, there is a need for different measuring techniques and units. Differentiate between an astronomical unit (AU) and a light year.

Note: a parsec is a basic unit of length (3.26 light years) for measuring distances to stars and galaxies.
Note: your textbook uses the terms frequency and wavelength when discussing waves but never explains what they are. Therefore:

**Frequency**: how many times per second a signal is sent. A frequency of 100 Hz means 100 signals per second.

**Wavelength**: the distance between two waves (signals).

As the frequency increases, the wavelength _______________.

1. **Electromagnetic radiation (EMR)** is waves composed of electric and magnetic fields that travel at the speed of light \( (3 \times 10^8 \text{ m/s}) \). List the different forms of EMR in order of increasing frequency (decreasing wavelength).
2. **Radio telescopes (radio astronomy):**

3. Celestial objects or certain areas in space that produce large amounts of radio waves (loud static) are called ______________ ______________. Telescopes that detect these waves are called ______________ ______________. These telescopes have a greater range than optical and can penetrate ______________ ______________. These telescopes produce images with less resolution than optical telescopes, however, the resolution can be increased if focusing on waves with ______________ wavelengths or using interferometry.

4. What are VLAs? Explain the technique of radio **interferometry**.

5. Describe how **very long base line (VLBI) interferometry** works.
Topics 3–5 Review

1. Define each term:
   (a) spectrum: ______________________________________________________________________
       ________________________________________________________________________________
   (b) light-year: ______________________________________________________________________
       ________________________________________________________________________________
   (c) triangulation: ____________________________________________________________________
       ________________________________________________________________________________
   (d) radio waves: _____________________________________________________________________
       ________________________________________________________________________________
   (e) adaptive optics: __________________________________________________________________
       ________________________________________________________________________________

Match each definition in column A with the correct term in column B. Draw a line from each definition to the corresponding term.

A                      B
2. energy waves which include visible light diffraction grating
3. apparent change of wave frequency caused by motion interferometry
4. a device used to produce a spectrum electromagnetic radiation
5. spectrum of a hot solid continuous
6. technique that combines images from two telescopes Doppler effect

Short Answers
7. How is an element identified in the Sun’s spectrum?
___________________________________________________________________________________
___________________________________________________________________________________

8. How do astronomers analyze starlight to decide if a star is moving toward or away from us?
___________________________________________________________________________________
___________________________________________________________________________________

9. The star Vega is 25 light-years away from us. If we sent a radio message to Vega, and another civilization on a planet circling that star answered us, in what year could we expect to hear a reply?
___________________________________________________________________________________
___________________________________________________________________________________

10. Why was it necessary to make radio telescopes so much bigger than optical telescopes?
___________________________________________________________________________________
___________________________________________________________________________________
11. Define each of the following terms in the space provided, and use the word in a complete sentence.

(a) electromagnetic radiation

(b) radio astronomy

(c) radio objects

(d) interferometry

(e) very long base line interferometry (VLBI)

12. How do astronomers use radio waves to learn about the composition of stars?
1. Differentiate between a **rocket** and a **payload**.

2. What is **exhaust velocity** and what does it determine?

3. Why do modern rockets like those used by the Space Shuttle use liquid fuel instead of solid fuel as a source of ____________ energy?

Two other rocket technologies are presently being experimented with: **ion drive engines** that use electrically charged xenon gas for fuel and **solar sails** that harvest solar energy.

4. What are **multistage rockets**? What’s the advantage?

5. ____________ have allowed the orbits of rockets to be calculated and controlled.

6. Explain the technique of **gravitational assist**.
7. Differentiate between **natural** and **artificial satellites**?

8. Identify and describe the two types of artificial satellites identified in your textbook on page 404. What are these satellites used for?

9. A satellite could transmit signals over a greater area of the Earth’s surface if you ______________ the radius of orbit.

10. Old satellites become **space junk**, which is dangerous, so how do we get rid of them?

11. What is **remote sensing**? Provide several applications of this technology.

12. What does **GPS** stand for and what is it used for?
Topic 7 - The Solar System

1. What is your understanding of the Big Bang Theory?

2. What is a galaxy? What is the name of the spiral galaxy that our solar system belongs to?

3. Milky way > solar system > sun > earth (size and mass)

4. The solar system consists of the sun, planets, moons, asteroids, and other smaller rock fragments.

5. Life-cycle of a star: It is believed that huge accumulations of dust and gases called nebulae are pulled together by gravity to form stars that go through stages of development.

They begin as red giants, become white dwarfs, and eventually evolve to supernova and neutron stars or black holes.

6. Composed mostly of the gas ___________, the ___________ is our closest star and the center of our _______ system. With a diameter 110 times that of Earth, its gravitational field is so intense that nuclear fusion takes place. What is nuclear fusion?
7. In the 1920s, E. Hertzsprung and H. Russell compared the surface temperature of stars with its brightness (luminosity). Stars fall into distinct groups:

![Hertzsprung-Russell Diagram]

8. **Solar flares** are bursts of energy released from the sun’s surface. These are associated with the Northern and Southern lights. Around the middle of the sun are cooler, darker **sunspots**. These are areas of less activity and are frequently linked to stormy weather on Earth. What is **solar wind**?

9. Planets:
   a. Make a phrase that will enable you to recite the planets in our solar system starting with the planet closest to the sun.

   b. The **inner planets** are also referred to as the _____________ planets because they have a _____________ composition. Name the inner planets:

   c. The **outer planets** are also referred to as the _Jovian_ planets because they have a _____________ composition. Name the outer planets:

   d. What is the relationship between average temperature of a planet and its distance from the sun? Draw a graph to show this relationship. Which planet seems to be an exception? Why?
e. It takes the Earth one year (12 Earth months) to orbit the sun. What is the relationship between the orbital period (the time it takes to orbit the sun) and the distance of the planet from the sun? Draw a graph to show this relationship.

f. It takes the Earth one day (24 Earth hours) to rotate on its axis. What is the relationship between the rotational period (the time it takes to rotate on its axis) and the length of day? Draw a graph to show this relationship.

10. What are moons?

11. There is an asteroid belt between the orbits of Jupiter and Mars. What are asteroids?

12. What are comets? Why do we see some comets more often than others?

13. Differentiate between a meteoroid, a meteor and a meteorite.

14. What is the purpose of **space probes** like the Voyager 1 and 2 spacecrafts?
Topic 8 - People in Space

In space there are many risks and dangers like solar and cosmic radiation, micrometeorites, and extreme temperatures. Plus there’s no food, air, or water. That is why the first flights into space were unmanned.

1. In 1957, the Russian Sputnik became big news. Why?

2. What is the name of the first spacecraft to *orbit* the Earth with a human payload (1961)?

3. What was the goal of the American Project Mercury?

4. What was the goal of the American Apollo Program? Identify when and who accomplished this goal?

5. What is the purpose of the *Space Shuttle* program? What is Canada’s major contribution the space shuttle program?

6. Explain the term *microgravity*.

7. Who was the first Canadian in space (1984)?

8. What is the purpose of the *International Space Station (ISS)*?

To be self-sufficient, inhabitants of the ISS must purify dirty water for drinking, recover moisture from inside the station and use solar panels for electricity.
Topics 6–8 Review

Definitions:

1. staged rocket
2. remote sensing
3. solar wind
4. microgravity
5. comets

Matching

6. device that records images from newer telescopes
   GPS
7. orbit that makes a satellite stay over one location on Earth
   Pluto
8. using a planet to change the orbit of a spacecraft
   CCD
9. satellite system used to locate things on Earth
   gravitational assist
10. the only planet not visited by a spacecraft from Earth
    geosynchronous

Short Answers

11. Suppose that a spacecraft were to be sent to Venus and another to Mars. Which spacecraft would need more shielding from the solar wind? Why?

12. The space shuttle is powered by a staged rocket system. Why?
Unit E Review

Definitions
1. heliocentric

2. spectroscope

3. red shift

4. payload

5. cosmonaut

True or False
7. The angle above the horizon of a star is its altitude.
8. The Sun’s light exhibits an emission spectrum.
9. An astronomical unit (AU) is the distance light travels in one year.
10. A satellite that orbits Earth in about 1.5 h is in a low Earth orbit.

Multiple Choice
11. An astronaut is tethered to the International Space Station, keeping a constant distance from the station.
The false statement here is
(a) The station’s velocity relative to the astronaut is zero.
(b) The astronaut’s velocity relative to the station is zero.
(c) The velocities of the station and the astronaut relative to Earth are different.
(d) The velocities of the station and the astronaut relative to Earth are the same.

12. The correct statement about a scientist and what he discovered is:
(a) Galileo, spectroscope
(b) Kepler, radio telescope
(c) Newton, law of gravity
(d) Ptolemy, elliptical orbits

13. Satellite dishes are becoming more popular with people interested in watching many TV channels. The satellites that these dishes are aimed at are in:
(a) geosynchronous orbits so that the satellite dish need not be moved
(b) low Earth orbits so the signals reach the customers in a fraction of a second
(c) low Earth orbits so the signals don’t have to be very powerful, thus saving money
(d) geosynchronous orbits so that the satellites can’t be harmed from Earth
Fill in the Blanks

14. When measuring the position of the Moon in the sky we can use _________-_________ coordinates. The angle clockwise from north is the _________ and the _________ is the angle above the horizon.

15. Reflecting telescopes have _________ for objectives. The magnification of a telescope is found by _________ the objective’s focal length by the eyepiece’s focal length.

16. If a star is approaching us, its light will be _________ _________. This is due to the _________ _________.

17. When triangulating to find the distance of an object that is far away, a _________ baseline is preferred in order to increase the _________ of the measurement.

18. Radio waves have an advantage over visible light for astronomy in that they can penetrate _________ and _________.

19. A rocket consists of a _________, _________, and a _________.

20. The weightless conditions that astronauts feel when in orbit is called _________. It is caused by _________.

21. Earth’s natural satellite is _________. The planet with the hottest surface temperature is _________. _________. is the biggest planet, and the farthest planet yet reached by a spacecraft from Earth is _________.

Short Answers

22. Explain how the rising and setting of the Sun and Moon are explained in a geocentric and heliocentric model of the universe.
   (a) geocentric __________________________________________________________
       __________________________________________________________
   (b) heliocentric _______________________________________________________
       _______________________________________________________

23. What did astronomers conclude from the observation that the light from almost all the galaxies is red shifted?

   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________

24. Why do astronomers want to make bigger and bigger telescopes? Give two reasons.

   _______________________________________________________________
   _______________________________________________________________
25. Give three ways that people are using the Global Positioning System.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

26. Why did astronomers want a telescope in space when they can build bigger ones on Earth?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Use the spectra here to answer the next question.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

27. Explain what the spectra of stars X and Y tell us about these stars.

________________________________________________________________________
Unit E Review – “I Can” Statements

I can: (Topic 1)
- Provide examples of celestial bodies and events
- Differentiate between altitude and azimuth
- Explain how the original geocentric model of the universe has evolved into the modern heliocentric model

I can: (Topic 2)
- Differentiate between reflecting and refracting telescopes

I can: (Topic 3)
- Describe how a spectroscope works
- Explain the Doppler effect
- Explain what can be determined from the spectral analysis of a star

I can: (Topic 4)
- Describe the advantage of building larger telescopes and of putting telescopes above the Earth’s atmosphere
- Describe how parallax and triangulation can be used to determine distances in space
- Differentiate between a light year and an astronomical unit

I can: (Topic 5)
- Describe different form of EMR in terms of frequency and wavelength
- Describe the advantages of radio telescopes and interferometry

I can: (Topic 6)
- Describe the parts of a rocket and the advantage of staged rockets
- Identify and describe different types of satellites and their uses

I can: (Topic 7)
- Define galaxy and explain the life cycle of a star
- Differentiate between the inner and outer planets
- Differentiate between a planets period of orbit versus its period of rotation
- Describe how space probes have increased our knowledge of space

I can: (Topic 8)
- Identify Canada’s contribution to the space exploration
- Describe how the Space Shuttle and the International Space Station have increased our knowledge of space
- Describe how the absence of gravity affects astronauts and space exploration