Exam 1 Format

- 8-10 multiple choice questions/chapter
- No calculator required
- Closed book.
- 60 minutes
- Green scantron (the one that says “Parscore” on the top). Purchase in bookstore, on the left when you enter.

Exam 1 Review Guide

- Do you know the definition of the key words?
- Do you know the concept associated with the keywords?
- Can you answer the problems solved in class?
- Can you explain the concepts shown by the figures shown in class (for example, can you write a caption)?

Exam 1 Review Guide

- If you try quiz questions with at least a day since you last tried them, can you get most of them correct?
- Can you give reasons the alternative answers in the quiz are wrong?
- Can you think of questions that test your understanding of a concept?

Lecture 1

Chapter 1

Keywords

- angular distance
- actual/apparent size
- arcmin/arcsec
- astronomical unit
- light year
- parsec

Keywords (and context)

- angular distance – size an object appears from perspective of an observer. Angular distance depends on position of observer.
- actual/apparent size – angular sizes are easy to measure but the actual size of something depends on how far away it is.
- arcmin/arcsec – 1 degree is divided into 60 arminutes. Know how to convert from radians to degrees to arcminutes

Keywords (and context)

- astronomical unit – the distance from the Sun to Earth. We discussed how to convert from astronomical units to light years and parsecs.
- light year – the distance light travels in one year
- parsec – close to a light year.
- also noted in class - Common prefixes should be known along with manipulation of numbers in scientific notation, distance = velocity x time

Review Questions

- Why are there many units for distance in astronomy? What are three units of distance in astronomy? How to convert from one unit to another, Chapter 1, questions 10-18.
- Why Pluto is not considered a planet
- How to estimate angular distances (Chapter 1, page 6; question 9). Definition of an arcminute and arcsecond (Chapter 1, question 7-8). The meaning of "angular distance" and "subtends". The difference between angular distance and actual distance. What happens to angular measure when things change (as covered in the group question, for example).
- Quiz yourself using questions 10-24 of the textbook Chapter 1 Quiz at http://bcs.whfreeman.com/universe7e.

Answers

- Why are there many units for distance in astronomy? Some are more convenient for describing certain lengths. For example, when discussing how far object are that you are seeing the light of now, it is useful to use light years. What are three units of distance in astronomy? AU, parsec (pc), and light year (ly). How to convert from one unit to another. See following slides. Chapter 1, questions 10-18. See following slides.
- Why Pluto is not considered a planet. Not heavy enough to clear other objects from its path.
- How to estimate angular distances (Chapter 1, page 6; question 9). Definition of an arcminute and arcsecond (Chapter 1, question 7-8). A degree is divided into 60 arcminutes. An arcminute is divided into 60 arcseconds. The meaning of "angular distance" and "subtends". If you connected a string to the top and bottom of the moon and tied the ends together in your hand on earth, you would say the moon subtends the angle between the two strings. The difference between angular distance and actual distance. Actual distance is what you would measure with a tape measure if you could visit the object. Apparent size is the size of the object as you see it. What happens to angular measure when things change (as covered in the group question, for example). As an object moves farther away, it appears to have a smaller angular size.
- Quiz yourself using questions 10-24 of the textbook Chapter 1 Quiz at http://bcs.whfreeman.com/universe7e. Solutions are provided.

Review Questions

- Chapter 1, questions 7-18
- Chapter 1 Quiz questions 10-24

Chapter 1, questions 7-18

Chapter 1, questions 7-18

7. What are degrees, arcminutes, and arcseconds used for? What are the relationships among these units of measure? Measuring angles. 60 arcminutes in a degree. 60 arcseconds in a arcminute.
8. With the aid of a diagram, explain what it means to say that the Moon subtends an angle of $1/2^{o}$. Connect string from top of moon to your eye. Connect string from bottom of moon to your eye. The angle the string makes in the angle the moon subtends.
9. How many arcseconds equal 1^{o}? 3600

Chapter 1, questions 7-18

10. What is an exponent? How are exponents used in powers-of-ten notation? Exponent is superscript of 10, for example in 10^x x is the exponent.
11. What are the advantages of using powers-of-ten notation? 10^6 is easier to write than 1000000.
12. Write the following numbers using powers-of-ten notation: (a) 10^7, (b) $6x10^4$, (c) 0.004 = $4x10^{-3}$, (d) $3.8x10^{10}$, (e) $4.11x10^2$ (or $4.20x10^2$)

Chapter 1, questions 7-18

13. How is an astronomical unit defined. Give an example of a situation in which this unit of measure would be convenient to use. 1 AU is the average distance from the Earth to the Sun. When talking about the orbital distances of other planets.
14. What is the advantage to the astronomer of using the light year as a unit of distance? Smaller numbers than using meters, km, etc. More related to a physical quantity (speed of light).
15. What is a parsec? 3.26 ly. How is it related to a kiloparsec and to a megaparsec? Differ by a factor of one-thousand and one-million, respectively.

Chapter 1, questions 7-18

16. Give the word or phrase that corresponds to the following standard abbreviations:
    A. km,
    B. cm,
    C. s,
    D. km/s,
    E. mi/h,
    F. m,
    G. m/s,
    H. h,
    I. y,
    J. g,
    K. kg

Chapter 1, questions 7-18

17. In the original (1977) Star Wars movie, Han Solo praises the speed of his spaceship by saying “It’s the ship that makes the Kessel run in less than 12 parsecs!” Explain why this statement is obvious misinformation. The “sec” in parsec may make you think it is a time, but it is not. It is a unit of distance.
18. A reporter once described a light-year as “the time it takes light to reach us traveling at the speed of light.” How would you correct this statement? “the distance light travels in one year”

Lecture 2

Chapter 1 and 2

Keywords

- Diurnal
- Sidereal
- Local Time
- Universal Time
- Ecliptic

Keywords (and context)

- Diurnal – means daily rotation
- Sidereal – star time. Is not the same as solar time (time for sun to repeat). We went over diagrams to explain why this is. This concept came up in two other lectures – one related to the orbital period of a planet and another with respect to the moon.
- Local Time – different than universal time. We discussed why this is important.

Keywords (and context)

- Universal Time – reference clock.
- Ecliptic – plane that the Earth rotates around the Sun in. Discussed the fact that orbit is not circular and relationship between this and the seasons.
- also discussed seasons and what causes them, the tilt of Earth with respect to the ecliptic, the direction of rotation of the Earth around the Sun, and the direction of rotation of the Earth about its axis.

Review Questions

- Textbook problems: 10, 11, 20, 36, 47
- Chapter 2 Quiz: 3, 4, 9, 14, 15, 23, 24

Textbook problems: 10, 11, 20, 36

10. Using a diagram, explain why the tilt of the Earth's axis relative to the Earth's orbit causes the seasons as we orbit the Sun.
11. Give two reasons why it's warmer in summer than in winter.
20. Why is it convenient to divide the Earth into time zones?

Textbook problems: 10, 11, 20, 36

10. Using a diagram, explain why the tilt of the Earth's axis relative to the Earth's orbit causes the seasons as we orbit the Sun. See lecture notes.
11. Give two reasons why it's warmer in summer than in winter. **Not** because the Earth is closer to the Sun. Angle of the Sun's rays onto the Earth's surface and time that the Sun is in the sky.
20. Why is it convenient to divide the Earth into time zones? Communication, trade, etc.

Textbook problems: 10, 11, 20, 36

36. In the northern hemisphere, houses are designed to have "southern exposure," that is, with the larges windows on the southern side of the house. But in the southern hemisphere houses are designed to have "northern exposure." Why are houses designed this way, and why is there a difference between the hemispheres?

Textbook problems: 10, 11, 20, 36

36. In the northern hemisphere, houses are designed to have “southern exposure,” that is, with the larges windows on the southern side of the house. But in the southern hemisphere houses are designed to have “northern exposure.” Why are houses designed this way, and why is there a difference between the hemispheres? See lecture notes.

Lecture 3

Chapter 2

Keywords

- Zenith
- Projection
- Meridian
- Tropic of Cancer
- Tropic of Capricorn
- Antarctic Circle
- Arctic Circle
- Declination
- Right ascension

Keywords (and context)

- Zenith – point overhead
- Projection – where a point appears. We went over a diagram that helped visualize this
- Meridian – (on a celestial sphere) a line connecting north pole to south pole and passing through observer’s zenith.
- Tropic of Cancer – special latitude. We discussed diagrams of why it was special.

Keywords (and context)

- Tropic of Capricorn – same as above
- Antarctic Circle – same as above
- Arctic Circle – same as above
- Declination – used to specify the position of an object on the celestial sphere
- Right ascension – same as above

Review Questions

- Textbook problems: 4, 5, 6, 8, 9, 12, 17
- CD or Online Quiz for Chapter 2: 5, 7, 8, 9, 11, 12, 13, 18, 19, 20, 22, 23, 24, 29

Chapter 2 questions: 4, 5, 6, 8, 9, 12, 17

4. Imagine that someone suggest sending a spacecraft to land on the surface of the celestial sphere. How would you respond to such a suggestion? What is the celestial equator? How is it related to the Earth's equator? How are the north and south celestial poles related to the Earth's axis of rotation? Where on Earth would you have to be for the celestial equator to pass through your zenith?
5. How many degrees is the angle from the horizon to the zenith? Does you answer depend on what point on the horizon you choose?

Chapter 2 questions: 4, 5, 6, 8, 9, 12, 17

4. Imagine that someone suggest sending a spacecraft to land on the surface of the celestial sphere. How would you respond to such a suggestion? Celestial sphere is imaginary object. You would need a unicorn to fly you to it.
5. What is the celestial equator? How is it related to the Earth's equator? How are the north and south celestial poles related to the Earth's axis of rotation? Where on Earth would you have to be for the celestial equator to pass through your zenith?
6. How many degrees is the angle from the horizon to the zenith? Does you answer depend on what point on the horizon you choose? 90. No.

Chapter 2 questions: 4, 5, 6, 8, 9, 12, 17

8. Is there any place on Earth where you could see the north celestial pole on the northern horizon? If so, where? Is there any place on Earth where you could see the north celestial pole on the western horizon? If so, where? Explain your answers.
9. How do the stars appear to move over the course of the night as seen from the North Pole? As seen from the equator? Why are these two motions different?
12. What is the ecliptic? Why is it tilted with respect to the celestial equator? Does the Sun appear to move along the ecliptic, celestial equator, or neither? By about how may degrees does the Sun appear?
17. Where on Earth do you have to be in order to see the Sun at the zenith? Will it be at the zenith ever day? Explain.

Chapter 2 questions: 4, 5, 6, 8, 9, 12, 17

8. Is there any place on Earth where you could see the north celestial pole on the northern horizon? If so, where? Is there any place on Earth where you could see the north celestial pole on the western horizon? If so, where? Explain your answers. Yes, the equator. No, for the same reason Earth's north pole will never be observed on the western horizon..
9. How do the stars appear to move over the course of the night as seen from the North Pole? As seen from the equator? Why are these two motions different? North pole: At zenith, circles. At horizon, they move horizontally. Equator: At zenith they are moving from east to west. At horizon they are moving almost horizontally.
12. What is the ecliptic? Why is it tilted with respect to the celestial equator? Does the Sun appear to move along the ecliptic, celestial equator, or neither? By about how may degrees does the Sun appear? Ecliptic is the plane Earth rotates CCW about the Sun in. Sun appears to move along the ecliptic at about 1 degree per day.
17. Where on Earth do you have to be in order to see the Sun at the zenith? Will it be at the zenith ever day? Explain. Between the Tropic of Cancer and the Tropic of Capricorn. No, the Sun will appear at zenith only once per year.

Lecture 4

Chapter 3

Key Words

- total eclipse
- annular eclipse
- apogee
- perigee
- sidereal month
- synodic month
- solar corona
- solar eclipse
- umbra
- penumbra
- new moon
- full moon

Key Words (and context)

- total eclipse – Moon completely blocks the Sun (only for people in certain places on Earth's surface). Otherwise faint solar corona is visible. If the Moon orbited the Earth in the ecliptic plane and the orbit was a perfect circle, there would be one total eclipse per month.
- annular eclipse – Moon partially blocks the Sun. Solar corona is not visible.
- apogee – farthest distance of an Earth-orbiting object.
- perigee – nearest distance of an Earth-orbiting object.
- sidereal month – time it takes for the moon to be in the same position with respect to the stars.
- synodic month – time it takes for the moon to be in the same position with respect to the sun.

Key Words (and context)

- solar corona – solar atmosphere that is only visible when light from sun is completely blocked.
- solar eclipse – moon is in Earth's shadow.
- umbra – during eclipse, no light from sun can hit the Earth.
- Penumbra - during eclipse, some light from sun can hit the Earth.
- new moon – moon appears dark.
- full moon – moon is fully illuminated.

Review Questions

- Textbook Chapter 3 problems: 1-4, 7, 8, 18,23,33.
- CD or Online Quiz for Chapter 3: 1-22

Chapter 3 questions 1-4,7,8,10,18,23,33.

1. (a) Explain why the moon exhibits phases. (b) A common misconception about the Moon's phases is that they are caused by the Earth's shadow. Use Figure 3-2 to explain why this is not correct.
2. How would the sequence and timing of lunar phases be affected if the Moon moved around its orbit (a) in the same direction, but at twice the speed; (b) at the same speed, but in the opposite direction?

Chapter 3 questions 1-4,7,8,10,18,23,33.

1. (a) Explain why the moon exhibits phases. (b) A common misconception about the Moon's phases is that they are caused by the Earth's shadow. Use Figure 3-2 to explain why this is not correct. (a) we see different perspectives of illuminated part of moon as it orbits the Earth. (b) Earth's shadow rarely covers the moon.
2. How would the sequence and timing of lunar phases be affected if the Moon moved around its orbit (a) in the same direction, but at twice the speed; (b) at the same speed, but in the opposite direction? (a) same phases, full moon twice as often. (b) phases would occur in opposite order.

Chapter 3 questions 1-4,7,8,10,18,23,33.

3. Is the far side of the moon (the side that can never be seen from Earth) the same as the dark side of the Moon? No. Se lecture notes or figure 3-4.
4. Astronomers sometimes refer to lunar phases in terms of the age of the Moon. This is the time that has elapsed since a new moon phase. Thus, the age of a full moon is half of a 29.5-day synodic period, or approximately 15 days. Find the approximate age of (a) a waxing crescent moon; (b) a third quarter moon; (c) a waning gibbous moon. (a) (1/8)x29, (b) (3/4)x29, (c) (5/8)x29

Chapter 3 questions 1-4,7,8,10,18,23,33.

7. What is the difference between a sidereal month and a synodic month? Which is longer? Why? Sidereal month is time it takes moon to repeat its position in the sky relative to distant stars. Synodic (lunar) month is time to repeat with respect to the Sun. Synodic month is longer. See diagram in notes or Figure 3-5 of text.
8. On a certain date the Moon is in the direction of the constellation Gemini as seen from Earth. When will the Moon next be in the direction of Gemini: one sidereal month later, or one synodic month later? One sidereal month later.

Chapter 3 questions 1-4,7,8,10,18,23,33.

10. Why don't we see lunar and solar eclipses each about one time per month?
18. How is an annular eclipse different from a total eclipse? What causes the difference?

Chapter 3 questions 1-4,7,8,10,18,23,33.

10. Why don't we see lunar and solar eclipses each about one time per month? Tilt of plane that the Moon orbits the Earth is tilted with respect to the ecliptic.
18. How is an annular eclipse different from a total eclipse? What causes the difference?

Lecture 5

Chapter 4

Key Words

- conjunction
- retrograde/protograde
- elongation
- ellipse
- geocentric model
- heliocentric model
- Kepler's laws

Key Words

- conjunction – inner planet is in line with sun (either in front of or behind)
- retrograde/protograde – movement of planet with respect to stars. Planet movement is usually eastward (protograde or direct). Sometimes it is retrograde (westward with respect to the stars).
- elongation – see figure 4-6 or notes.
- ellipse – shape of a planet's orbit around the Sun. A circle is a regular ellipse, while an ellipse that is very non-circlar (very "eccentric") is flat.
- geocentric model – every thing rotates around Earth.
- heliocentric model – planets rotate about Sun.
- Kepler's laws – orbits are elliptical, equal areas in equal time, and the farther away planets rotate more slowly.

Key Words

- Occam's razor
- parallax
- period (of a planet)
- Ptolemaic system

Key Words

- Occam's razor – simple explanations are more likely to be correct.
- parallax – apparent difference in position of object because change in observation point
- period (of a planet) – the time it takes a planet to complete on orbit of the Sun
- Ptolemaic system - geocentric

Review Questions

- CD or Online Quiz for Chapter 4: 1-27, but omit 10, 11, 15, 19, 22, 25, 26.

Lecture 6

Chapter 4

Key Words

- Newton's laws (of motion)
- tidal forces
- universal constant of gravitation
- weight vs. mass
- Force
- acceleration
- gravity

Key Words

- Newton's laws (of motion) Objects in motion tend to stay in motion unless acted on by an external force. Force applied to an object causes a change in velocity that is inversely proportional to object's mass. Equal and opposite forces of one object on another and vice-versa.
- tidal forces – cause level of water to change with respect to land. Both the Sun and Moon create tidal forces. The Sun's force is ~ ½ of the Moon's.
- universal constant of gravitation – part of Newton's equation that relates the force between massive objects.
- weight vs. mass – mass does not depend on where you step on the scale (Earth vs. Moon, for example). Weight does.
- Force – causes acceleration that in inversely proportional to mass
- Acceleration – a change in velocity
- Gravity – force that pulls massive objects together

Review Questions

- Textbook Chapter 4: 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42.
- CD or Online Quiz for Chapter 4: 29-45, but omit 36, 41, 42.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

1. In what direction the a planet move relative to the stars when it is in direct motion? When it is in retrograde motion? How do these compare with the direction in which we see the Sun move relative to the stars?
2. (a) In what direction does a planet move relative to the horizon over the course of one night? (b) The answer to (a) is the same whether the planet is in direct motion or retrograde motion. What does this tell you about the speed at which planets move on the celestial sphere?

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

1. In what direction the a planet move relative to the stars when it is in direct motion? When it is in retrograde motion? How do these compare with the direction in which we see the Sun move relative to the stars? Direct (or protograde) is eastward. Retrograde is westward. Sun moves east with respect to distant stars.
2. (a) In what direction does a planet move relative to the horizon over the course of one night? (b) The answer to (a) is the same whether the planet is in direct motion or retrograde motion. What does this tell you about the speed at which planets move on the celestial sphere? (a) same as stars (rise in the east, set in the west). (b) This says the planets move a very small distance (due to protograde or retrograde motion) over the course of a night.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

4. What is the significance of Occam's razor as a tool for analyzing theories?
6. How did Copernicus determine thtat the orbits of Mercury and Venus must be smaller than the Earth's orbit?
9. What is the difference between the synodic period and the sidereal period of a planet?

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

4. What is the significance of Occam's razor as a tool for analyzing theories? See definition.
6. How did Copernicus determine that the orbits of Mercury and Venus must be smaller than the Earth's orbit? He only observed them in the daytime and close to the Sun. See Figure 4-6.
9. What is the difference between the synodic period and the sidereal period of a planet? Synodic is time for planet to be in same position relative to Sun. Sidereal period is time it takes to complete its orbit.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

10. What is parallax? What did Tycho Brahe conclude from his attempt to measure the parallax of a supernova and a comet? Parallax is the apparent movement of an object because of a change in position of an observer. His parallax measurements were small, so he concluded they were very vary away.
11. What observations did Tycho Brahe make in an attempt to test the heliocentric model? What were his results? Explain why modern astronomers get different results. Found measurements of nearby objects had small parallax as expected from geocentric model. The problem is that the actual parallax was too small for instruments to measure.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

14. At what point in a planet's elliptical oribit does it move fastest? At what point does it move slowest? At what point does it sweep out an area at the fastest rate?
18. What observations did Galileo make that reinforced the heliocentric model? Why did these observations contradict the older model of Ptolemy? Why could these observations not have been made before Galileo's time?

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

14. At what point in a planet's elliptical orbit does it move fastest? When it is nearest (perihelion). At what point does it move slowest? Farthest (aphelion). At what point does it sweep out an area at the fastest rate? Always (Kepler's law).
18. What observations did Galileo make that reinforced the heliocentric model? Phases of Venus and moon's orbiting Jupiter. Why did these observations contradict the older model of Ptolemy? Geocentric model predicted Venus to have different phases. Why could these observations not have been made before Galileo's time? Telescopes were not around.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

21. What is the difference between weight and mass?
22. What is your weight in pounds and in newtons? What is your mass in kilograms?

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

21. What is the difference between weight and mass? See definition.
22. What is your weight in pounds and in newtons? What is your mass in kilograms? On Earth's surface, 198 lbs (a weight) is the same as 198 / (2.25 lbs/kg) = 88 kg (a mass). W = m x g = (88 kg) x 9.8 m/s^2= 8.6 x 10^2 Newton.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

23. Suppose that the Earth were moved to a distance of 3.0 AU from the Sun. How much stronger or weaker would the Sun's gravitational pull be on the Earth? Explain.
24. How far would you have to go from Earth to be completely beyond the pull of its gravity? Explain.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

23. Suppose that the Earth were moved to a distance of 3.0 AU from the Sun. How much stronger or weaker would the Sun's gravitational pull be on the Earth? Explain. 1/9. Newton's law of gravitation says force is inversely proportional to the square of their separation distance. $(1/3^2) = 1/9$.
24. How far would you have to go from Earth to be completely beyond the pull of its gravity? Explain. Infinite. Force equation says that as long as there is a finite separation there is a force.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

27. What is a tidal force? How do tidal forces produce tides in the Earth's oceans?
29. Figure 4-2 shows the retrograde motion of Mars as seen from Earth. Sketch a similar figure that shows how Earth would appear to move against the background of stars during this same time period as seen by an observer on Mars.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

27. What is a tidal force? How do tidal forces produce tides in the Earth's oceans? Tidal force is force on ocean water that depends on how far the Moon (or Sun) is away from that point in the ocean.
29. Figure 4-2 shows the retrograde motion of Mars as seen from Earth. Sketch a similar figure that shows how Earth would appear to move against the background of stars during this same time period as seen by an observer on Mars. Use sketch in lecture notes or Figure 4-5.

Chapter 4 questions : 1, 2, 4, 6, 9, 10, 11, 14, 18, 21, 22, 23, 24, 27, 29, 39, 42

39. Suppose that you traveled to a planet with 4 times the mass and 4 times the diameter of the Earth. Would you weigh more or less on that planet than on Earth? By what factor? $F=GmM/r^2$-$G(2m)M/(2r)^2=(1/4)GmM/r^2$
42. A satellite is said to be in "geosynchronous" orbit if it appears always to remain over the exact same spot on Earth. (a) What is the period of this orbit? Same as Earth's (b) At what distance from the center of the Earth must such a satellite be placed into orbit? Use Kepler's law that relates orbital period and distance. 4.2 x 10^7 meters (c) Explain why the orbit must be in the plane of the Earth's equator. Projection of satellite onto Earth would change positions.

Lecture 7

Chapter 5

Key Words

- frequency
- wavelength
- absorption/emission spectrum

$$c=\lambda\nu \qquad E\sim\frac{1}{\lambda}$$

Key Words

- frequency – the time it takes for something to repeat, such as the peak point in a passing wave.
- wavelength – length between peaks in a wave.
- absorption/emission spectrum – objects absorb and emit electromagnetic radiation only when the radiation has a special wavelength.

$$c=\lambda\nu \qquad E=\frac{hc}{\lambda}$$

Key Words

- frequency
- wavelength
- absorption/emission spectrum
- also covered relationship between energy and wavelength (and color) and the wave vs particle picture for photons

$$c = \lambda \nu \qquad E = \frac{hc}{\lambda}$$

Review Questions

- ~~Textbook Chapter 5: 2, 4-8, 10, 15, 16, 20, 21.~~
- Textbook Chapter 5: 2, 4-7, 15, 16.
- ~~CD or Online Quiz for Chapter 5: 3, 6-9, 20, 21.~~
- CD or Online Quiz for Chapter 5: 3, 6.

Chapter 5, questions 2, 4-7, 15, 16

2. How long does it take light to travel from the Sun to the Earth, a distance of 1.50x10^8 km?
3. (a) Describe an experiment where light behaves like a wave. (b) Describe an experiment where light behaves like a particle.
4. What is meant by the frequency of light? How is frequency related to wavelength?

Chapter 5, questions 2, 4-7, 15, 16

2. How long does it take light to travel from the Sun to the Earth, a distance of 1.50x10^8 km? 8 minutes. See lecture notes.
4. (a) Describe an experiment where light behaves like a wave. (b) Describe an experiment where light behaves like a particle. (a) light passing through closely-spaced slits. (b) photoelectric experiment or solar sails.
5. What is meant by the frequency of light? How is frequency related to wavelength? Frequency is the time it takes peaks in a wave to pass a fixed point. $c = \lambda \nu$

Chapter 5, questions 2, 4-7, 15, 16

6. A cellular phone is actually a radio transmitter and receiver. You receive an incoming call int eh form of a radio wave of frequency 880.6 MHz. What is the wavelength (in meters) of this wave?
7. A light source emits infrared radiation at a wavelength of 1150 nm. What is the frequency of this radiation?

Chapter 5, questions 2, 4-7, 15, 16

6. A cellular phone is actually a radio transmitter and receiver. You receive an incoming call in the form of a radio wave of frequency 880.6 MHz. What is the wavelength (in meters) of this wave? 0.34 meters. Use c = 3 x 10^8 and $c = \lambda \nu$
7. A light source emits infrared radiation at a wavelength of 1150 nm. What is the frequency of this radiation? 2.6 x 10^{14} cycles per second (Hz). Use $c = \lambda \nu$

Chapter 5, questions 2, 4-7, 15, 16

15. How is the energy of a photon related to its wavelength? What kind of photons carry the most energy? What kind of photons carry the least energy?
16. To emit the same amount of light energy per second, which must emit more photons per second: a source of red light, or a source of blue light?

Chapter 5, questions 2, 4-7, 15, 16

15. How is the energy of a photon related to its wavelength? What kind of photons carry the most energy? What kind of photons carry the least energy? Energy is inversely proportional to wavelength. For visible light, blue light has more energy per photon and red light has less. For all other electromagnetic radiation, gamma rays have the highest energy, radio waves the lowest. See lecture notes or Figure 5-7 of text.
16. To emit the same amount of light energy per second, which must emit more photons per second: a source of red light, or a source of blue light? Red.

Sample question

- Why do different elements display different patterns of lines in their spectra?
  - they emit or absorb photons with different frequencies
  - they have a different number of neutrons
  - light passes through them at different speeds
  - they have a different number of protons

Sample question

- Why do different elements display different patterns of lines in their spectra?
  - they emit or absorb photons with different frequencies
  - they have a different number of neutrons
  - light passes through them at different speeds
  - they have a different number of protons

Sample question

- The wavelength of blue light is less than that of red light. Blue light has
  - A lower energy and lower frequency than red
  - A higher velocity and higher frequency than red
  - A higher energy and lower frequency than red
  - A lower velocity and lower frequency than red

Sample question

- The wavelength of blue light is less than that of red light. Blue light has
  - A lower energy and lower frequency than red
  - A higher velocity and higher frequency than red
  - A higher energy and lower frequency than red
  - A lower velocity and lower frequency than red

$$c = \lambda \nu \qquad E = \frac{hc}{\lambda}$$