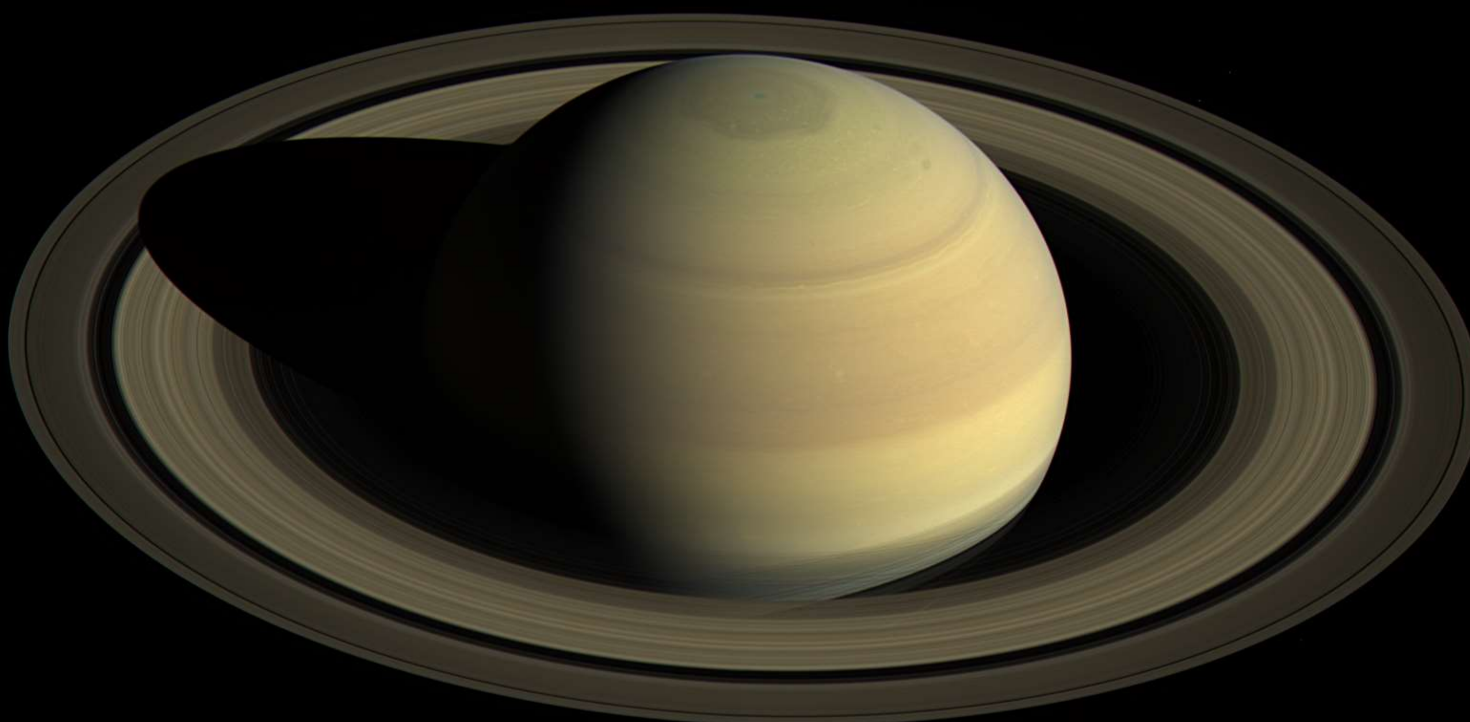
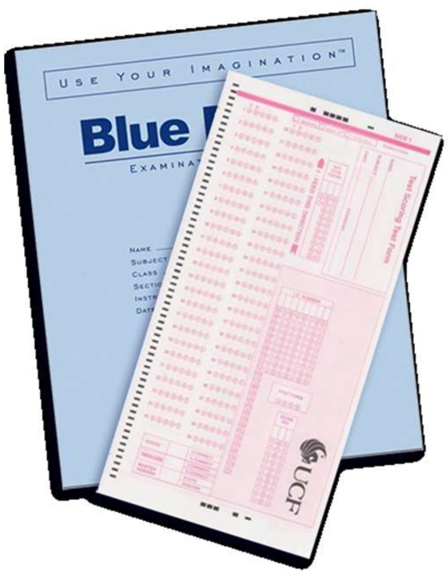
AST 2002
Introduction to Astronomy



The Exam… what to expect

Exam will be in Class on Friday 9th Feb

- When you come in, please make sure you have plenty of space when you chose a seat



Do Bring:

- Scantron

https://ucfsga.com/services/free-scantrons-and-blue-books/

- Pencil (2B or #2 recommended)
- Make sure you know your PID
- Scientific Calculator
- An ID – you will need your ID to hand in the exam.

Don't Bring:

- Books, notes, or phones

The Exam… what to expect

The Exam will consist of ~35 multiple choice questions.

There will be a few matching questions

There will be ~10 true/false questions

There will be ~5 questions requiring the use if your scientific calculator, and another 5 or so that require some calculation

There will be ~5 questions that are meant to tease your brain…

It will be based mostly on the lecture content BUT the general knowledge questions may rely on content within the books (chapters 1-5 of the essential cosmic perspective, chapters 1-6 of the OpenStax book)

Study Guide – Chapter 1

Topics, lecture slides:

- Common distances used in astronomy, ch1_pt1 slide 8
  - Know how to calculate how distances light travels in time; see ch1_pt1 slide 6
- Features of the Solar System, ch1_pt1 slides 13-19
  - Can you tell the Kuiper Belt from the Oort cloud?
  - Can you name the planets, in order of increasing distance from the Sun, and tell me why Pluto isn't one?
- Our Place in the Milky Way, ch1_pt2 slides 4-7
  - What is the nearest star?
  - What is our place in the Milky Way?
  - What is the name of the black hole in the center?
- Our Place in the Universe, ch1_pt2 slides 8-15
  - How big is the Universe?
  - Are we seeing galaxies as they are now, where they are now or where they were back when the light reaching us now left them?

Study Guide – Chapter 1 cont.

Topics, lecture slides:

- Spaceship Earth, ch1_pt2 slide 16
  - Understand how you are moving on the Earth and how the Earth is moving through our Solar System and through space

- The Cosmic Calendar, ch1_pt2 slide 18
  - how old is the Universe?
  - how old is the solar system?
  - how long ago were the dinosaurs killed?
  - how long has known human civilization existed?

Answers to the Homework from Chapter 1

Question 1: Which of the following has your "address" in the correct order?

A. you, Earth, solar system, Local Group, Local Supercluster, Milky Way

B. you, Earth, solar system, Milky Way, Local Supercluster, Local Group

C. you, Earth, solar system, Local Group, Milky Way, Local Supercluster

D. you, Earth, Local Group, Local Supercluster, solar system, Milky Way

E. you, Earth, solar system, Milky Way, Local Group, Local Supercluster

Answers to the Homework from Chapter 1

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B. you, Earth, solar system, Milky Way, Local Supercluster, Local Group

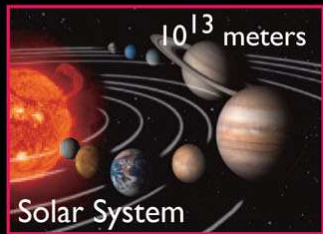
C. you, Earth, solar system, Local Group, Milky Way, Local Supercluster

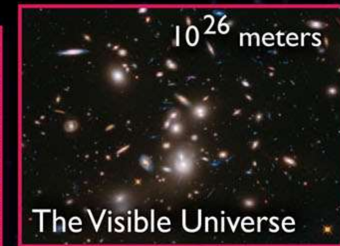
D. you, Earth, Local Group, Local Supercluster, solar system, Milky Way

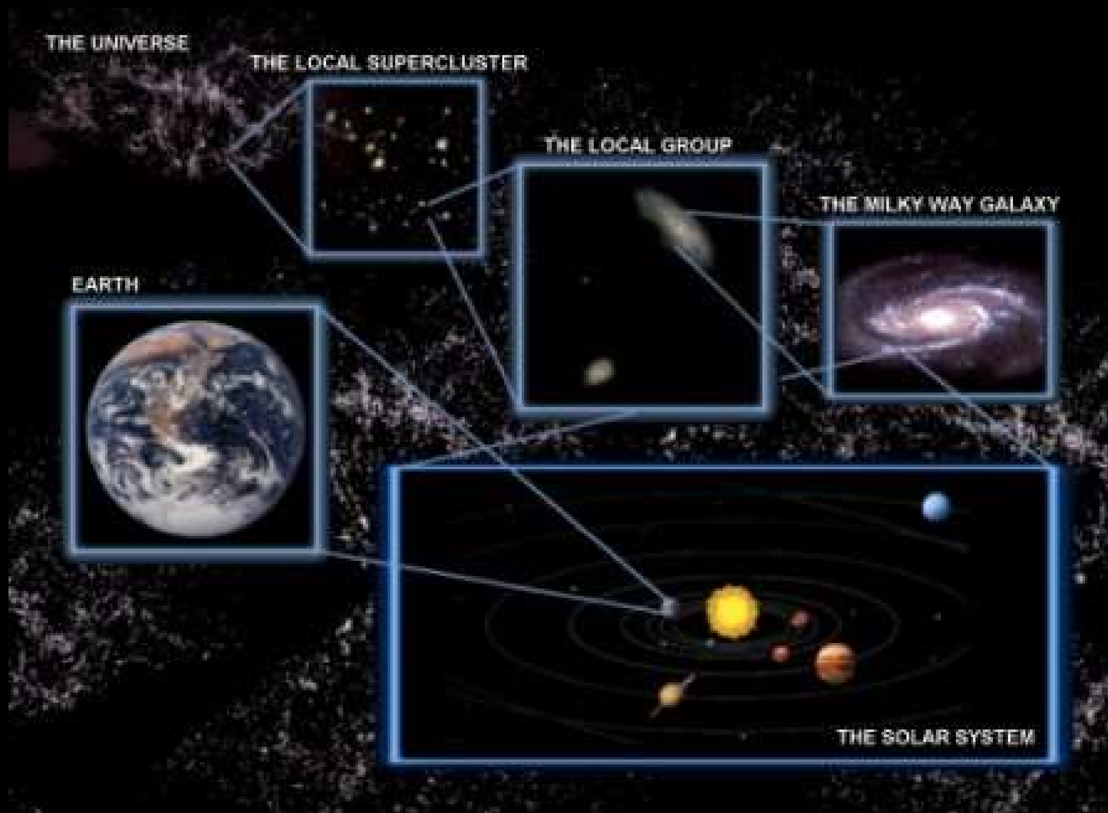
E. you, Earth, solar system, Milky Way, Local Group, Local Supercluster

Our Cosmic Address

Our sun is one of 400 billion stars in the Milky Way galaxy, which is one of more than 100 billion galaxies in the visible universe.







Answers to the Homework from Chapter 1

Question 2: Which of the following statements does *not* use the term *light-year* in an appropriate way?

A. It's about 4 light-years from here to Alpha Centauri.

B. It will take me light-years to complete this homework assignment.

C. A light-year is about 10 trillion kilometers.

D. It will take the Voyager spacecraft about 20,000 years to travel just 1 light-year.

E. The Milky Way Galaxy is about 100,000 light-years in diameter.

Answers to the Homework from Chapter 1

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E. The Milky Way Galaxy is about 100,000 light-years in diameter.

Answers to the Homework from Chapter 1

Question 3: One *light-hour* is the distance that light travels in an hour. How far is this, in kilometers? (Recall that the speed of light is 300,000 km/s.)

A. 300,000 km
B. 18 million km
C. 100 million km
D. 1.08 billion km
E. 9.46 trillion km

Calculating How Far Light Travels per Unit of Time…

$$1 \text{ light-year} = \text{speed of light } \times 1 \text{ year (in seconds)}$$

$$= (2.998 \times 10^8 \frac{m}{s}) \times \left(\frac{365.25\ days}{year} \times \frac{24\ hours}{day} \times \frac{60\ min.}{hour} \times \frac{60\ s}{min}\right)$$

$$= (2.998 \times 10^8 \frac{m}{s}) \times \left(\frac{365.25\ days}{year} \times \frac{24\ hours}{day} \times \frac{60\ min.}{hour} \times \frac{60\ s}{min}\right)$$

$$= (2.998 \times 10^8 \frac{m}{s}) \times (3.156 \times 10^7\ s)$$

= 9.463×10^{15} m or 9.463×10^{12} km or ~ 10 trillion km

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$$= (2.998 \times 10^8 \frac{m}{s}) \times \left(\frac{60\ min.}{hour} \times \frac{60\ s}{min}\right)$$

$$= (2.998 \times 10^8 \frac{m}{s}) \times \left(\frac{60\ min.}{hour} \times \frac{60\ s}{min}\right)$$

$$= (2.998 \times 10^8 \frac{m}{s}) \times (3600\ s)$$

= 1.079×10^{12} m or 1.079×10^9 km or ~ 1.08 billion km

Answers to the Homework from Chapter 1

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B. 18 million km

C. 100 million km

D. 1.08 billion km

E. 9.46 trillion km

Answers to the Homework from Chapter 1

Question 5: An astronomical unit (AU) is

A. any very large unit, such as a light-year.

B. the *average* distance between Earth and the Sun.

C. the *current* distance between Earth and the Sun.

D. the average distance between any planet and the Sun.

Answers to the Homework from Chapter 1

Question 5: An astronomical unit (AU) is

A. any very large unit, such as a light-year.

B. the *average* distance between Earth and the Sun.

C. the *current* distance between Earth and the Sun.

D. the average distance between any planet and the Sun.

Study Guide – Chapter 2

Topics, lecture slides:

- Describing locations on Earth and in Space ch1_pt2 slides 22-23
    - Longitude and Latitude, Declination and Right Ascension

How Earth Rotates ch1_pt2 slides 25-26

- what is a sidereal vs. solar day? see also ch2_pt2 slide 11
- what direction does the Earth rotate? - Sunrise vs. Sunset

Celestial Poles and Stars ch1_p2 slides 28-31

- how is Earth tilted?
- what are circumpolar stars? See also ch2_pt2 slide 27

Measuring angles in the sky ch2_pt2 slides 8-9

- How many degrees approximately is a fist? A finger?

Study Guide – Chapter 2 cont.

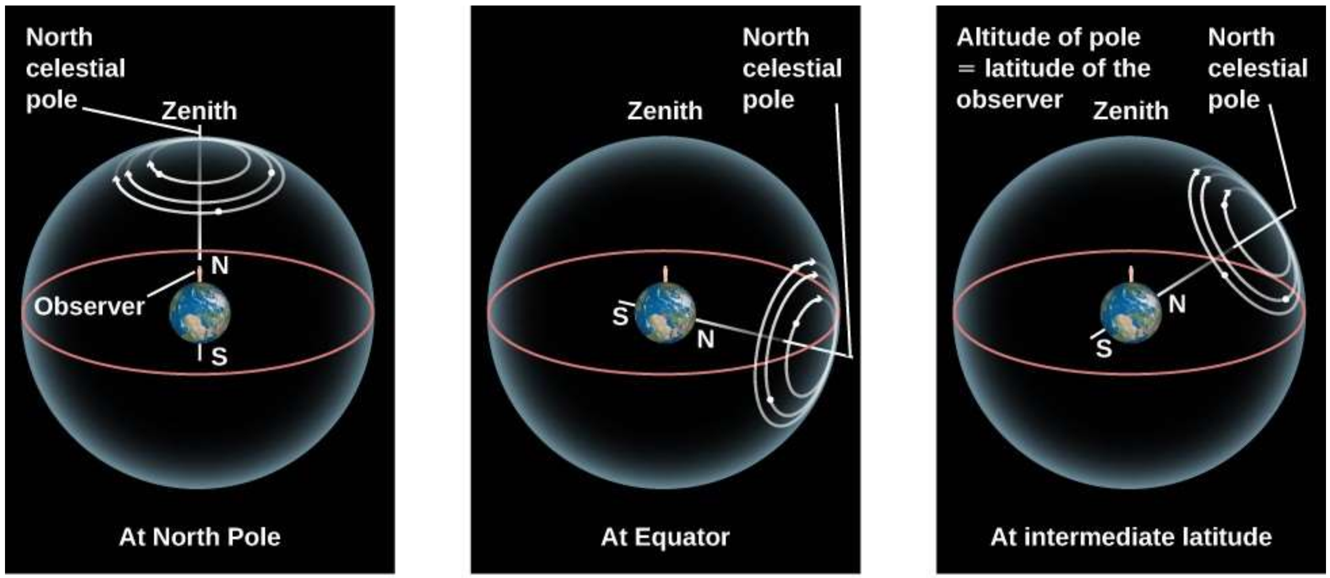
Topics, lecture slides:

- Celestial and Ecliptic planes, ch2_pt2 slides 12-13
  - What is the equinox so important?

How the sky at night changes, ch2_pt2 slides 14-28

- slide 14 is important to understand..
- How does it differ at the poles versus at the equator? i.e. what stars/constellations can you and can't you see?

How does the night sky change by location on the Earth? (slide 14!)



(a) (b) (c)

a) At the North Pole:

- we would see only the top half of the celestial sphere.
- The Zenith would point approximately towards Polaris.
- The night sky would be almost the same each night (but for precession)
- All circumpolar stars are visible (no stars ‘rise’ or ‘set’)

Study Guide – Chapter 2 cont.

What are seasons? ch2_pt2_slides 29-33

- also ch2_pt3 slide 12
- seasons are due to tilting, not planetary distance - see ch3_pt2 slide 13-14

The constellations, ch2_pt2, slide 23 (watch videos), slide 24, slide 36

- also ch2_pt2 slides 3-4
- be able to determine which constellations are visible the Sun is 'visiting' at time of year.

The Phases of the Moon ch2_pt2 slide 34

- also ch2_pt3 slides 13-16 (slide 13 is very important)
- be able to identify phases of the moon (waxing vs. waning)
- should be able to determine when each phase of the moon is visible
- example in ch3_pt1 slides 2-4

Eclipses, ch2_pt3 slides 17-20, 24-27

- what are nodes? Umbra/Penumbra?
- conditions for solar eclipse, lunar eclipse

Calculation – How BIG are things? Ch2_pt3 slides 22-23

Answers to the Homework from Chapter 2

- **Question 4:** Approximately how fast are you moving with the rotation of Earth?

A. 13,000 km/hr
B. 1,300 km/hr
C. 130 km/hr
D. 13 km/hr
E. not moving at all

Answers to the Homework from Chapter 2

- **Question 4:** Approximately how fast are you moving with the rotation of Earth?

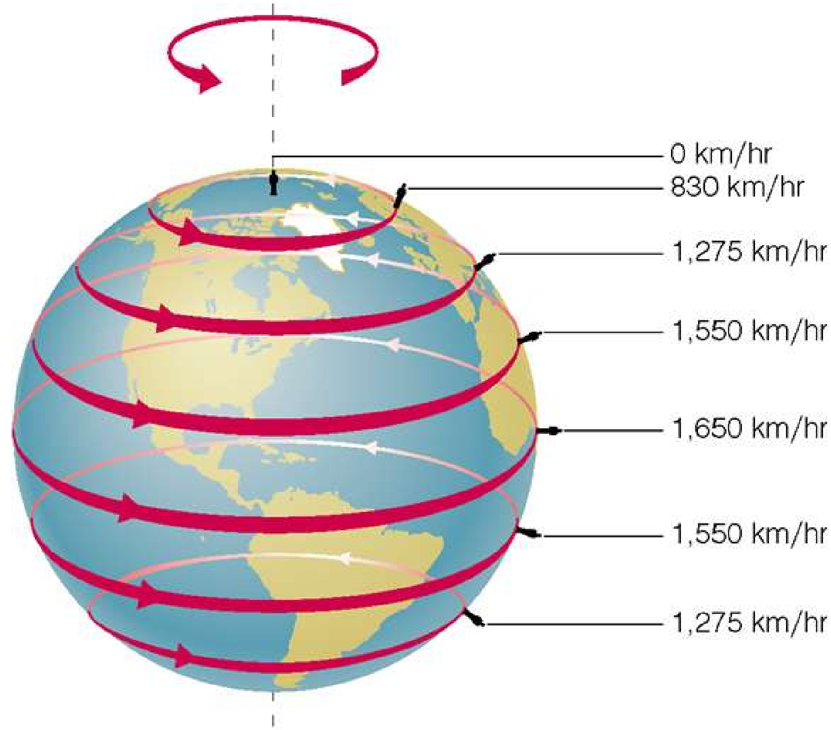
A. 13,000 km/hr

B. 1,300 km/hr

C. 130 km/hr

D. 13 km/hr

E. not moving at all



From ch2_pt2 slide 28

Answers to the Homework from Chapter 2

- **Question 6:** Which of the following correctly describes the *meridian* in your sky?

A. a half-circle extending from your horizon due east, through your zenith, to your horizon due west

B. a half-circle extending from your horizon due north, through your zenith, to your horizon due south

C. a half-circle extending from your horizon due east, through the north celestial pole, to your horizon due west

D. the point directly over your head

E. the boundary between the portion of the celestial sphere you can see at any moment and the portion that you cannot see

Answers to the Homework from Chapter 2

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Answers to the Homework from Chapter 2

- **Question 7:** What makes the North Star, Polaris, special?

A. It is the brightest star in the sky.

B. It is the star straight overhead.

C. It appears very near the north celestial pole.

D. It is the star directly on your northern horizon.

E. It can be used to determine your longitude on Earth.

Answers to the Homework from Chapter 2

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Answers to the Homework from Chapter 2

- **Question 8:** Why do we have seasons on Earth?

A. As Earth goes around the Sun and Earth's axis remains pointed toward Polaris, the Northern and Southern hemispheres alternately receive more and less direct sunlight.

B. The tilt of Earth's axis constantly changes between 0 and 23 1/2°, giving us summer when Earth is tilted more and winter when it is straight up.

C. Earth's distance from the Sun varies, so that it is summer when we are closer to the Sun and winter when we are farther from the Sun.

D. Seasons are caused by the influence of the planet Jupiter on our orbit.

Answers to the Homework from Chapter 2

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Answers to the Homework from Chapter 2

- **Question 14:** If the Sun is at a mean distance of 1 AU from Earth (1 AU = 1.496×10^8 km), and has a radius of 696,392 km, what is its angular diameter in the sky?

A. 0.27°

B 0.39°

C. 0.46°

D. 0.53°

Answers to the Homework from Chapter 2

Question 14: If the Sun is at a mean distance of 1 AU from Earth (1 AU = 1.496×10^8 km), and has a radius of 696,392 km, what is its angular diameter in the sky?

A. 0.27°

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Answers to the Homework from Chapter 2

Question 14: If the Sun is at a mean distance of 1 AU from Earth (1 AU = 1.496×10^8 km), and has a ***radius*** of 696,392 km, what is its angular diameter in the sky?

$$\text{angular size} \times \frac{2\pi}{360} = \frac{\text{physical size}}{\text{distance}}$$

A. 0.27°

B. 0.39°

C. 0.46°

D. 0.53°

$$\text{angular size} = \frac{2 \times 696{,}392\ km}{1.496 \times 10^8\ km} \times \frac{360°}{2\pi}$$

Study Guide – Chapter 3

The motions of the Planets, ch3_pt1 slide 5 (watch videos)

- heliocentric *vs.* geocentric views
    - how do both explain retrograde motion?
    - what is an epicenter? See also ch3_pt2 slides 2-3
    - why wasn't geocentric model accepted?
    - what is parallax?
    - why is it difficult to believe the Earth is moving?

Calculation of distance to stars, ch3_pt2 slides 16-17

- should be able to calculate a distance given an angle (in arc seconds)
- should be able to calculate an angle given a distance
- remember 1 parsec = 3.26 light years!

What was the role of each of these astronomers? see also ch3_pt2 slide 4

- Claudius Ptolemy, ch3_pt1 slide 10
- Copernicus ch3_pt1 slide 29-30
- Tycho Brahe ch3_pt1 slide 31
- Johannes Kepler ch3_pt1 slide 33

Study Guide – Chapter 3 cont.

Kepler's Laws - ch3_pt2 slides 5 – 19

$$e = \sqrt{1 - \left(\frac{b}{a}\right)^2}$$

1st law: bodies move in elliptical paths

- be able to determine eccentricity from semi-major axis and focus
- be able to determine eccentricity from semi-major and semi-minor axis
- Why is semi-major axis so important (ch3_pt2 slide 9)
- What are perihelion and aphelion?

2nd law: As a planet moves around its orbit it sweeps out equal areas in equal times

- Bodies in orbit will speed up as they get closer to the Sun
- Be able to relate velocity to perihelion/aphelion

3rd Law: More distant planets orbit at slower average speeds. $p^2 = a^3$ (ch3_pt2 slide 15-17)

- Given an orbital period should be able to calculate distance from Sun
- Given a distance from the Sun, should be able to calculate an orbital period

Study Guide – Chapter 3 cont.

The importance of Galileo, ch3_pt2 slides 20-27

- Showed that objects in motion stay in motion unless a force acts on them
- Used telescopes to show heavenly imperfections (sunspots, mountains and valleys on the Moon)
- Used telescope to determine that there were many stars in the milky way
- Showed that there were other moons in orbit around other bodies (Jupiter's Moons)
- Observed all of the phases of Venus.
  - How does this prove heliocentrism? ch3_pt2 slide 27

What are the hallmarks of Science? ch3_pt2 slide 32

Study Guide – Chapter 4

Newtons Laws of Motion ch3_pt3_ch4_pt1 slides 19-23

1st law: object in motion will not change its course unless a force acts upon it.

- Understand relationships between position, velocity, acceleration and jerk.

2nd Law: Net forces cause a change in the motion of an object, F=ma

- Centripetal forces, ch4_pt2 slides 5, 10-11
- Mass and Weight
- understand the difference between mass & weight ch4_pt2 slide 14
- understand how acceleration affects weight ch4_pt2_slide 17, ch4_p4 slides 6-7
- be able to explain why people experience weightlessness in orbit
  - in constant free-fall.

3rd Law: For every force there is an equal and opposite reaction force.

- Example – rockets

Importance of the Inverse square law ch4_pt2 slide 12, 13

- Be able to use this to explain changes in Force or Light intensity over distance

What are momentum and inertia? Ch4_pt2 slides 20-22

- Be able to determine qualitatively how much an object has based on mass and velocity

Study Guide – Chapter 4 cont.

Different forms of energy, ch4_pt2 slides 8-9

- Thermal energy (kinetic energy of particles) and kinetic energy ($K.E. = \frac{1}{2}mv^2$)
- conservation of energy between different forms
  - potential and kinetic as example
  - $E=mc^2$

Conservation of angular momentum, Ch4_pt2 slides 16-17

- Understand the *inverse* relationship between radial distance and velocity

Newtons Law of Gravity Ch4_pt2 slides 23-29

- Acts as $1/r^2$ (inverse square law!)
- Newton's version of Kepler's 3rd Law. ch4_pt2 slides 24-25

CALCULATION OF THIS WILL NOT BE ON THE MID-TERM… THIS TIME!

- Bound and unbound orbits (ch4_pt2 slide 26)
- What are gravity assists, and how do they work?
- That each planet has an escape velocity required to break orbit
  - Not based on mass, which leads to understanding why H/He on larger planets
  - *(Because for each temperature, H/He will travel faster since they are lighter!)*

Study Guide – Chapter 4 cont.

Tidal Forces ch4_tidal_forces_ch5_pt1 slides 8-13

- Moon and Sun can act in tandem or against each other

spring and neap tides ch4_tidal_forces_ch5_pt1 slide 10

- Moons influence on the Earth causing tides ~ every 12 hours
  - why slightly more than 12 hours?
- Earth's influence on the Moon, synchronous orbit so same side always faces us.
- Transfer of angular momentum from Earth to the moon
  - Earths rotation is slowing
  - The Earth-moon distance is increasing

Study Guide – Chapter 5

The relationship between frequency, wavelength and speed of light

- Should be able to calculate wavelength/frequency and what happens to one when the other is changed (e.g., doubled), $f \lambda = c$ (ch5_pt1 slide 22)
- Relationship between frequency and energy, E=hc (h is Planck's constant) c (ch5_pt1 slide 22)
- Red-shifted and blue-shifted terminology (how does this affect frequency, energy, wavelength?

What is Matter?

- Know that an atom is made up from protons, neutrons and electrons ch5_pt1 slide 23
- Know that isotopes have different numbers of neutrons. Ch5_pt1 slide 24

Light-matter interactions ch5_pt1 slide 29-31

- absorbed, transmitted, reflected, scattered and emitted light ch5_pt1 slide 29-31, ch5_pt2 slide 36
- know that energy levels in atoms and molecules are quantized 0 have discrete transitions at specific wavelengths, e.g., ch5_pt1 slides 32-35
- it takes more energy (shorter wavelength) to interact with different transitions...
    - radiowaves and microwaves = rotations
    - infrared light = vibrations (thermal energy, heat)
    - visible light - electronic excitations
    - UV light and X-rays - bond splitting and ionization ... all on slide 26
- know the order of these light waves, ch5_pt2 slides 13-14

Study Guide – Chapter 5 cont.

Continuous spectra

- Stefan Boltzmann law for determining energy given temperature (or vice versa)
- Wien's Law for determining average wavelength given temperature (or vice versa)
- Understand that for an increase in temperature, more light and blue-shift
- All bodies heated up have a ~continuous close to 'black body' spectrum
- As objects are heated they emit more light, ch5_pt1 slide 36

absorption spectra

- Earth's atmosphere is an example, so are clouds of dust in space
- Will occur as dips in the continuous spectrum where light is removed (absorbed)

emission spectra

- Will appear as additional intensity on top of the continuous spectrum
- Will need to be populated by some condition (e.g., high temperature)

Study Guide – Chapter 5 cont.

The doppler effect

- What is the doppler effect?
- How can we use this to determine velocities
- Based on change in wavelength should be able to determine whether object is moving away or towards us.
  - Note the sign. Think about it. Limited to Radial information to/from us

Telescope design

- Know the difference between refractor and reflector telescope
- Light gathering power: What is it, why is it important?
- Resolving power: What is it, why is it important?
- Magnifying power: What is it, why is it important? Or not as important…
- Interferometry - helps with resolving power for radio telescopes.
- Why put telescopes in space?
- 1. Less light pollution
- 2. No atmospheric absorptions
  - This is worst for UV/X-rays and bad for IR and gamma rays
  - but isn't really a big problem for visible and radiotelescopes
  - changes in air density (can be improved using adaptive optics)

Good Luck!

I will post the rest of the solutions on-line tonight…