AS101 Exam Study Guide:

Light & Matter:

-Light has properties of both waves and particles

Properties of a Wave:
-Wave length: distance between peaks
-Frequency (f): number of peaks that pass through a location every second
-Speed (v): wavelength times frequency

Changing wavelength or frequency will have the inverse effect on the other
example: increasing wavelength will decrease frequency

Relationships B/W Properties:
-particle properties are related to energy/ protons
-Lower wavelength means more energy

This explains colour:

-different colours associate with different wavelengths (and correspond to different energy levels and frequencies)

Doppler Effect:
-The rate at which an object is moving towards or away from us is called radial velocity
-Doppler effect reveals the radial velocity

Redshift:
-two objects are getting farther from each other:
-frequency is decreasing (wavelength is increasing)
-the light is "red shifted"

Blue shift:
-two objects are approaching together:
-frequency is increasing (wavelength is decreasing)
-the light is "blue shift"

How does light interact with matter?
1.Emmision-> the sun
2. Absorption-> black T shirt

3. Transmission-> light passing through
4. Reflection/ scattering-> the Moon, a mirror

Light and Heat

- **If you heat up object, you'll produce electromagnetic radiation (including visible light)**
- **If the object is dense: it will emit a full spectrum**
- **If the object is thin (gas): it will produce light at certain colours (certain wavelengths)**

Blackbody

-Hot, dense objects emit a perfect spectrum of light

Bohr Model

-Atoms emit electromagnetic radiation due to quantum "jumps" in energy levels

(The photon needs to have the exact amount of energy (aka the exact wavelength of light) required for a transition)

Energy Levels

-Different elements have different energy levels. Which means they'll absorb different photons. Which means they will give off different colours!
-The atom absorbs the photons it likes, and then spits it out
"absorption lines" for hydrogen

Kirchhoff's Laws Summary

1. **A hot, dense object produces a continuous spectrum (light at all wavelengths)**
2. **Low density gas produces an emission line spectrum (bright lines at specific wavelengths)**
3. **Low density gas in front of a hotter blackbody source produces an absorption line spectrum (dark lines on a continuous spectrum at specific wavelengths)**

TELESCOPES

Telescopes:

-Telescopes are light collectors
-It's raining light, and telescopes are the buckets!

Refraction and reflection:

Refraction:
-The bending of light
-Light travels slower through denser mediums
-chromatic aberration

Reflection:
-The bouncing of light
-Smooth surfaces can create images (mirrors)
-scientist use reflecting telescopes
-doesn't differ from chromatic aberration
Light gathering Power
-Bigger mirror, more POWER
-LGP is proportional to diameter squared
-Double the diameter, QUADRUPLE ($2^{2)}$ THE LGP
-Triple the diameter, get nine times ($3^{2)}$ THE LGP

Resolving Power- Resolution
-resolution: how clear is an image?
-Double the size mirror= twice the resolution
-also, shorter wavelengths provide better resolution

EYEPIECES: - Magnification
-Magnification: zooming in and out. More magnification doesn't mean the image will be brighter or show more detail! (aka no difference in resolution)
Magnification= Focal length of telescope (over) focal length of eyepiece

CCD
-Quantitative way to analyse light from a telescope
-only tells us the amount of light, not the colour
-objective data to work with

Solar System:

Comparing the types of planets
Terrestrial Planets:
Mercury, Venus, Earth, Mars
-small
-close to the sun
-small mass
-made of: sold rock, high density
-a few moons
-no rings

Jovian Planets:
Jupiter, Saturn, Uranus, Neptune
-Huge
-far from the sun

-huge mass
-made of: gaseous, low density
-Many moons
-rings

Asteroids:
-Smaller asteroids are weird shapes
-The structure of the asteroid is greater than the gravity on itself
-Larger asteroids have more gravity and therefore become more of a spherical shape

Comets:
-Comets come from:
-The Kuiper belt (the suburbs of Neptune 50 AU away)
-And the Oort Cloud (way out there, 50000 AU away from the sun)

Meteo:
-Meteoroid: a rock in the atmosphere
-Meteor: the streak of light created by a meteoroid as it burns up
Meteorite: a meteoroid that made it down to the earth

Radioactive dating- Half Life
- we have a decaying water bottle
-after 2 years, half the water bottle will be remaining
-after 2 additional years (4 years total) one quarter of the original water bottle will remain
-The "half life" of the bottle is 2 years!
-In other words, the amount of water bottle we have left is cut in half every 2 years
-This is how we can tell how old something in space is!

Example:
-A mysterious rock is discovered with 12 grams of the element Zylophote.
- We know that the rock used to have 96 grams of Zylophote in it…
• And we know that the half life of Zylophote is 10 million years.
96à48à24à12.3 times
3 x 10 million= 30 million
-The rock is 30 million years' old

Solar System Formation:

Solar formation
-gas kept sticking together and getting hotter and denser
-They keep attracting each other until the pressure becomes so great that a star is born!

-EVERYTHING ROTATES AND REVOLVES THE SAME WAY
-Counter clockwise when viewed above

Solar Nebula Theory:
-Everything is getting pulled in towards these growing stars. And they're spinning
-When things spin fast, they go into disks

Planet Formation:
-What about all the other stuff in the cloud?
-Matter condensed (solidified) to provide a starting point for planets to form, and then went through accretion (snowballing)

Two types of planets:
-There was such a clear divide B/W the two types of planets… as if there was some kind of line B/W them

Heavy Bombardment:
-All the stuff in the early system eventually collided together and settled down to form the solar system we know today!

Terrestrial Planets:

Terrestrial Club:
Mercury
Venus
Earth
Mars

Terrestrial planet formation:
1. **Condensation**
2. **Accretion**
3. **Differentiation**

Differentiation:
-As earth cooled down, different layers were formed
-Denser materials sink to the bottom
-Exterior cools down first
Crust: low density rock

Mantle: denser solid rock, sloshes around near crystal
Liquid core: liquid because its so hot
Inner core: solid because its so dense and such high pressure

How do we know?
-P waves and S waves
-S waves cannot travel through liquids

Convection Motions:
-Causes plate tectonic shifts
-creates volcanoes, mountains
-Earth's ocean absorbs excess C02 (unlike Venus)

Magnetic Field:
-All that activity inside a planet creates a magnetic field (because of the "dynamo effect")
-**Field=shield**! Blocks the dangerous solar winds and protects our atmosphere

Mass Vs. Geology: (slide 55)
-smaller things cool down faster
-less gravity to hang onto the air
-less convection motion, no magnetic field, atmosphere gets blown away by solar winds
-if its closer to the sun, more activity, makes it harder to hang onto

WHATS UP ON VENUS?
-Runaway green house effect
-Volcanoes emit carbon dioxide
-But its too hot for the ocean, and so there's no where for it to dissolve in to

WHATS UP ON THE MOON?
-almost **no atmosphere**
-highlands and Maria
-**highlands** are **lighter**
-**Maria** is **darker** and smoother

Jovian Planets and Beyond:

The Jovian Club:
Jupiter
Saturn
Uranus
Neptune

Jovian Planet formation:
-begins with condensation and accretion, just like the terrestrials... but now were outside the water-ice line!
-So more stuff to condense

Jupiter:
-made of hydrogen and helium
-consists of belts and zones
Belts= dark, low and warm
Zones=Light, high, cool
-Jupiter's moons… even though they are small, they are geologically active
-Tidal stressing= can create geological activity
-Gravitational tugs give Lo and Europa friction, heat and geological activity

Saturn:
-Saturn's rings and the Roche limit
-the area where matter cannot form a sphere (gravitate together) because Saturn is yanking on it with its gravity
-Roche limit

-The moons of Saturn "shepherd" the rings that are outside the Roche limit
-Shepherd moons= prevent the rings from spreading out and dissipating

The Ice Giants- Uranus and Neptune:
-Mostly made of Hydrogen and Helium (like Jupiter and Saturn)
-But since they're smaller, they don't have enough pressure for liquid metallic hydrogen to form
-Neptune: Internal Heat, Uranus does not
-Uranus has a weird tilt (it collided with a planetesimal way back when)

Dwarf Planets:
-They don't quite belong with the planets
-The planet club criteria- (PLUTO IS APART OF THIS CLUB)
1. orbit the sun
2.spherical
3.clear the neighbourhood

Extrasolar Planets:
-About 1/3 of stars have planets
-If a terrestrial planet is in the "habitable zone". It could have liquid water and be a candidate for life!
-Depends on:

-distance from star (must be in the “Goldilocks Zone”)
-thickness and atmosphere