ES 104 Review Questions Earth Science 12th ed. Unit I

Chapter 1

1. a) Dynamics of oceans: oceanography,
   b) study of Earth: geology,
   c) atmosphere: meteorology and climatology, and
   d) Earth's place in universe: astronomy

2. Renewable resources can be created in short timespans, like a season, a year, a lifetime. Nonrenewable resources require many millions of years to be generated. Plant material like corn, wood, and phenomena like wind and precipitation, are renewable resources. Nonrenewable resources include petroleum, created from organisms that died many millions of years ago; and metals, which are in finite amounts on Earth.

4. Natural hazards: earthquakes, landslides, hurricanes, tornadoes, volcanoes, asteroid impacts, floods, droughts, wildfire…

7. The four "spheres" that constitute our environment are the hydrosphere, or water portion of Earth; the atmosphere, Earth's gaseous envelope of air; the solid Earth, consisting of the dense core, less dense mantle, and crust; and the biosphere, which includes all life on Earth.

9. The crust, the thin rocky outer layer of Earth, is divided into oceanic and continental crust. Oceanic crust is on average about 7 kilometers thick and is composed of the igneous rocks basalt and gabbro. Continental crust averages about 40 kilometers in thickness and consists primarily of granodiorite. Beneath the crust is the mantle, a solid layer that extends down to a depth of about 2900 kilometers, and contains more than 82 percent of Earth's volume. The mantle is composed of a dense igneous rock called peridotite. The innermost layer of Earth is the core, which is a molten sphere composed of an iron–nickel alloy.

10. The asthenosphere, located between 70 and 700 kilometers below the surface of Earth, consists of approximately 10 percent melted rock. This zone lies wholly within the mantle. The lithosphere lies above the asthenosphere and includes the crust and part of the upper mantle (that part above the asthenosphere). The asthenosphere behaves plastically; the lithosphere is rigid.

13. Major regions of the ocean floor: oceanic ridge system, abyssal plains, and continental shelves.

16. Earth's energy comes from Sun, and from internal heat: left over from gravitational contraction and from decay of radioactive elements.

6. The theory for the origin of the solar system, called the nebular hypothesis: approximately 5 billion years ago the bodies of the solar system condensed from an enormous cloud. As the cloud contracted and began to rotate, the proto-Sun began to form.

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The protoplanets (planets in the making) formed from material that had condensed and accreted inside the cloud. The inner planets (Mercury, Venus, Earth, and Mars) were unable to retain appreciable amounts of the lighter components of the primordial cloud, whereas the outer planets (Jupiter, Saturn, Uranus, and Neptune) accumulated large amounts of hydrogen and other light materials because of their much colder temperatures.

Chapter 21

2. Retrograde motion occurs when Earth, which travels faster than Mars, passes Mars, which makes Mars appear to be going backward. Rather than using one circle for an orbit, Ptolemy placed the planet on a small circle (epicycle), which revolved on a large circle (deferent) around Earth. By trial and error he was able to select just the right combinations of circles to produce the amount of retrograde motion observed for each planet.

3. Copernicus placed Sun at the center of the solar system. Next to the theory of organic evolution, this proposal perhaps most disputed the human concept of our role in the universe.

4. Tycho Brahe's greatest contribution to science was his accurate observations of Mars that were later used by Kepler to determine the three laws of planetary motion.

8. No, Galileo did not invent the telescope, however, he was the first to use it astronomically.

11. Newton determined the orbits of the planets are the result of gravitation and inertia. (*Inertia* is the tendency of a moving body to travel in a straight line unless acted on by an outside force.)

14. Moon’s cycle of phases lasts 29.5 days, the synodic month

15. As viewed from the northern hemisphere, the left edge of Moon will be illuminated during the crescent phase that precedes the new-Moon phase; the right-edge will be illuminated during the crescent phase that follows the new-Moon phase.

16. First-quarter phase is 1 week after new; full-Moon phase is about two weeks after new.

17. The visible crescent Moon in early evening will be waxing (growing) because the cycle is progressing from new Moon to first-quarter phase.

18. The same lunar hemisphere always faces Earth because its period of rotation and its period of revolution (orbit) around Earth is the same.

19. The slow lunar rotation, along with the absence of an atmosphere, accounts for the high surface temperature of 127°C (261°F) on the day-side of the Moon and the low surface temperature of –173°C (–280°F) on its night side.

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20. Solar eclipse: Moon is between Sun and Earth—the eclipse is the shadow of Moon on Earth, only occurs at new phase of Moon.
Lunar eclipse: Earth is between Moon and Sun—eclipse is the shadow of Earth on Moon. Only occurs at full phase of Moon.

Chapter 22

1. The criteria used to distinguish between the Jovian and terrestrial planets are size, density, composition, and rate of rotation.

2. Material that planets are made of: Gases, ices rocks—
   Gases: hydrogen and helium;
   ices: ammonia, methane, carbon dioxide, and water; and
   rocks: silicate minerals and iron

   Materials are placed in these groups according to their melting points; gases have the lowest melting points.

   The dense terrestrial planets contain mainly rocks; the less dense Jovian planets are composed primarily of gases and ices.

4. The greater the crater density, the longer the topographic feature must have existed.

5. Moon's history:
   (a) Accumulation of debris formed the Moon.
   (b) Heat from the accumulation of material may have melted the Moon's outer layer.
   (c) Light igneous rocks floated upward to form the lunar surface, known as the highlands.
   (d) Large meteoroids collided with the Moon to form the maria basins.
   (e) Fluid basaltic lava filled the basins to produce the flat maria.
   (f) The last major features to form on the Moon were the large rayed craters.

6. Maria and the Columbia Plateau are both composed of great thicknesses of basalt

7. Mars has been most studied because it is the only planet whose surface can be viewed telescopically because it lacks a thick atmosphere, and it is close to Earth.

8. Similar to Earth, Mars has white polar ice caps, large volcanic peaks, fracture zones suggesting rift faulting, and channels that appear to have been carved by flowing water.

12. Jupiter's Great Red Spot apparently is a counterclockwise-rotating storm.

14. Io has active sulfurous volcanic centers. Other than Earth, and Neptune's moon Triton, Io is the only volcanically active body discovered in our solar system.

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15. The small size, inclined orbits and retrograde motion of the four outer satellites of Jupiter indicate that they were captured asteroids or KBOs.
16. Jupiter and Saturn are similar in that they are both large Jovian planets with numerous satellites; both have ring systems, although Saturn's rings are much more pronounced; and both have dynamic atmospheres with cyclonic storms on their surfaces.

19. Earth, Jupiter's moon Io, and Neptune's moon Triton are known to have active volcanic-like activity.

20. Most asteroids are found between the orbits of Mars and Jupiter.

21. There will be a meteor shower if Earth passes through the tail of a comet.

22. Short-period comets (periods less than 200 years) come from the Kuiper Belt; long-period comets come from the Oort Cloud. They boil off gases when they near Sun, and diminish in size each time they pass it, eventually becoming a swarm of metallic and rocky bits of dust. It no longer gains a tail when it passes Sun. If they get too close, Sun's gravity will pull them in.

23. A meteoroid is a piece of space junk. A meteor is a meteoroid that is heated to glowing by friction when passing through a planet's atmosphere. A meteorite is the solid remnant of the meteor that was not burned up in the atmosphere.

24. Meteoroids come from interplanetary debris not incorporated into planets when the solar system formed, the Asteroid Belt and solid remains of comets degraded by Sun as their orbit passed it.

25. Meteor craters are more common on Moon because it has no atmosphere to burn up incoming space debris. Also, our weather and tectonics have obliterated all but the largest and the most recent meteorite craters on Earth. Moon does not have these to destroy the craters.

Chapter 23

1. Electromagnetic radiation is the term used to describe the collection that includes gamma rays, x-rays, ultraviolet light, visible light, infrared light, and radio waves.

2. Red has the longest wavelength, violet the shortest.

7. By examining the shift of the star's spectrum, known as the Doppler effect, astronomers can determine whether a star is moving toward or away from Earth. Blue shifted spectra occur when they are moving toward Earth, red shifted spectra from moving away.

9. The three properties of telescopes that aid astronomers are (1) light-gathering power, (2) resolving power, and (3) magnifying power.

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11. Earth's atmosphere greatly limits the resolving power of earthbound telescopes, because air movement causes the light from celestial objects to be distorted, which blurs the photograph. The problem can be eliminated by placing a telescope in Earth orbit.

18. Sun is about 109 times greater diameter than Earth.

19. The photosphere is considered the solar surface, since most of the light we see originates there; it has granules and sunspots. The chromosphere is the thin lower layer of the solar atmosphere found directly above the photosphere; it has spicules and prominences. The outermost portion of the solar atmosphere is the very tenuous envelope of ionized gas called the corona, which extends for millions of kilometers from the solar surface: this is the solar wind.

20. Granules: surface appearance of convective activity within the subsurface Sun.
    Sunspots: large, cooler areas that persist for hours or days, associated with convection, often occurring in oppositely magnetized pairs.
    Prominences: arches of ionized gases from Sun's chromosphere, extending into the corona, held in magnetic fields for days or weeks above Sun's surface
    Solar flares: explosive events associated with sunspots, that release UV, radio and x-ray radiation, and intensify the solar wind. They create the auroras, and interfere with radio communication.

21. A sunspot is quite hot, but cooler than the adjacent Sun surface. It is very bright, just not as bright as other parts of Sun's surface.

22. Solar winds are ionized gases of the corona, with speeds great enough to escape Sun's gravity. They travel 250 to 800 km/s.

23. The "fuel" that is consumed by the Sun is hydrogen nuclei.

24. In the proton-proton reaction, the hydrogen nuclei (protons) are converted to helium nuclei, with a small percentage of the matter (0.7 percent) converted to energy.

Chapter 24

1. Proxima Centauri is about 4.3 light-years x 300,000 km/s x 60 s/min x 60 min/hr x 24 hr/d x 365.25 d/yr = 40.7 trillion kilometers away.

2. The most basic method of determining stellar distances is to use stellar parallax, which is the extremely slight back-and-forth shifting in a nearby star's position due to the orbital motion of Earth. As distance increases, stellar parallax will decrease.

5. A star's color is an indication of its surface temperature.

6. Very hot stars appear blue. Medium-temperature stars appear yellow, like the Sun. Red stars are much cooler.

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7. Binary stars are used to determine the mass of a star.

15. The giant stage results because the zone of hydrogen fusion continually migrates outward. After the hydrogen in the star's core is used up, further contraction heats the star's interior. This energy in turn heats and enormously expands the star's outer envelope. While the envelope of a red giant expands, the core continues to collapse and become hotter until it is hot enough to initiate helium fusion.

17. Sun-like stars begin as a cloud of gases and dust: mostly hydrogen. Some mechanism causes the cloud to become concentrated enough to begin to gravitationally contract on their own. The temperature increases with the contraction, and begins to radiate heat: now we have a protostar.

    Continued contraction heats the center very intensely, and the hydrogen begin to fuse: the fusion energy is what generates the electromagnetic radiation that the star emits. Now it has become a main-sequence star, where the gas pressure of the fusion exactly balances the gravitational contraction of the massive amount of material. This continues for about 90% of its lifespan, until the star consumes its core of hydrogen.

    Then the hydrogen fusion migrates outward, leaving an inner core of helium that is not undergoing fusion. Because there is no fusion to support the core against the pressure of gravity, the core contracts, and is heated by this contraction. The radiated heat accelerates the hydrogen fusion in the outer layers, causing the star to expand to a red giant stage. Because it is larger, the heat at the surface is disseminated, and it is cooler than it had been at main-sequence stage. The core continues to collapse and become hotter, and eventually its temperature causes the helium to fuse into carbon.

    When the helium is exhausted, the collapse of the core is so violent that there is a shock-wave explosion, blowing much of its material away into a nebula surrounding the remnant core of incredibly dense material. It no longer has fusion, but remains hot as a white dwarf radiating body illuminating the nebula of cast-off material. The white dwarf will eventually cool to the point where it no longer glows with visible light…it will become a black dwarf.

19. A medium-mass (Sun-like) star becomes a red giant. When its hydrogen and helium fuel is exhausted, it collapses and becomes a white dwarf. During the collapse, a medium-mass star may cast off its outer atmosphere and produce a planetary nebula.

21. The general structure of the Milky Way Galaxy is a very flat disc about 100,000 light-years across, composed of perhaps 100 billion stars, arranged into at least three spiral arms. There is a bulge in the center that contains a black hole as the gravitational force that holds all the stars in rotation around it. Sun is about 2/3 the way out one of the spiral arms.

22. There are spiral galaxies, which are very large, and contain both old and young stars. Elliptical galaxies are ovoid or spherical, lacking spiral arms, and contain old stars. Irregular galaxies lack symmetry and are composed of young stars.