Astronomy 1102/1104 19 March, 2009
Our Solar System

Examination 2

Practice version

Name: _____

Signature: _____

Student ID number: _____

Section: _____

Instructions:

On the scannable answer sheet:
- Fill in your name (last name first!) and ID number (in col. A-J).
- Put your section number in columns K-M
- Identify the form in Special Codes column P.
- Answer all 40 questions using a number 2 pencil.

In addition:
- Do not open your exam until instructed to do so.
- Be sure to also answer each question in the blanks provided on this exam sheet.
- The exam ends at 12:00.
- When done, raise your hand and a TA will collect your exam.
- No one may leave between 11:50 and 12:00.

And of course:
- You may not use any notes, texts, calculators or communications devices.
- All work must be your own.

Score: _____ out of 40.

Useful equations:

$p^2 \propto a^3$

$F = ma$

$F = G\, m_1\, m_2 / r^2$

$v = \lambda\upsilon$ (for light, v=c)

$E = h\upsilon$ (h = Planck's constant.)

$\theta_R \sim \lambda/D$ (The constant of proportionality depends on the units of λ and D.)

$\lambda_{mI} = C/T$ (If λ in μm and T in K, then C = 2880 μm K.)

$L = 4\pi r^2\, \sigma T^4$ (σ = the Stefan-Boltzmann constant.)

$\Delta\lambda/\lambda = v/c$

$T = T_{ref} / R^{1/2}$ (If R is in AU, then T_{ref} = 300 K.)

Constants (which you probably won't need):

$c = 2.998 \times 10^8$ m/s

$h = 6.626 \times 10^{-34}$ J/s

$\sigma = 6.570 \times 10^{-8}$ W m^{-2} K^{-4}

Pick the best answer to each question.

_____ 1. Which of the following is NOT an example of the greenhouse effect?

a. The heating of a rock sitting in the sunlight.
b. The heating of the atmosphere of Venus with its large content of carbon dioxide.
c. The warming of a car parked in the sun with its windows rolled up.
d. The warming of the air in a greenhouse full of plants by the Sun.
e. All of the above are examples of the greenhouse effect.

_____ 2. A photon in which part of the electromagnetic spectrum would have the most energy?

a. Optical.
b. X-ray.
c. Gamma ray.
d. Ultraviolet.
e. All of the above have the same energy; the only differ by wavelength or frequency.

_____ 3. The atmosphere of Mars is composed almost entirely of carbon dioxide. Why isn't there a strong greenhouse effect keeping Mars warm?

a. The atmosphere on Mars is too thin to trap a significant amount of heat.
b. There are no humans living on Mars, so no greenhouse gases are added to the atmosphere.
c. Mars does not have enough internal heat to drive the greenhouse effect.
d. The greenhouse effect requires an ozone layer, which Mars does not have.
e. Mars is too far from the Sun for the greenhouse effect to work.

_____ 4. Which of the following is not a terrestrial world ?

a. Earth's Moon.
b. Mars.
c. Venus.
d. Pluto.
e. Mercury.

_____ 5. Which of the following theories does NOT explain how life originated on Earth?

a. The theory of evolution.
b. Panspermia theory.
c. The bombardment from comets and meteorites brought the material necessary for the formation of life on Earth.
d. Early conditions on Earth could allow simple organic molecules to form.
e. All of the above explain how life may have originated on Earth.

_____ 6. We know that the energy of a visible photon is much higher than the energy of a microwave photon. Why, then, do we use microwave ovens to heat food?

a. It would be very expensive to build an oven that produces visible light.
b. Visible light would make the food radioactive.
c. We don't have means of creating visible light artificially.
d. A visible light oven would heat the food in a few seconds.
e. The microwave photons get absorbed more efficiently by the water in the food.

_____ 7. Which component of the Earth's atmosphere resulted primarily from life?

a. Water vapor.
b. Carbon dioxide.
c. Oxygen.
d. Nitrogen.
e. Argon.

_____ 8. Two exoplanets have been discovered orbiting a nearby star at distances of 4 and 49 AU. If neither have atmospheres, what is the ratio of the surface temperature of the inner planet to the outer planet?

a. 4:49.
b. 2:1.
c. 7:2.
d. 49:4.
e. 2352:16.

_____ 9. Which of the following transitions within a hydrogen atom causes the emission of the longest wavelength photon?

a. From energy level 10 to 1.
b. From energy level 2 to 1.
c. From energy level 3 to 2.
d. From energy level 1 to 2.
e. From energy level 0 to 1.

_____ 10. Jupiter and Saturn are examples of ...

a. Terrestrial worlds.
b. Jovian worlds.
c. Kuiper Belt objects.
d. Comets.
e. Asteroids.

_____ 11. What produces chains of volcanoes like the Hawaiian islands?

a. Volcanic activity on linear faults along subduction zones.
b. Tectonic motion of a crustal plate over an underlying hot spot.
c. Volcanic activity over faults formed along the rims of suboceanic craters.
d. Linear series of hot spots produced by the collision of continental plates.
e. Prehistoric development committees with an eye for long-term tourism opportunities.

_____ 12. When scientists refer to evolution as a theory, they mean that ...

a. the observational evidence that evolution has occurred is very limited.
b. evolution remains an unproven hypothesis.
c. the mechanism which explains the evidence from the fossil record is well established.
d. Both (a) and (b).
e. None of the above.

_____ 13. Electromagnetic radiation ...

a. propagates through a luminiferous aether.
b. is the cosmic equivalent of sound waves.
c. can be described as particles or waves.
d. requires a medium with charged particles to propagate.
e. None of the above.

_____ 14. The maria on the Moon are dark areas that ...

a. consist of younger rock than the highlands.
b. are shaped like giant ancient impact basins.
c. have few craters than the highland regions.
d. filled in with lava after the rest of the Moon's surface had formed.
e. All of the above.

_____ 15. Radiation of which of the following colors has the shortest wavelength?

a. Blue.
b. Red.
c. Green.
d. Yellow.
e. Infrared.

_____ 16. Which planet has the highest surfact temperature in the Solar System?

a. Venus.
b. Mercury.
c. Earth.
d. Mars.
e. Pluto.

_____ 17. Object A is twice as large but is at half the temperature (on the Kelvin scale) as Object B. When observed from the same distance ...

a. Object A is twice as bright.
b. Object A is four times brighter.
c. Object B is twice as bright.
d. Object B is four times brighter.
e. Both are equally bright.

_____ 18. Which of the following has a spectrum LEAST like a theoretical blackbody?

a. The Moon.
b. The human body.
c. A fluorescent bulb.
d. An incandescent bulb (the ones with a heated filament).
e. A star.

_____ 19. Which of the following methods have been used to study the surface and interior of the Moon?

a. Radioactive dating.
b. Crater counting.
c. Moonquakes.
d. All of the above.
e. None of the above.

_____ 20. The reason that small planets tend to lose interior heat faster than larger planets is essentially the same as the reason that ...

a. a large baked potato takes longer to cool than a small baked potato.
b. Earth contains more metal than the Moon.
c. thunderstorms tend to form on hot summer days.
d. gas bubbles form and rise upward in boiling water.
e. None of the above.

_____ 21. Why does Earth's atmosphere currently have so little hydrogen?

a. Earth does not have enough mass to hold onto the hydrogen.
b. Earth is too close to the Sun, so the hydrogen atoms are moving too fast.
c. All of the hydrogen combined with oxygen to form water.
d. Both (a) and (b).
e. None of the above.

_____ 22. The temperature of the star Sirius is about 10,000 K, and its peak emission is in the ultraviolet at 300 nm. A mysterious object discovered nearby is found to be so hot, its emission peaks at 3 nm, in the X-ray part of the spectrum. What is the temperature of this object?

a. About 100 K.
b. About 1000 K.
c. About 10,000 K.
d. About 100,000 K
e. About 1,000,000 K

_____ 23. What design did the Mars rovers use to land safely on the surface of Mars?

a. Giant airbags.
b. Retrorockets.
c. Slinkies.
d. They landed in deep deposits of soft sand.
e. They landed in populated areas, squashing Martians instead of the rovers.

_____ 24. If albedo and atmosphere are neglected, the effective temperature of a planet is equal to...

a. a constant divided by the square root of the planet's distance from the Sun.
b. the area of the planet divided by a constant of proportionality
c. the square root of the planet's area divided by the planet's distance from the Sun.
d. the volume of the planet divided by its surface area.
e. the area of a circle cast by the planet's shadow divided by a constant.

_____ 25. Objects at room temperature (300 K) glow most brightly in what part of the electromagnetic spectrum?

a. Radio.
b. Infrared.
c. Optical.
d. Ultraviolet.
e. X-ray.

_____ 26. Using crater densities, astronomers can determine ...

a. absolute ages of planetary surfaces.
b. relative ages of planetary surfaces.
c. absolute mineral densities of planetary surfaces.
d. relative mineral densities of planetary surfaces.
e. None of the above.

_____ 27. Bad hair day. The Sun has suddenly collapsed into a black hole. Its mass is unchanged. What happens to the force of gravity on the Earth?

a. It grows strong enough to pull the Earth into the new black hole.
b. It grows stronger, but the Earth's orbit is unchanged.
c. It grows weaker, allowing the Earth to escape the Solar System.
d. It grows weaker, allowing the Earth to migrate outward in its orbit.
e. It remains the same.

_____ 28. Which of the following is most numerous in the Solar System?

a. Objects in the Main Asteroid Belt and the Kuiper Belt.
b. Major planets.
c. Moons of the major planets (defined as those larger than 5-10 km).
d. Comets.
e. Major league baseball teams.

_____ 29. Long-term climate change in the terrestrial planets can result from which of the following?

a. Changes in greenhouse gas abundance.
b. Variations in Solar luminosity.
c. Subtle changes in a planet's orbit and rotation axis.
d. Changes in albedo (reflectivity).
e. All of the above.

_____ 30. A newly discovered planetary system consists of a red dwarf and two planets, both with 15 times the mass of Earth, in circular orbits at 3 and 6 AU. How much stronger is the force of gravity on the planet at 3 AU compared to the planet at 6 AU?

a. Twice as strong.
b. Four times as strong.
c. Eight times as strong.
d. Nine times as strong.
e. None of the above; the force is weaker at 3 AU.

_____ 31. The surface pressure of a planet indicates the amount of atmosphere above it. Ranked in order from HIGHEST TO LOWEST average surface pressure, the terrestrial planetary atmospheres are...

a. Mercury, Venus, Earth, Mars.
b. Mars, Mercury, Earth, Venus.
c. Venus, Earth, Mars, Mercury.
d. Venus, Mars, Earth, Mercury.
e. Earth, Venus, Mars, Mercury.

_____ 32. A spectrum has four visible spectral lines, but all are shifted to shorter wavelengths by the same percentage of their wavelength. Which of the following is true?

a. The source is composed of hydrogen, but the gas is hotter than normal.
b. The hydrogen is in an excited state.
c. The source must be moving away from us.
d. The source must be moving towards us.
e. There must be a second source between us and the source with the spectral lines.

_____ 33. The asthenosphere is ...

a. another word for the magma in a volcano.
b. the fluid layer of the mantle upon which tectonic plates move.
c. the layer of tectonic plates that make up the Earth's surface.
d. the liquid part of the Earth's core.
e. the solid part of the Earth's core.

_____ 34. Photons in which of the following portions of the electromagnetic spectrum have the least energy?

a. Radio.
b. X-rays.
c. Far infrared.
d. Near infrared.
e. Ultraviolet.

_____ 35. Why are the blueberries found by the Opportunity Rover so important?

a. They contain iron, which is evidence of life on Mars.
b. They are an example of minerals which form in rocks immersed in water.
c. Their color reveals that they were oxidized when an ancient Mars had oxygen in its atmosphere.
d. They have formed only in the last several thousand years.
e. None of the above.

_____ 36. Which of the following statements about Arecibo Observatory is true?

a. Its angular resolution is limited by atmospheric seeing.
b. It operates at optical wavelengths.
c. Its angular resolution is superior to the best of the optical telescopes.
d. It is the largest single-dish telescope on Earth.
e. All of the above.

_____ 37. The Mars Exploration Rovers Spirit and Opportunity have been operating on Mars for ...

a. 90 days.
b. 1 year.
c. 2 years.
d. 5 years.
e. 10 years.

_____ 38. The spectral lines produced when atoms in a gas are absorbing photons from a beam of light look ...

a. bright.
b. dark.
c. dim.
d. multicolored.
e. redshifted to infinity and beyond.

_____ 39. When radioactively dating a rock, how do geologists correct for the amount of a daughter isotope in the rock when it formed?

a. By sending samples of the rock to different laboratories.
b. By examining minerals in the rock that formed with different amounts of the parent and daughter.
c. By the isosymmetric method.
d. By tagging the rock with different radioactive tracers.
e. The cannot make this correction, which is why radioactive dating does not work.

_____ 40. Any theory of the formation of the Solar System should explain some key properties of the Solar System. Which of the following is NOT one of them?

a. Most planets/bodies orbit close to same plane.
b. More massive bodies orbit in circular orbits.
c. Most bodies orbit in same direction.
d. There are exactly eight planets.
e. All of the above are key properties which need to be explained.