

# 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:**

$$p^2 \propto a^3$$

$$F = ma$$

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

$$v = \lambda \nu \quad (\text{for light, } v=c)$$

$$E = h\nu \quad (h = \text{Planck's constant.})$$

$$\theta_R \sim \lambda/D \quad (\text{The constant of proportionality depends on the units of } \lambda \text{ and } D.)$$

$$\lambda_{\text{mI}} = C/T \quad (\text{If } \lambda \text{ in } \mu\text{m} \text{ and } T \text{ in K, then } C = 2880 \mu\text{m K.})$$

$$L = 4\pi r^2 \sigma T^4 \quad (\sigma = \text{the Stefan-Boltzmann constant.})$$

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

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

**Constants** (which you probably won't need):

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

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

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

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; they 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.