Mid-term Exam 2

Practice Version

Name (written legibly): _____

Honor Pledge: *On my honor, I have neither given nor received unauthorized aid on this examination.*

Signature: _____ Student PID: _____

Instructions:

On the scannable answer sheet:
● Fill in your name (last name, then first name) and ID number and sign in the blank above.
● Identify the form number in the *last column* of the sequence number block.
● 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 form.
● The exam ends at 1:10.
● When done, raise your hand and we will collect both this form and your answer sheet.
● No one may leave between 12:55 and 1:10.

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:

$v = \lambda \upsilon$ (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.)

λ_{peak} (µm) = 2880 / T (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 × 10^8 m/s

h = 6.626 × 10^{-34} J/s

σ = 6.570 × 10^{-8} W m^{-2} K^{-4}

Pick the best answer to each question.

_____1. If a wave is moving at 6 m/s with a frequency of 2 Hz, what is its wavelength?
$(1 \text{ Hz} = 1 \text{ s}^{-1}.)$

a. 12 m.
b. 6 m.
c. 3 m.
d. 2 m.
e. 1/3 m.

_____ 2. Which of the following colors has waves of the lowest frequency?

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

_____ 3. Which of the following colors has photons with the least energy?

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

_____ 4. When a wave refracts, it ...

a. changes direction as it passes from one medium to another.
b. bounces off of a surface back in the direction it came.
c. bends around obstacles in its path.
d. expands or contracts, depending on its Doppler shift.
e. All of the above.

_____ 5. Which space telescope would have better angular resolution?

a. A 4-meter telescope observing at a wavelength of 10 μm.
b. A 4-meter telescope observing at a wavelength of 20 μm.
c. A 2-meter telescope observing at a wavelength of 20 μm.
d. A 1-meter telescope observing at a wavelength of 1 μm.
e. A 1-meter telescope observing at a wavelength of 0.5 μm.

_____ 6. What is the biggest advantage of putting a telescope on a 10,000-foot mountain?

a. It gets you above most of the water vapor in the Earth's atmosphere.
b. It gets you above most of the clouds.
c. It gets you above most of the atmospheric turbulence that smears images.
d. It gets you above atmospheric ozone.
e. All of the above.

_____ 7. Astronomy at which of the following wavelengths had to await the Space Age?

a. Optical.
b. Mid-infrared.
c. Near-infrared.
d. Radio.
e. Gamma rays.

_____ 8. A blackbody ...

a. is a perfect absorber of light at all wavelengths.
b. is a perfect emitter of light at all wavelengths.
c. has an albedo of zero.
d. All of the above.
e. None of the above.

_____ 9. Cool objects in the outer Solar System beyond Pluto can have temperatures as low as 30 K. Where does the emission from these objects peak?

a. In the optical (0.3 µm).
b. In the near-infrared (1 µm).
c. In the mid-infrared (10 µm).
d. In the far-infrared (100 µm).
e. High-frequency radio (1 µm).

_____ 10. Two stars have the same temperature, but Star A has 10 times the radius of Star B.

a. Stars A and B have the same luminosity.
b. Star A is 10 times more luminous than Star B.
c. Star A is 100 times more luminous than Star B.
d. Star A is 1,000 times more luminous than Star B.
e. Star A is 10,000 times more luminous than Star B.

_____ 11. Two stars have the same temperature and radius, but Star A is 100 times more distant than Star B. How much brighter does Star B appear to be than Star A?

a. They appear to be the same.
b. 10 times brighter.
c. 100 times brighter.
d. 1,000 times brighter.
e. 10,000 times brighter.

_____ 12. Which part of Unit 2 could best be described as quantum mechanics?

a. The wave nature of light.
b. Explaining why each atom and molecule has a unique spectral fingerprint.
c. Comparing refracting and reflecting telescopes.
d. Doppler shifts from objects moving toward and away from us.
e. Why the resolution of space telescopes is better than ground-based telescopes.

_____ 13. A spectrum of the disk of the Sun would be observed as ...

a. a continuous spectrum.
b. an absorption spectrum.
c. an emission spectrum.
d. All of the above.
e. None of the above.

_____ 14. Spectroscopy can measure which of the following properties of a planet?

a. Whether it's approaching or traveling away from us.
b. Its chemical composition.
c. Its surface temperature.
d. All of the above.
e. None of the above.

_____ 15. If we observe a star orbiting a black hole and we are looking edge-on at the system, what would we see?

a. Blue-shifted spectral lines.
b. Red-shifted spectral lines.
c. Spectral lines that oscillate between red-shifted and blue-shifted.
d. Broadened spectral lines.
e. Spectral lines that do not shift during the orbit.

_____ 16. The Sun is composed primarily of ...

a. hydrogen.
b. helium.
c. hydrocarbon compounds.
d. rock and iron.
e. aether.

_____ 17. Solar flares ...

a. can generate aurorae around Earth's polar regions.
b. are associated with sunspots.
c. are more likely during Solar maxima.
d. can lead to dangerous cosmic ray fluxes in space.
e. All of the above.

_____ 18. What will happen to the Sun when it exhausts the nuclear fuel in its core?

a. It will explode in a supernova and its core will become a neutron star.
b. Its core will contract, its envelope will expand, and it will become a red giant.
c. It will collapse into a black hole.
d. It will find another fuel source without changing the size of its core or envelope.
e. Its core will expand and vaporize.

_____ 19. As described in lecture, dwarf planets are ...

a. objects that have cleared their orbits but are not spheroidal.
b. objects that have cleared their orbits and are spheroidal.
c. objects that have not cleared their orbits and are too small to be spheroidal.
d. planetary-sized objects orbiting another planet.
e. a compromise so that people don't feel so bad that Pluto was demoted.

_____ 20. There are many more impact craters in the Southern Hemisphere of Mars than in the Northern Hemisphere. What does this imply about Mars?

a. The surface in the Northern Hemisphere is the same age as the surface in the Southern Hemisphere.
b. The surface in the Southern Hemisphere is older than the surface in the Northern Hemisphere.
c. Mars's magnetic field can deflect impactors from the Northern Hemisphere but not the Southern Hemisphere.
d. The surface in the Northern Hemisphere is older than the surface in the Southern Hemisphere.
e. You cannot deduce anything from this information.

_____ 21. The Sun contains how much of the mass in the Solar System?

a. Less than 1%.
b. About 10%.
c. About half.
d. About 90%.
e. More than 99%.

_____ 22. Which of the following statements about radioactive dating of rocks is true?

a. There is no way to determine the initial abundance of the daughter species; analysts must always assume a value.
b. The half-life of a given isotope varies with location in the Solar System.
c. Samples must be returned to Earth because the laboratory equipment is too massive to put on a space mission.
d. All half-lives are centuries or shorter, leaving only minute traces for study in ancient rocks.
e. All of the above are true.

_____ 23. What is the significance of the Ring of Fire around the Pacific Basin on Earth?

a. It arises from the settling of continental plates smashed into each other around the rim of a giant impact basin.
b. Geologic evidence shows that it was more active in the past, indicating that the Earth's interior has cooled significantly in the past 300 million years.
c. Past flare-ups in the Ring of Fire have ended ice ages on Earth.
d. Volcanic activity around the Pacific ocean is driven by the subduction of the ocean floor under surrounding continental plates.
e. It inspired one of Johnny Cash's most famous songs.

_____ 24. How does sedimentary rock form?

a. In layers, usually in a liquid.
b. From the cooling of lava after eruptions.
c. From the re-heating of previously formed rock.
d. In the shocks from crater impacts.
e. In subduction zones at the boundaries of tectonic plates.

_____ 25. Which of the following worlds has the least geologically active surface?

a. Venus.
b. The Earth.
c. The Moon.
d. Mars.
e. All of the above are currently active.

_____ 26. Given two worlds of similar density, which will cool more quickly?

a. The larger of the two.
b. The smaller of the two.
c. The one with the thicker atmosphere.
d. The one with the thinner atmosphere.
e. The one further from the Sun.

_____ 27. How can astronomers probe the interiors of the Earth and other worlds?

a. By measuring the timing of waves generated by earthquakes.
b. By studying the magnetic field around a world.
c. By measuring the mass and radius and thus the mean density.
d. By looking for evidence of tectonic activity on the surface.
e. All of the above.

_____ 28. A planet is more likely to hold down an atmosphere if ...

a. It orbits a hotter star.
b. The semi-major axis of its orbit is smaller.
c. It has less mass.
d. It is more dense.
e. The escape velocity from its surface is lower.

_____ 29. Why is the Earth not a perfect blackbody?

a. Its surface reflects some sunlight instead of absorbing it.
b. Clouds reflect some sunlight before it reaches the surface.
c. Its atmosphere absorbs some of the radiation re-emitted from its surface.
d. Its albedo is not zero.
e. All of the above.

_____ 30. Which of the following worlds has the hottest surface temperature?

a. Earth.
b. Venus.
c. Mars.
d. The Moon.
e. Mercury.

_____ 31. Which of the following worlds has the densest atmosphere?

a. Venus.
b. Earth.
c. The Moon.
d. Mars.
e. Mercury.

_____ 32. In the northern hemisphere, the rotation around high-pressure systems is ...

a. clockwise in the summer, and counter-clockwise in the winter.
b. clockwise in the winter, and counter-clockwise in the summer.
c. clockwise.
d. counter-clockwise.
e. None of the above.

_____ 33. Multi-cellular organisms first evolved ...

a. 100 million years after the formation of Earth.
b. within 1 billion years after the formation of Earth.
c. between 1 billion and 500 million years ago.
d. about 500 million years ago.
e. about 65 million years ago.

_____ 34. 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.

_____ 35. Which of the following does evolution NOT explain?

a. The evidence from the fossil record.
b. How life first arose on Earth.
c. The similarity in DNA in related species.
d. How natural selection leads to changes in species.
e. Evolution can explain all of the above.

_____ 36. The Viking Landers ...

a. landed on Mars in the 1970s.
b. both crashed into the surface of Mars.
c. discovered clear evidence for life on Mars.
d. discovered clear evidence that water had once flowed on the Martian surface.
e. discovered evidence that Mars had formed in the Asteroid Belt.

_____ 37. 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.

_____ 38. Where is the water on Mars now?

a. In the polar caps and probably in sub-surface layers.
b. In thick clouds in the atmosphere.
c. All of it escaped to space.
d. Flowing through Valles Marineris.
e. In small ponds in the centers of hundreds of craters.

_____ 39. The dominant greenhouse gas on Venus is ...

a. water vapor.
b. carbon dioxide.
c. molecular nitrogen.
d. methane.
e. sulfur dioxide.

_____ 40. Which of the following statements about Milankovitch cycles is false?

a. They model variations in the Sun's irradiation of a planet over long periods of time.
b. They are related to changes in a planet's obliquity, precession, and eccentricity.
c. They explain the ice ages on Earth reasonably well.
d. They show that the greenhouse effect on Venus is temporary.
e. They could explain long-term variations in the climate of Mars.