ASTRONOMY 121

PUZZLAHS

SPRING 2009

PUZZLAH # 1

When did human beings start to ask scientific questions?

(A) In the twentieth century

(B) Around 1800 AD

(C) Around 1500 AD

(D) Over 10,000 years ago

PUZZLAH #2

Once a result has been accepted by scientific authorities, it cannot be questioned further.

(A) True

(B) False

PUZZLAH # 3

In a scale model where the Earth is the size of a basketball, how thick would the Earth's atmosphere be?

(A) About 10 inches

(B) About 6 inches

(C) About 2 inches

(D) About 0.25 inch

(E) About the thickness of printer paper

PUZZLAH # 4

In a scale model where the Sun is the size of an orange, how far would the next nearest star be?

(A) Back of classroom

(B) Clark Hall Lobby

(C) The Rotunda

(D) Richmond

(E) Kansas

PUZZLAH # 5

The signal from the classic TV program "Gilligan's Island" has been propagating outward from the Earth since 1965 at the speed of light. Suppose there was an intelligent alien species in a nearby planetary system that picked up the signal and sent back a message of lavish praise. (OK—maybe not so intelligent.) Suppose the return signal was received in 2005. What is the maximum distance of the aliens from Earth?

(A) 1 billion miles

(B) 40 billion miles

(C) 1 light year

(D) 20 light years

(E) 40 light years

PUZZLAH # 6

Have we been able to photograph our own Galaxy (the Milky Way Galaxy) from outside?

(A) Yes

(B) No

PUZZLAH #7

The number of stars in the observable universe is

(A) much smaller than the number of grains of sand on a beach on Earth

(B) about the same as the number of grains of sand on <u>all</u> the beaches on Earth

(C) much larger than the number of grains of sand on <u>all</u> the beaches on Earth

PUZZLAH #8

If the universe is infinite in spatial extent, as we believe it to be, what fraction of its volume are our most powerful telescopes able to probe?

(A) 90%

(B) 50%

(C) A very small amount, a few %

(D) 0%

PUZZLAH #9

In what way does life on Earth depend on the stars?

(A) A star (the Sun) provides essential energy inputs to our biosphere

(B) Planets form as byproducts of star formation

(C) Essential organic materials (e.g. C, N, O) originate inside stars.

(D) All of the above

(E) None of the above

PUZZLAH #10

If you go out at 9 PM on a clear night, turn to the south, and look up at the sky, you will see certain patterns of stars. How will those patterns change if you come back at midnight?

(A) The patterns you see are always the same (they never change).

(B) The patterns you see change during the night but are always the same at a given time of night.

(C) The patterns change during the night and also change at a given time of night from month to month.

PUZZLAH #11

During the daytime, the Sun moves from east to west across the sky. In which direction do the stars move after the Sun has set?

(A) The stars are stationary; they don't move

(B) West

(C) East

(D) North

(E) South

PUZZLAH #12

Why are stars not visible during the daytime?

(A) No stars lie in the directions which can be seen then

(B) Star brightnesses increase at dusk and fade at dawn

(C) Scattered sunlight in Earth's atmosphere

(D) Clouds

PUZZLAH #13

The 12 brightest constellations are those which are members of the "Zodiac."

(A) True

(B) False

PUZZLAH # 14

Measure the angular diameter of the Sun on a clear day as follows. Don't look directly at the sun. Instead put your hand (palm out & fingers together) in front of your eyes at arm's length. Close one eye. Then, carefully fold down fingers, keeping the Sun's light covered until you can't remove any more fingers without letting sunlight pass. Remember that your index finger will subtend about 1 degree in width when held at arm's length.

How wide is the Sun in degrees?

(A) 30

(B) 20

(C) 10

(D) 5

(E) 1 degree or less

PUZZLAH #15

The "diurnal" rotation of the sky is from east to west ("westward") with respect to our horizon. What is the direction of movement from one day to the next of the Sun and the Moon with respect to the stars?

(A) The Sun and Moon do not move with respect to the stars

(B) Eastward

(C) Westward

PUZZLAH #16

Constellations are ...

(A) Animals & gods in the sky

(B) Composed of "second magnitude" stars

(C) Composed of stars which are near one another in space

(D) Arbitrary patterns picked out by the eye

(E) Permanent features of the heavens

PUZZLAH #17

Refer to the diagram of the Earth's orbit and the Zodical constellations. What constellation is the Sun in today? [Hint: the Earth moves counterclockwise during the year in the diagram.]

(A) Capricorn

(B) Scorpio

(C) Cancer

(D) Gemini

PUZZLAH #18

The Earth's polar axis is tilted 66.5 degrees out of the plane of its orbit. Suppose there was a planet with its polar axis lying in the plane of its orbit — i.e. a tilt of 0 degrees.

How would the seasons on this planet compare to the Earth's seasons?

(A) More extreme.

(B) Less extreme.

(C) Same as the Earth's.

PUZZLAH #19

Which kind of early society would MOST depend on a familiarity with astronomy?

(A) Interior, temperate climate

(B) Coastal

(C) Interior, tropical climate

PUZZLAH #20

Why is the heliacal rising of a planet, as opposed to a star, not useful as a calendar-keeping mechanism?

(A) Planets are always swamped by sunlight in pre-dawn sky

(B) Planets are always too close to the Sun

(C) Planets move with respect to the stars

(D) Planets are too faint compared to the brightest stars

PUZZLAH #21

Archaeologists investigating an ancient building site in Australia believe they have found an alignment corresponding to the direction to the Sun on the summer solstice. In which direction does it lead from the center of the building?

(A) North of due East

(B) Due East

(C) South of due East

(D) Due South

(E) Due West

PUZZLAH # 22

Here is an extract from an article that appeared in the Washington Post:

> **"Five planets will appear to line up in the night sky this month in a highly unusual, evocative celestial event. Jupiter, Mars, and Saturn have formed what appears with the naked eye to be a nearly straight line in the western sky each night...On May 5, Venus, Mars, and Saturn...will group together to form a perfect equilateral triangle. In the Middle East, the triangle will appear to hang above Bethlehem."**

What is wrong with this statement?

(A) Planets in the sky can never form a straight line

(B) Venus, Mars, and Jupiter never appear close to one another

(C) The triangle would not be visible in the Middle East

(D) The comment about Bethlehem is meaningless. It could equally well have said "will appear to hang above Bayonne, New Jersey"

PUZZLAH #23

The Moon is a spherical body that completes an orbit around the Earth once a month. True or false: the "far side" of the Moon is always dark.

(A) True

(B) False

PUZZLAH #24

Suppose you were an astronaut standing on the Moon at the time when the Moon shows a "gibbous" phase as seen from Earth. What phase would the Earth be showing to you?

(A) Gibbous

(B) Crescent

(C) First Quarter

(D) Full

(E) Earth would not show phases

PUZZLAH #25

The sky appears to rotate around the Earth once a day. Which of the following is an important clue that helps us to tell the difference between the following two possible situations? (1) the Earth is stationary at the center of a Universe that rotates about it once a day; or: (2) the Earth spins on its axis once a day in a stationary Universe.

(A) The rotation takes about 24 hours, same as the solar day

(B) The rotation of the sky is westward

(C) The rotation involves the whole sky, except for the north/south poles

(D) The Earth is a sphere and therefore must be spinning

(E) None of the above

PUZZLAH #26

How does the size of the "retrograde loop" shown by Saturn compare to that of Mars?

(A) Larger

(B) Smaller

(C) The same

PUZZLAH #27

You have two objects, A and B, both of which are the same shape. B weighs twice as much as A. You drop both simultaneously from a height of 3 feet. What happens?

(A) A (the lighter object) hits the ground first.

(B) B (the heavier object) hits the ground first.

(C) They hit at the same time.

PUZZLAH #28

You are planning a mission to Mars and you want your spacecraft to encounter Mars when the planet is moving the least rapidly in its orbit. You therefore arrange for the encounter to occur at ...

(A) Aphelion (farthest from Sun)

(B) Perihelion (nearest Sun)

(C) Halfway between perihelion and aphelion

(D) It doesn't matter, since Mars always moves at same speed

PUZZLAH #29

I am willing to gamble one point of Puzzlah credit as follows:

(A) I bet that Mr. O'Connell CAN throw a tennis ball hard enough to put it into orbit.

(B) I bet that Mr. O'Connell CANNOT throw a tennis ball hard enough to put it into orbit.

PUZZLAH #30

Suppose our scientific knowledge of electricity could be magically "subtracted" from our civilization. What would disappear from this room?

(A) All iPods, cellphones, computers, etc.

(B) (A) plus all lights, heat, air conditioning, etc.

(C) (A) & (B) plus all plastics and metals.

(D) Everything, except a bunch of naked people.

PUZZLAH #31

How much daylight is "saved" during Daylight Savings Time to be recovered later in the year?

(A) 1 hour a day

(B) 4 minutes a day

(C) Depends on cloud cover

(D) None

PUZZLAH #32

AM radio transmissions are EM waves with a wavelength of about 300 meters. VHF television transmissions have a wavelength of about 1 meter. Which do you think is more susceptible to "blocking" by trees or buildings?

(A) The shorter wavelength (TV)

(B) The longer wavelength (AM radio)

(C) Neither: blocking would be the same

PUZZLAH #33

Fluorescent lights are powered by passing an electrical current through a hot gas. What is that gas made of?

I'll show you a set of comparison spectra for different materials. Answer the question by comparing the emission line spectrum of a fluorescent lamp to those.

(A) Hydrogen

(B) Carbon Dioxide

(C) Mercury

(D) Neon

PUZZLAH #34

True or false?

"Atomic energy" is a misnomer. For instance, a hydrogen bomb really isn't an example of "atomic" energy, whereas fire is.

(A) True

(B) False

PUZZLAH #35

Stars condense from the very dilute "interstellar" gas, which has a number density of about 1 atom per cubic centimeter. The Sun, a typical star, has an average mass density of about 1 gram per cubic centimeter. How large a volume of the interstellar medium would have to be compressed to yield a single cubic centimeter of solar material? Give your answer as the side of the cube containing the material.

(A) 10 centimeters

(B) 1000 centimeters

(C) 100,000 centimeters (one kilometer)

(D) 100 million centimeters (1000 kilometers)

PUZZLAH #36

What causes the reddish-pink tone in the color images of the star forming regions?

(A) Hotter materials are red-colored

(B) Prismatic effects in Earth's atmosphere

(C) Optical illusion caused by distance of objects shown

(D) Hydrogen gas

PUZZLAH #37

A new planet the size of the Earth's Moon is suddenly discovered orbiting between Jupiter and Saturn. What materials are likely to be most common in the planet? [Hint: base your answer on the part of the protoplanetary disk where the planet formed.]

(A) Metals

(B) Ices

(C) Rocky materials (like the Earth's Moon)

PUZZLAH #38

An alien spacecraft is approaching our solar system looking for signs of intelligent life. Which signature do you think will be the easiest to detect from a distance?

(A) Oxygen and ozone in the atmosphere

(B) Airplanes

(C) Radio and TV transmissions and artificial lighting

(D) Large structures, such as cities and highways

PUZZLAH #39

Long before we had sent space probes to the vicinity of Saturn, we had an accurate estimate of its mass. How was this determined?

(A) From its size

(B) From its orbit around the Sun

(C) From its satellites' orbits

(D) From its surface color

(E) From its distance from the Sun

PUZZLAH #40

“Plate tectonic" activity depends on a planet having a warm interior that is capable of driving “convection currents” in its mantle. Mars is a smaller planet than the Earth, with only about 10% of the Earth’s mass. Do you expect Mars to show more or less tectonic activity than Earth?

(A) Mars should have more tectonic activity

(B) Mars should have less tectonic activity

PUZZLAH #41

I'm going to show you pictures of two regions on the Moon's surface, one which is heavily cratered and one which is lightly cratered. Which surface is older?

(A) The lightly-cratered surface is older.

(B) The heavily-cratered surface is older.

(C) Can't tell the age of a surface from its cratering density.

PUZZLAH #42

Why aren't there as many impact craters on the Earth as there are on the Moon?

(A) Earth is younger and formed after the period of intense bombardment.

(B) Earth's atmosphere protects it from any impacts.

(C) Crust recycling and weathering erases craters.

(D) Impactors are deflected by Earth's higher gravity.

PUZZLAH # 43

You are using a small refracting telescope and a friend places her hand over the right half of its main lens. What happens to the image you see through the 'scope?

(A) The image becomes dimmer but is not blocked out.

(B) The whole image becomes badly blurred.

(C) Half of the image is blocked out.

PUZZLAH #44

An amateur astronomer reports a possible alien spacecraft, with an orbit lying between Mercury and Venus. Quick-thinking officials at the Department of Homeland Security commandeer all professional telescopes to make observations of the object for one hour the next night at midnight. Is this going to help us learn more about the object?

(A) Yes, concentrated observations will help reveal the nature of the object.

(B) Yes, but only if the object has a high albedo (i.e. reflects most sunlight).

(C) No, they're ignorant of basic astronomical facts known by any ASTR 121 student.

PUZZLAH #45

Suppose there were a planet with a surface temperature of 400 degrees C. What relative proportion of igneous and sedimentary rocks might you expect on its surface?

(A) About equal proportions

(B) More igneous than sedimentary

(C) More sedimentary than igneous

PUZZLAH #46

The temperature at the surface of Venus is higher than the surface temperature of Mercury, despite the fact that Mercury is much closer to the Sun. Why?

(A) Mercury's thick atmosphere

(B) Venus' thick atmosphere

(C) Active volcanos on Venus' surface

(D) The tilt of Mercury's rotational axis

PUZZLAH #47

The Martian polar caps could be made out of either water ice or "dry" ice (frozen carbon dioxide).

Suppose you could monitor one characteristic of the polar caps while taking images of them during several months in the Martian spring. Which characteristic would most easily help you tell water ice from dry ice?

(A) Color

(B) Temperature

(C) Altitude

(D) Pressure

PUZZLAH #48

The atmosphere of Mars is composed mainly of carbon dioxide (CO_2), but its surface is quite cold compared to the Earth's. Why are scientists therefore concerned about "global warming" on the Earth?

(A) Earth's pole is tilted differently with respect to orbit, so seasons are more extreme.

(B) Earth's atmosphere has proportionately more CO_2 than Mars'.

(C) Earth is closer to the Sun.

(D) Mars' atmosphere is better shielded from Sunlight by clouds.

(E) Mars has larger oceans to cool the surface.

PUZZLAH #49

The striking red/pink color of Mars' surface is caused by iron oxides (rust). Mars has more iron in its crust than does the Earth. Does this suggest that the interior of Mars is more or less "differentiated" than Earth's?

(A) Mars is more differentiated than Earth.

(B) Mars is less differentiated than Earth.

PUZZLAH #19

It is dusk. Looking toward the western horizon you see an eerie, blazing white light about halfway up the sky. It is brighter than anything else in the sky. It pulsates a little bit. For five minutes, it seems to hover, maybe jittering a little this way and that. It is soundless. Quickly applying your familiarity with the sky learned in ASTR 121, you find that the stars behind it are in the constellation Aries.

What is it?

(A) Hamal, the brightest star in the constellation Aries

(B) Venus

(C) An ice crystal cloud

(D) A jet plane

(E) An alien spacecraft

PUZZLAH #20

Carbon dioxide is the best known of the "greenhouse" gases produced by human activity which are now almost certain to be causing heating of the Earth's atmosphere. About what fraction of the atmosphere does carbon dioxide constitute at the present time?

(A) A lot: over 50%

(B) A moderate amount: 1% – 50%

(C) A tiny amount: less than 0.1%

PUZZLAH #21

We believe the satellites of Jupiter and Saturn formed in the same region of the "solar nebula" as their parent planets did. However, instead of being big gas bags, the satellites have solid surfaces, more like the terrestrial planets. What material do you suppose would be more prevalent on their surfaces than we find on the Earth's Moon?

(A) Silicates

(B) Iron

(C) Ice

(D) Igneous rocks (lava)

PUZZLAH #22

Suppose that the (partially-refined) metals in a typical metallic asteroid would bring about $0.50 per kilogram on the commodities market. Assuming you could corral one, how much would a 1 kilometer diameter metallic asteroid be worth? (The mass density of a typical metallic asteroid might be 10 grams per cubic centimeter.)

(A) About $1 million

(B) About $1 billion

(C) About $1 trillion

PUZZLAH #22

Most periodic comets, like Halley's, have very elongated, elliptical orbits. This means that they spend:

(A) Most of their time in the outer part of their orbit (far from the Sun)

(B) Most of their time in the inner part of their orbit (near the Sun)

(C) About equal amounts of time near the Sun and far from the Sun.

[Assume that "Inner" and "outer" refer to the regions inside or outside 50% of the comet's maximum distance from the Sun.]

PUZZLAH # 23

As an average American, your chance of dying in a major asteroid impact is...

(A) vastly smaller than

(B) vastly larger than

(C) about the same as

...dying in a commercial airplane accident.

PUZZLAH #24

How distant is the nearest advanced alien civilization capable of interstellar spaceflight?

(A) Nearby (10 light years)

(B) Medium distant but in our Galaxy (thousands of light years)

(C) Very distant, outside our Galaxy (millions of light years)

(D) No such civilization exists in the Universe.

PUZZLAH # xx

If the Sun can have a maximum distance on the

celestial sphere of 23.5 degrees north or south of the celestial equator, what is the maximum distance from the equator for the Moon?

(A) 0 degrees (Moon stays on equator)

(B) 23.5 degrees

(C) 28.5 degrees

(D) 90 degrees