PHYSICS 176: ASTRONOMY
1st Midterm Exam,
February 26, 1999

Name:

Lab section and TA:

Score:

As a member of the Wm. & Mary community, I pledge not to lie, cheat or steal, either in my academic or personal life. I understand that such acts violate the honor code and undermine the community of trust of which we are all stewards.
Signed:

You have fifty minutes to complete this exam. You may use a hand-held calculator and a single sheet of formulas.

In the following questions, indicate the correct answer. Mark your answer clearly. Ambiguous answers will be incorrect

Possibly useful formulae or constants:
$c = 3X10^8$ m/s = 1 A.U./8 mins. = 1 LY/Y;
$\lambda f = c$;
(arc length) $s = R\theta$ (with θ in radians);
Area of circle = πR^2;
Surface area of a sphere = = $4\pi R^2$;
Volume of sphere = $(4/3)\ \pi R^3$;
1 radian = 57.3 deg.;
1 deg. = 60' ; 1' = 60" ;
1 A.U.=1.5 X 10^8 km;
1 nm =1 X 10^{-9} m
1 μm = 1 X 10^{-6}m

What does an astronomer include in 'the Universe'?
___ space and time
___ matter (including living things)
___ energy of all forms
___ all of these

In one *hour*, radio waves leaving Los Angeles could reach approximately as far as (choose the *closest*)
___ the Moon (400,000 km).
___ Mars (1.4 A.U.)
___ Saturn (10 A.U.)
___ the nearest star (other than the sun!)

Through how many degrees, arc minutes, or arc seconds does the Moon move in one *day* relative to the background of stars?
___ 12 deg.
___ ½ deg.
___ 1'
___ 1"

By how many minutes do the solar and sidereal day differ?
___ 1 minute
___ 2 minutes
___ 4 minutes
___ 15 minutes

In what way did Newton improve Kepler's laws?
___ He determined the astronomical unit.
___ He found that planetary orbits were not always an ellipse.
___ He discovered the variation in orbital speed.
___ He discovered the dependence on mass in Kepler's Third Law.

The distance between neighboring wave crests is the ? of a wave?
___ wavelength
___ frequency
___ amplitude
___ period

What is the physical difference between the various colors that make up the visible spectrum?
___ the speed of the waves
___ the amplitude of the waves
___ the wavelength
___the temperature of the wave

Which of the following is not an electromagnetic wave?
___ ultrasound
___ infrared
___ gamma rays
___ these are all electromagnetic waves

How does apparent brightness of light emitted by a star change with distance?
___ it does not change.
___ it is proportional to the distance.
___ it is inversely proportional to the distance.
___ it is inversely proportional to the square of the distance.

Which of the following forms of radiation have the highest energy?
___ ultraviolet
___ gamma rays
___ infrared
___ X-rays

What is the wavelength of a 10^{15} Hz laser beam?
___ 3×10^{-5} m
___ 3×10^{-6} m
___ 3×10^{-7} m
___ 3×10^{-8} m

Why are astronomers building bigger telescopes?
___ to gather more light to see fainter objects
___ to improve the resolution of their detectors
___ to see object farther away, hence farther in the past
___ all of these reasons

How many radio telescopes are found in an interferometer?
___ None. This is an optical telescope technique.
___ One. This method is similar to adaptive optics, but for radio telescopes.
___ Two. They are used for making parallax measurements.
___ Two or more. They are used to synthesize the resolution of a larger telescope.

What advantage is there in viewing objects at wavelengths other than optical?
___ Some objects emit little or no optical radiation.
___ other wavelengths give different information about the physical conditions of the objects.
___ Resolution can be significantly better at wavelengths other than optical.
___ All of the above.

A 1-m telescope can collect a given amount of light in 1 hour. Under the same observing conditions, how much time would be required for a 4-m telescope to perform the same task?}
___ 4 minutes
___ 15 minutes
___ 20 minutes
___ 30 minutes

What would be the equivalent single-antenna diameter of a radio telescope constructed from 9 separate 100-m diameter antennae?
___ 400 m diameter antenna
___ 300 m diameter antenna
___ 200 m diameter antenna
___ 150 m diameter antenna

The mass of the earth can be estimated by:
___ measuring the average density of rocks and material near the surface, then multiplying by the volume of the Earth
___ measuring the distance to the Moon and the period of its orbit (1 month)
___ measuring the distance to the Sun and knowing the period of the Earth's orbit (1 year)
___ comparing the weights of different objects of known materials

Which of these objects does not rise in the east and set in the west?
___ Sun
___ planets
___ stars
___ none of these

Why are different stars seen at different times of the year?
___ the tilt of the Earth's axis changes significantly during the year.
___ the orbit of the Earth around the sun causes different parts of the sky to be visible at night.
___ The Sun moves around the Earth and blocks various stars throughout the year.
___ All of these

Given that the distance to the Moon is 384,000 km and its angular size is 0.5 degrees, calculate the Moon's diameter.
___ 1680 km
___ 10,500 km
___ 3350 km
___ 192,000 km

What was still a major flaw in the Copernican model?
___ Although the planets moved around the Sun, the Sun moved around the Earth.
___ Epicycles were still needed to explain retrograde motion.
___ All the paths of the planets were still circles.
___ Stars were considered local objects within the solar system.

Approximately how long does an Earth-Venus radar signal take to complete its round trip when Earth and Venus are at their closest to one another (0.3 A.U.)?
___ 30 seconds
___ 5 minutes
___ 1 hour
___ 1 day

For a wave of constant velocity, like electromagnetic waves, how are the wavelength and frequency related?
___ Wavelength is inversely proportional to the frequency.
___ Wavelength is proportional to the frequency.
___ Wavelength is proportional to the inverse square of the frequency.
___ Wavelength is proportional to the frequency squared.

For which of the following forms of electromagnetic radiation is the Earth's atmosphere completely opaque?
___ X-rays
___ visible light
___ infrared
___ radio

What is the wavelength of a 200 MHz radio signal?
___ 150 m
___ 15 m
___ 1.5 m
___ 15 cm

What is the primary advantage the Hubble Space Telescope has over ground-based telescopes?
___ all regions of the sky are dark in outer space.
___ there is no blurring due to the atmosphere.
___ being weightless in space, it can utilize the largest mirror ever built.
___ it has a better view of celestial objects because it is closer to them.

Which of the following methods presently have the best spatial resolution for astronomical observing?
___ optical telescopes deployed from space or with adaptive optics
___ radio interferometers
___ X-ray imaging
___ gamma-ray telescopes

Earth's average density is:
___ about equal to the density of water
___ significantly greater than the density of surface rocks but less than that of lead
___ about equal to the density of lead
___ approximately the density of surface rocks

What is the primary cause of the tides?
___ the Earth's rotation makes the oceans 'squash a bit' nearer to the equator
___ the Moon's orbital motion exerts a drag on the Earth
___ global wind patterns
___ the gravitational influence of the Sun and Moon

Why are there no tides on land?
___ Because the Moon and Sun only exert a pull on the oceans.
___ there are, but they are significantly smaller than those in the oceans are.
___ The Earth's crust is too stiff to respond to weak tidal forces.

If the Earth were displaced from its present orbit onto another orbit with twice the diameter (2 A.U) how long would the new 'year' be?
___ 1.4 years
___ 2 years
___ ½ year
___ 2.8 years

What would happen to Earth if the Sun's gravity were suddenly ``turned off"?
___ Nothing; it would continue to orbit the Sun.
___ It would move off in a straight line.
___ It would fall into the Sun.
___ It would slowly spiral away from the Sun.

What is the frequency of a 600 nm red photon?
___ 2×10^{15} Hz
___ 5×10^{14} Hz
___ 5×10^{15} Hz
___ 2×10^{14} Hz

A certain telescope can achieve (diffraction-limited) angular resolution of 0.1'' for red light (of wavelength 700 nm). What would its resolution be (a) in the infrared at 1.4 μm; and (b) in the ultraviolet at 100 nm?}
___ 0.01 and 0.25 arc seconds
___ 0.1 and .01 arc seconds
___ 0.2 and 0.05 arc seconds
___0.2 and 0.014 arc seconds

The Hubble telescope has a resolution of approximately 0.05'' in the visible. How far apart must two objects be on the Moon (at a distance of 380,000 km) for them to be resolvable? (choose the closest match)
___ 4 cm
___ 4 m
___ 40 m
___ 4 km