Astronomy 101 Quiz 2+34 Form Akey

Name: ____________________________

Lab section number: ________________

(In the format "M0**". See back page; if you get this wrong you may not get your quiz back!)

Contents:

- Question 1: which form do you have?
- Questions 2-11: Quiz 2 retake (10 questions)
- Questions 12-21: Quiz 3+4 (10 questions)

Instructions:

- Quiz time: 45 minutes
- Please put bags under your seats to allow proctors to move around the room.
- There is scratch paper and a blank seasons diagram on the back. You may tear these off.
- You may use notes that you handwrote yourself, or wrote with a stylus and printed, along with your exercises. No electronic devices or things written by others are allowed, with the exception of a photocopy of a lab prepared by your group together if we ran out of printouts.
- If you have a question, raise your hand, and a proctor will assist you.
- Do not attempt to communicate with anyone other than teaching staff during the quiz.
- **Circle your answers on this paper as well as completing the Scantron. Turn both in to us at the end of class.**
- **Put your name as "Last First" on your Scantron as well as your SUID.**

Good luck!

Lab Schedule

Section	**Instructor**	**Time**
M024	Sierra Thomas	Monday 8:00 AM-9:20 AM
M003	Sierra Thomas	Monday 9:30 AM-10:50 AM
M004	Kishan Sankharva	Monday 11:00 AM-12:20 PM
M005	Kishan Sankharva	Monday 12:45 PM-2:05 PM
M006	Chad Skerbec	Monday 2:15 PM-3:35 PM
M007	Chad Skerbec	Monday 3:45 PM-5:05 PM
M008	Tyler Hain	Monday 5:15 PM-6:35 PM
M009	Tyler Hain	Monday 6:45 PM-8:05 PM
M010	Vidyesh Rao	Monday 8:15 PM-9:35 PM
M027	Tyler Hain	Tuesday 3:30 PM-4:50 PM
M028	Tyler Hain	Tuesday 5:00 PM-6:20 PM
M029	Vidyesh Rao	Tuesday 6:30 PM-7:50 PM
M030	Vidyesh Rao	Tuesday 8:00 PM-9:20 PM
M025	Sierra Thomas	Wednesday 8:00 AM-9:20 AM
M011	Sierra Thomas	Wednesday 9:30 AM-10:50 AM
M012	Chad Skerbec	Wednesday 11:00 AM-12:20 PM
M013	Chad Skerbec	Wednesday 12:45 PM-2:05 PM
M014	Byron Sleight	Wednesday 2:15 PM-3:35 PM
M015	Byron Sleight	Wednesday 3:45 PM-5:05 PM
M016	Byron Sleight	Wednesday 5:15 PM-6:35 PM
M017	Patrick Adams	Wednesday 6:45 PM-8:05 PM
M018	Patrick Adams	Wednesday 8:15 PM-9:35 PM
M019	Byron Sleight	Thursday 5:00 PM-6:20 PM
M020	Patrick Adams	Thursday 6:30 PM-7:50 PM
M031	Vincent Musso	Thursday 8:00 PM-9:20 PM
M026	Vidyesh Rao	Friday 8:00 AM-9:20 AM
M021	Kishan Sankharva	Friday 9:30 AM-10:50 AM
M022	Vincent Musso	Friday 11:00 AM-12:20 PM
M023	Vincent Musso	Friday 12:45 PM-2:05 PM

`(Question formid)`

1. What form is your exam? (Your exam is form Akey.)

   (A) Form A

   (B) Form B

   (C) Form C

   (D) Form D

   (E) Form E

`(Question axial-tilt-increase)`

2. Suppose that the axial tilt of Earth were to increase from its current value of 23° to 30°. Which of the following would happen?

   (A) The South Pole would get more hours of sunlight in December

   (B) **Syracuse, NY would get more hours of sunlight in June**

   (C) The size of the Antarctic Circle would decrease

   (D) Pretoria, South Africa (latitude 26° S) would get more hours of sunlight in June

   (E) None of the above would happen

   Increasing the axial tilt would make the seasons more intense. Since our days are already long in June, this would make them even longer.

`(Question tell-time-azimuth)`

3. “Here we don’t tell time by the rising and setting of the Sun. Instead we tell time by its direction. See that mountain straight ahead of us? When the Sun is over that mountain, we call that 12:00 AM. Look to your right, now; when the Sun is that way, over the the building there, that’s 6:00 AM. Now look directly behind us, opposite the mountain; when the Sun is there, it’s 12:00 PM.

   Finally, look to your left. When the Sun is over there, to the left of the mountain, it’s 6:00 PM.”

   Where might these people be?

   (A) This method of telling time could work anywhere on Earth; we just don’t do it

   (B) They are on the Tropic of Cancer

   (C) **They are in Antarctica**

   (D) They are on the Equator

   (E) This method of telling time won’t work anywhere on Earth

   This narrative describes the Sun moving in a 360° *circle around you without setting. This can only happen during the 24-hour days which occur within the Arctic and Antarctic Circles during their summers.*

`(Question moon-surface-facing-earth)`

4. What fraction of the Moon’s surface is *facing toward Earth* at any given time?

   (A) It depends on the phase of the Moon

   (B) **Half of it**

   (C) All of it

   (D) More than half of it

   (E) Less than half of it

   Half of it; we use this information to understand the moon phases.

`(Question equinox)`

5. On the March equinox, where on Earth would get the most hours of sunlight?

   (A) Havana, Cuba (latitude 23° N, near the Tropic of Cancer)

   (B) Murmansk, Russia (latitude 69° N, near the Arctic Circle)

   (C) Christchurch, New Zealand (latitude 44° S)

   (D) Accra, Ghana (latitude 6° N, near the Equator)

   (E) **All of these places would get the same amount of sunlight**

   On the equinox, everywhere on Earth is halfway between summer and winter, getting exactly 12 hours of sunlight.

`(Question moon-phase-beijing)`

6. Beijing is located at about the same latitude as Syracuse, but is at nearly the opposite longitude. (That is, Beijing is close to on the "opposite side" of the globe to Syracuse.)

   Suppose that you look out your window in Syracuse on a clear summer morning and you see a beautiful crescent moon just on the eastern horizon as it rises. It is a lovely sight, so you take a picture and send it to your friend who lives near Beijing.

   Thanks to the Internet, they get your picture and take a picture of the Moon from their home and send it back to you. What would their picture of the Moon look like?

   (A) **A crescent moon just setting on the western horizon**

   (B) A gibbous moon just rising on the eastern horizon

   (C) A crescent moon just rising on the eastern horizon

   (D) A gibbous moon high in their sky

   (E) A gibbous moon just setting on the western horizon

   The phase of the moon is the same regardless of where you are on Earth, since it depends on our perspective of the Moon's surface, and the Earth is very small compared to the Moon's orbit. However, since Beijing is on the opposite side of the globe to Syracuse, things are setting in Beijing when they are rising in Syracuse. We know this is true for the Sun; it is true for everything else in the sky as well.

`(Question animal-most-sunlight)`

7. Which animal could see sunlight for the most total hours during the year?

   (A) **An arctic tern (a small bird) that spends June in England, spends December in Antarctica, and flies back and forth during the other months**

   (B) A Canada goose (a large bird common in Syracuse) that spends May through August in northern Canada, December through February in the southern USA, and flies back and forth during the other months

   (C) A rattlesnake living in Mexico City, near the Tropic of Cancer

   (D) An emperor penguin (a large flightless bird) that spends its life within the Antarctic Circle

   (E) An African elephant living near the equator in Africa

   The Arctic tern is spending June in the Northern Hemisphere (which is summer), then flying south so it spends December in the Southern Hemisphere (which is also summer). Thus, it experiences summer twice a year and never experiences winter, and thus sees long days all year round! None of the other animals get to do this.

`(Question crescent-placement)`

8. You look at the sky and see the Moon and the Sun close to each other in the sky. What is the phase of the Moon?

   (A) Full

   (B) **Crescent**

   (C) Half

   (D) Gibbous

   (E) New

   If the Sun and the Moon are near each other in the sky, then the Sun is mostly shining on the opposite face of the Moon than the face pointing to Earth. In this case, we will only see a little of the Moon's surface lit – a crescent.

`(Question day-variation-least)`

9. Which place on Earth experiences the least changes in the amount of sunlight they get each day during the year?

   (A) Christchurch, New Zealand (latitude 44° S)

   (B) Havana, Cuba (latitude 23° N, near the Tropic of Cancer)

   (C) **Accra, Ghana (latitude 6° N, near the Equator)**

   (D) Murmansk, Russia (latitude 69° N, near the Arctic Circle)

   (E) The North Pole

   Since the equator has no variation in day length at all, but the poles have extreme variation, we want a location nearest the Equator.

`(Question polar-night)`

10. If you are standing exactly on the Antarctic Circle, you will experience exactly one day of polar night each year – a day when the Sun does not rise above the horizon at all. This day is:

    (A) The September equinox

    (B) The March equinox

    (C) **The June solstice**

    (D) The December solstice

    (E) None of the above

    The shortest day is the Winter Solstice. In the Southern Hemisphere, this is in June.

`(Question half-moon-phase)`

11. The Sun has just set; you see the Moon at its highest point in the sky, halfway between rising and setting.

    What is the phase of the Moon?

    (A) Full moon
    (B) Waning crescent
    (C) Waning gibbous
    (D) Waning half
    (E) **Waxing half**

    By drawing a diagram, you can see that if the Moon is high in the sky at sunset, it is a waxing half moon.

`(Question kepler-first)`

12. How many of the following depict possible orbits of a planet around a star?

    (A) One of them
    (B) Two of them
    (C) **Three of them**
    (D) Four of them
    (E) All five of them

    Orbits must be ellipses, with the Sun at one focus.

`(Question io-europa-kepler-third)`

13. Of the four moons of Jupiter that Galileo saw through his telescope, the nearest two are Io and Europa. They orbit Jupiter in nearly circular orbits.

    Europa takes exactly twice as long as Io to orbit Jupiter.

    From this, what can you conclude about the size of their orbits?

    (A) Europa's orbit is exactly twice the size of Io's orbit

    (B) Europa's orbit is more than twice the size of Io's orbit

    (C) **Europa's orbit is larger than Io's orbit, but less than twice the size of Io's orbit**

    (D) Europa's orbit is smaller than Io's orbit, but greater than half the size of Io's orbit

    (E) You can't conclude anything about the size of its orbit, since Kepler's laws of orbital motion do not apply here.

    Kepler's third law says that the time a planet takes to orbit the Sun will more than double if the size of its orbit doubles. Working backwards, then for the time a planet takes to orbit the Sun to double, the distance from the Sun must increase – but less than double.
    Since Kepler's laws apply to moons orbiting Jupiter just as they apply to planets orbiting the Sun, this logic works here, too.

`(Question acceleration-force)`

14. Consider the Moon orbiting the Earth. (The Moon's mass is about 1/100 of the Earth's mass.)

    Thinking about their gravitational pull on each other, consider the following statements:

    - I. The Moon's gravity pulls on the Earth with the same force that the Earth's gravity pulls on the Moon.
    - II. The Moon's gravity causes the Earth to accelerate at the same rate that the Earth's gravity causes the Moon to accelerate.
    - III. The Earth's gravitational pull causes the Moon to accelerate, but the Moon's gravity does not cause the Earth to accelerate.

    Which of these are true?

    (A) III only
    (B) I and II
    (C) I and III
    (D) **I only**
    (E) II only

    Newton's third law says that if the Earth applies a force to the Moon, the Moon applies an equal and opposite force in the other direction. This can also be seen from the law of gravity – $F_g = \frac{G m_E m_M}{r^2}$ *– since this is the same regardless of which object is pulling on which. So (I) is true.*
    However, (II) is not true, since the same force will cause a much larger acceleration of the lighter Moon than the heavier Earth, since $a = F/m$*.*
    Both of them, however, will accelerate in response to this force, so (III) is also not true.

`(Question epicycles-why)`

15. Why were "epicycles" (loop-the-loop motions) a necessary part of Ptolemy's geocentric model of the solar system?

    (A) They were needed to explain the difference between the solar and sidereal day
    (B) They were needed to explain the rising and setting of the planets
    (C) **They were needed to explain the retrograde motion of the planets**
    (D) They were needed to explain the motion of the Sun through the Zodiac
    (E) They were needed to explain the precession of the equinoxes

    Since the Ptolemaic model doesn't involve a moving Earth, these epicycles were the only way to explain retrograde motion.

(Question kepler-newton)

16. Which statement is true about Kepler's laws of orbits and Newton's laws of gravity and of motion?

    (A) Kepler discovered the laws of orbital motion after applying the new mathematics of calculus to Newton's laws of motion and of gravity

    (B) Kepler's laws of orbits only apply to planets orbiting the Sun, while Newton's laws of motion only apply to objects moving near the Earth

    (C) **Newton's laws of gravity and motion explain why Kepler's laws of orbits are true for planets orbiting the Sun**

    (D) Kepler's laws of orbits do not apply to planets in nearly circular orbits, while Newton's laws of motion do not apply to planets in highly elliptical orbits

    (E) None of the above are true.

    Kepler's laws are consequences of Newton's laws of motion. You can see this in the Orbit Simulator lab, where we programmed a computer with Newton's laws and out came all of the elliptical orbits that are familiar to us.

(Question mars-rock-fall)

17. You carry two rocks – one with mass 10 kg and one with mass 5 kg – to Mars, where there is very little air. Then you drop both rocks from one meter off of the ground.

    Which is true?

    (A) Mars' gravity pulls on the big rock with twice the force that it pulls on the little rock, so the big rock will strike the ground first.

    (B) **Mars' gravity pulls on the big rock with twice the force that it pulls on the little rock, but both of them take the same amount of time to fall.**

    (C) Mars' gravity pulls on the big rock with the same force that it pulls on the little rock, and both of them take the same amount of time to fall.

    (D) Mars' gravity pulls on the big rock with the same force that it pulls on the little rock, but the little rock will strike the ground first

    (E) Mars' gravity pulls on the big rock with the same force that it pulls on the little rock, but the big rock will strike the ground first.

    We know they must take the same time to fall because we did the experiment in class. However, the larger rock experiences twice the force ($F_g = \frac{GM_{\text{mars}} m_{\text{rock}}}{r^2}$).

(Question copernicus-fail)

18. Which of the following was a significant *problem* with the heliocentric model proposed by Copernicus, in which all of the planets orbited the Sun in circular orbits and the Moon orbited the Earth?

    (A) It could not explain the phases of Venus that Galileo observed using a telescope

    (B) It could not account for the phases of the Moon as seen from Earth

    (C) **It did not make very accurate predictions about how the planets appeared to move in the sky**

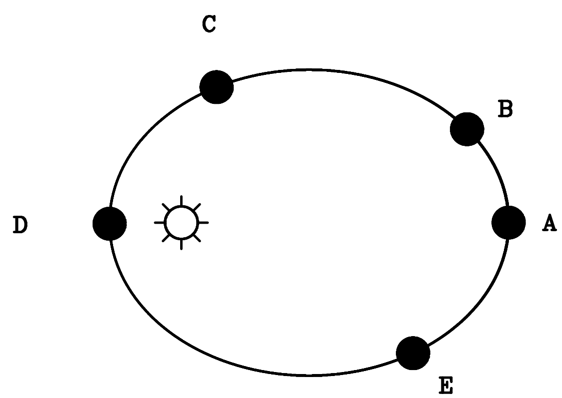
    (D) It could not explain retrograde motion in a simple way

    (E) It could not explain the difference between the length of the solar and sidereal day

    Copernicus' heliocentric model did not make very accurate predictions since it used circular, rather than elliptical, shapes for the orbits.

(Question second-law-speed)

19. This graph shows the orbit of a highly eccentric planet. You will refer to it in the next two questions.



At what point is the planet *slowing down*?

(A) Point A

(B) Point B

(C) Point C

(D) Point D

(E) **Point E**

You needed the added information (given in class) that the planet is moving counterclockwise here. It is thus slowing down when it is moving from perihelion to aphelion.

(Question energy-highest)

20. In the graph of the planet's orbit in the previous question, at what point does the planet have the *highest potential energy*?

    (A) **Point A**
    (B) Point B
    (C) Point C
    (D) Point D
    (E) Point E

    The highest potential energy happens when the planet is furthest from the Sun ("furthest distance to fall").

(Question gravity-one-quarter)

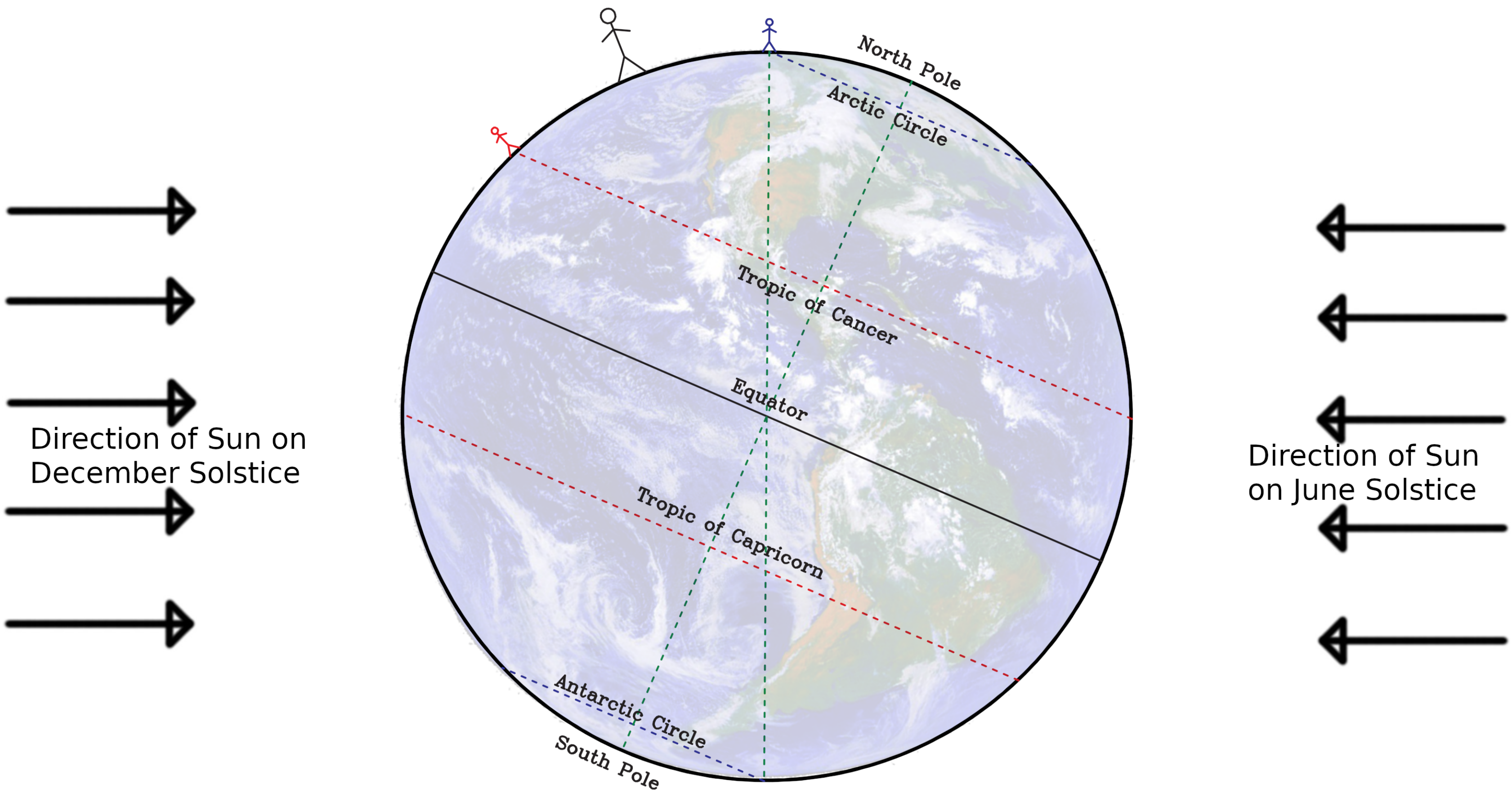
21. Halley's comet has an extremely eccentric orbit. Its perihelion is around 0.59 AU from the Sun, while its aphelion is around 35 AU from the Sun.

    This means that it is about 60 times further from the Sun at aphelion than it is at perihelion.

    Which statement is true about the acceleration of Halley's comet due to the Sun's gravity?

    (A) The Sun's gravity causes the same acceleration at perihelion as at aphelion.
    (B) **The Sun's gravity causes about 3600 times the acceleration at perihelion as at aphelion.** *(The significance of 3600 is that* $60 \times 60 = 3600$*.)*
    (C) The Sun's gravity causes about 60 times the acceleration at perihelion as at aphelion.
    (D) The Sun's gravity causes about 8 times the acceleration at perihelion as at aphelion. *(The significance of 8 is that* $8 \times 8 \approx 60$*.)*
    (E) You cannot figure this out without knowing the masses of the Sun and Halley's comet.

    Since the acceleration of the comet is proportional to the force it feels, and force is inversely proportional to distance squared ($F_g = \frac{GMm}{r^2}$*), being 60 times closer at perihelion means the acceleration will be* $60^2 = 3600$ *times stronger.*



Direction of Sun on
December Solstice
North Pole
Arctic Circle
Tropic of Cancer
Equator
Tropic of Capricorn
Antarctic Circle
South Pole
Direction of Sun
on June Solstice

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Answer key 23251123353343323512