Astronomy 101 Exam 1 Form D-key

Name: _____

Lab section number: _____

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

- Exam time: one hour and twenty minutes
- Please put bags under your seats to allow proctors to move around the room.
- Please choose the **best** answer to each question.
- You may use only pencils and pens for this exam; no notes, **cellphones, or smartwatches** are allowed.
- If you have a question, raise your hand, and a proctor will assist you.
- You may use a single-sided 8.5x11 inch page of notes you wrote yourself, along with your globes with any annotations.
- Do not attempt to communicate with anyone other than teaching staff during the exam.

Good luck!

Lab Schedule

Section	Instructor	Time
M024	Jiaxin Sun	Monday 8:00AM-9:20AM
M003	Pan Dong	Monday 9:30AM-10:50AM
M004	Pan Dong	Monday 11:00AM-12:20PM
M005	Pan Dong	Monday 12:45PM-2:05PM
M006	Pan Dong	Monday 2:15PM-3:35PM
M007	Suman Kundu	Monday 3:45PM-5:05PM
M008	Suman Kundu	Monday 5:15PM-6:35PM
M009	Suman Kundu	Monday 6:45PM-8:05PM
M010	Suman Kundu	Monday 8:15PM-9:35PM
M027	Julian Georg	Tuesday 3:30PM-4:50PM
M028	Julian Georg	Tuesday 5:00PM-6:20PM
M029	Julian Georg	Tuesday 6:30PM-7:50PM
M030	Julian Georg	Tuesday 8:00PM-9:20PM
M025	Ohana Benevides Rodrigues	Wednesday 8:00AM-9:20AM
M011	Ohana Benevides Rodrigues	Wednesday 9:30AM-10:50AM
M012	Ohana Benevides Rodrigues	Wednesday 11:00AM-12:20PM
M013	Scott Bassler	Wednesday 12:45PM-2:05PM
M014	Jiaxin Sun	Wednesday 2:15PM-3:35PM
M015	Sarthak Gupta	Wednesday 3:45PM-5:05PM
M016	Sarthak Gupta	Wednesday 5:15PM-6:35PM
M017	Elizabeth Lawson-Keister	Wednesday 6:45PM-8:05PM
M018	Elizabeth Lawson-Keister	Wednesday 8:15PM-9:35PM
M019	Sarthak Gupta	Thursday 5:00PM-6:20PM
M020	Sarthak Gupta	Thursday 6:30PM-7:50PM
M031	Ohana Benevides Rodrigues	Thursday 8:00PM-9:20PM
M026	Elizabeth Lawson-Keister	Friday 8:00AM-9:20AM
M021	Elizabeth Lawson-Keister	Friday 9:30AM-10:50AM
M022	Jiaxin Sun	Friday 11:00AM-12:20PM
M023	Jiaxin Sun	Friday 12:45PM-2:05PM

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(Question celestial-sphere-one-day)
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1. Over the course of **one day**, the celestial sphere model will work reasonably well to predict the motions of which of the following?

   (A) The Moon
   (B) The Sun
   (C) Mars
   (D) The distant stars
   (E) **All of the above**

   Over the course of one day, the Earth has not moved much around the Sun, nor have the Moon or Mars moved much. Thus, over one day,the celestial sphere model ("things rotate around the celestial pole once per day") works reasonably well.

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(Question suggest-1)
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2. When it is summer in the Southern Hemisphere, where is the star Polaris located in the sky if you are viewing from Tierra del Fuego, Chile (latitude 55° S)? *(Thanks to Michael for the question!)*

   (A) High in the southern sky
   (B) At the zenith
   (C) Low in the southern sky
   (D) High in the northern sky
   (E) **Below the horizon**

   In the Southern Hemisphere, you can't see the North Celestial Pole; it is below thehorizon.

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(Question stop-rotation)
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3. Suppose that the Earth stopped rotating on its axis, while keeping everything else the same. That is, suppose that the Earth continued traveling around the Sun as it does now, but stopped spinning, so that we were always facing in precisely the same direction. What would the consequences of this be?

    - 1. Earth would no longer experience sidereal days
    - 2. Earth would no longer experience solar days
    - 3. The length of our solar days would become one year long
    - 4. The length of our sidereal days would become one year long

    (A) 2 only
    (B) 1, 2, 3, and 4
    (C) 2 and 4
    (D) 1 only
    (E) **1 and 3**

    The sidereal day is caused solely by the Earth's rotation. If the Earth stopped rotating, the stars other than the Sun would stop moving in the sky, and thus we would no longer experience sidereal days. The solar day is based on the motion of the Sun in the sky. If the Earth stopped rotating but continued revolving around the Sun, it wouldn't return to the same location in the sky until the Earth completed one full orbit. Earth would have "daytime" and "nighttime" sides as before, but if it stopped rotating it would take an entire year for a place on Earth to go from day to night and back again. Thus, the solar day would be a year long.

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(Question new-moon-reason)
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4. During a new moon, why are we unable to see the Moon?

    (A) Because the amount of light created by the Moon changes with its phase
    (B) Because the Earth casts a shadow on the Moon, blocking the sunlight from it
    (C) **Because the part of the Moon facing the Earth is not lit by the Sun**
    (D) None of the above are correct.

    Half of the Moon is always lit; during a new moon, that half is facing away from us.

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(Question solar-eclipse)
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5. A solar eclipse happens when the Moon gets between the Earth and the Sun, so the Moon blocks the Sun's light from hitting the Earth very briefly.

   What is the phase of the Moon when this happens? *(Thanks to Ariana for the question!)*

   (A) A waning half moon

   (B) A full moon

   (C) **A new moon**

   (D) A waxing half moon

   (E) Solar eclipses can happen during any phase of the Moon

   When the Moon is between the Sun and the Earth, the Sun lights the side of the Moonfacing toward it, which we can't see at all from Earth. This is a new moon.

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(Question name-of-class)
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6. This course goes by the code AST 101. What is this short for?

   (A) **Astronomy 101**

   (B) Astrology 101

   Astronomy is the scientific study of the workings of the cosmos, and the name of this course. Astrology is the thing that tells you what you'll have for dinner tonight.

`(Question tidal-lock-day)`

7. Suppose that the Earth's rotation was changed so that the same face of the Earth was always pointed at the Sun, much like the same face of the Moon is always pointed at the Earth.
What would happen as a consequence of this?

   - 1. Earth would no longer experience sidereal days
   - 2. Earth would no longer experience solar days
   - 3. The length of our solar days would become one year long
   - 4. The length of our sidereal days would become one year long

   (A) 1, 2, 3, and 4
   (B) 2 only
   (C) **2 and 4**
   (D) 1 and 3
   (E) 1 only

   If the same face of the Earth were always pointed at the Sun, then we would no longer experience solar days – half of the Earth would always be in daytime, and half would always be innighttime. If this were true it would take one full year for the Earth to rotate once (since its rotation is now locked to its orbit); this would make the sidereal day a year long.

`(Question sunrise-moonrise)`

8. You are lost in the desert shortly after sunset. You're not sure which way is which, and a raven stole your compass as a shiny bauble for its nest. You notice, however, that there is a beautiful crescent moon just above the horizon in front of you. The bright part of the crescent points downward, toward the horizon.

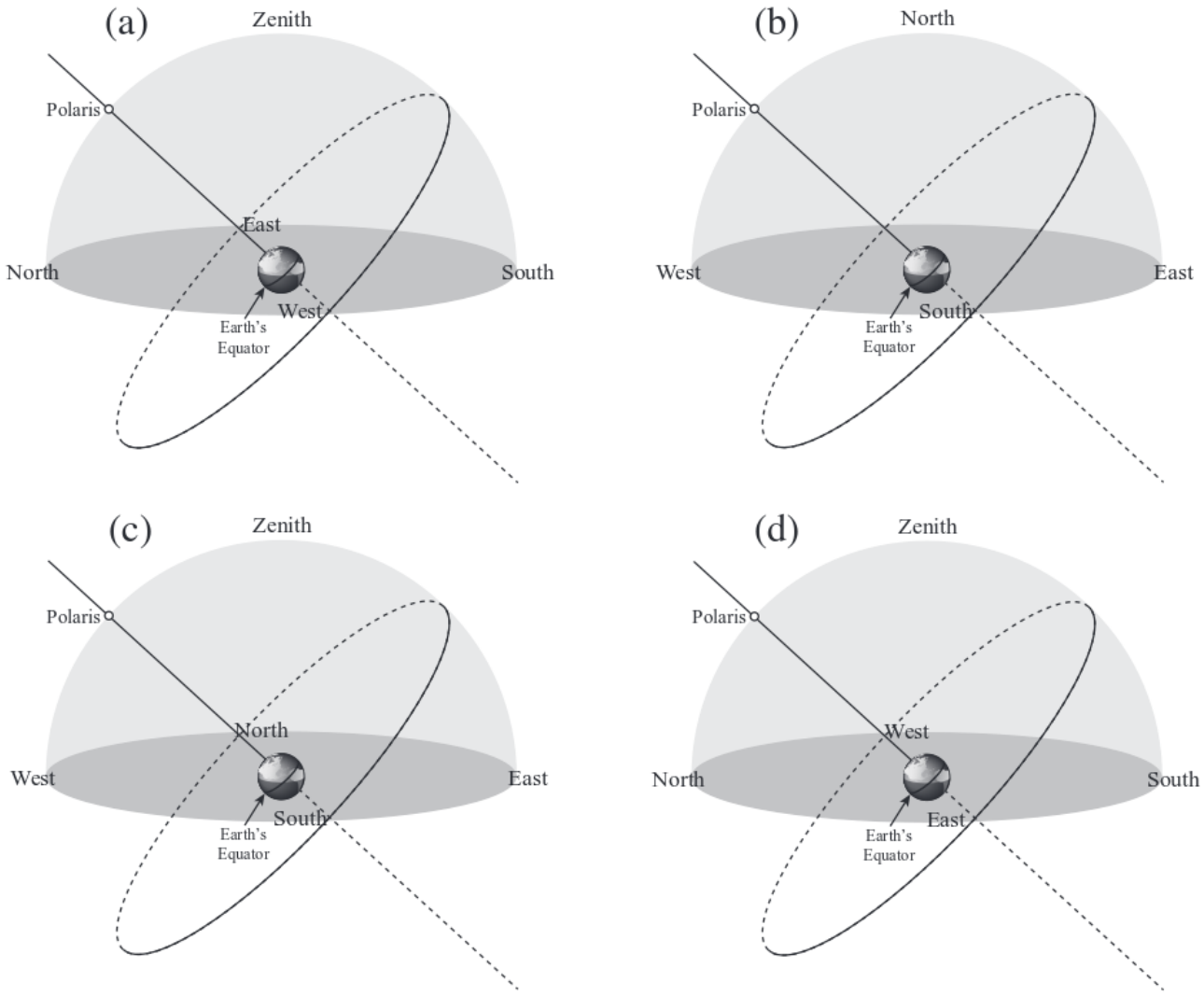
   Which direction are you facing?

   (A) North
   (B) East
   (C) South
   (D) **West**

   There are multiple ways to do this problem (involving drawing diagrams). But the simplestis to observe that a crescent moon happens when the Moon is close to the Sun. So if the Sun has just set, and the Moon is a crescent, then the Moon is about to set as well. Things set in the West.

`(Question horizon-diagram)`

9. Which of the following diagrams is correctly labelled?



The answer is (a). North is the direction on the horizon underneath the North Star; South is opposite it, and East is to the right when you're looking north. The zenith is straight overhead (which is "up" on this diagram).

`(Question zodiac-2)`

10. On June 1, you note that the constellation Scorpius is directly overhead, exactly at midnight.

    Which will be true about Scorpius six months later, on December 1?

    (A) **It will be located behind the Sun, and will thus be highest in the sky at solar noon**
    (B) It will again be highest in the sky at midnight
    (C) It will be highest in the sky at 1 AM
    (D) It will be highest in the sky at 6 AM
    (E) It will never come above the horizon in December

    If Scorpius is overhead at midnight, it is located on the opposite side of Earth from the Sun. Six months later, however, they will be lined up – that means Scorpius will be directly overhead at noon. (Draw a diagram.)

`(Question moonlight-fraction)`

11. During a new moon, what fraction of the Moon's entire surface is lit by the Sun? *(Thanks to Molly for the question!)*

    (A) All of it
    (B) **Half of it**
    (C) More than half, but not all of it
    (D) None of it
    (E) Some, but less than half, of it

    The Moon is a lump of rock floating out in space, just like the Earth. Like the Earth, it has a sunlit side and a "nighttime" side.So half of it is lit – during a new moon, it's the half pointed away from us.

`(Question sky-location-describe)`

12. Which two pieces of information are required to describe the apparent location of an object in the sky?

    (A) Its azimuth (north/south/east/west) and its distance from us

    (B) Its synodic period and its phase

    (C) Its altitude (elevation above the horizon, in degrees) and its distance from us

    (D) **Its azimuth (north/south/east/west) and its altitude (elevation above the horizon, in degrees)**

    (E) Its latitude and longitude

    As we discussed in class early in the semester, to describe where to look to see something in the sky,you need to tell which point on the horizon it is above (north/south/east/west)and whether it is close to the horizon or near the zenith.

`(Question seasons-causes)`

13. Consider the following statements regarding the reason Syracuse is warmer in the summer than ther winter:

    1. Syracuse receives more direct sunlight in the summer than the winter.
    2. Syracuse receives more hours of sunlight in the summer each day than during the winter.
    3. Syracuse is closer to the Sun in the summer than in the winter.

    Which of these statements are true?

    (A) **1 and 2**

    (B) 1 only

    (C) 3 only

    (D) 2 only

    (E) 1, 2, and 3

    (1) and (2) are both true and are the causes of the seasons; (3) is not true, since we areactually slightly closer during our winter.

`(Question day-length-2)`

14. Which of the following locations on Earth experiences the shortest days on the September equinox?

    (A) Cape Town, South Africa (latitude 33° S)

    (B) Helsinki, Finland (latitude 60° N)

    (C) McMurdo Station, Antarctica (latitude 78° S)

    (D) Chongqing, China (latitude 30° N)

    (E) **All of these places would have days that are the same length on the September equinox.**

    The equinox is a time when the Earth is neither tilted away from nor toward the Sun. Everywhere on Earth will experience 12 hour days and 12 hour nights.

`(Question sidereal-day)`

15. The star Algol rises at 9:40 PM tonight; it will rise at 9:36 PM tomorrow night. Which of the following are true?

    - 1. This happens because the sidereal day is shorter than the solar day.
    - 2. This happens because the Earth also revolves around the Sun in the same direction as it rotates on its axis.
    - 3. This will only happen this way in the Northern Hemisphere; if we were to do this on the Equator, it would rise again at 9:40 PM tomorrow night.

    (A) 2 only

    (B) 1 and 3

    (C) 3 only

    (D) **1 and 2**

    (E) 1 only

    Both (1) and (2) are correct. The sidereal day (which goes from star-rise to star-rise)is four minutes shorter than the solar day (which is our familiar 24 hour day). However,as discussed in class, the difference between the sidereal and solar days is a productof the combination of the Earth's revolution and rotation.

`(Question sun-movement)`

16. Imagine that you could see the Sun and the stars at the same time.

    On September 23, 2018, you observe that the constellation Virgo lies behind the Sun. On which *other* days would the constellation Virgo also lie behind the Sun?

    - 1. September 24, 2018 (one day later)
    - 2. October 23, 2018 (one month later)
    - 3. September 24, 2019 (one year later)

    (A) 2 and 3
    (B) 2 only
    (C) 3 only
    (D) **1 and 3**
    (E) 1 only

    One year later the Earth will be located in the same place in its orbit. One day laterit will be located very near to the same place, since it doesn't move much every day.But a month later, it will be in a different part of its orbit, and a different constellationwill be behind the Sun.

`(Question celestial-sphere-motion)`

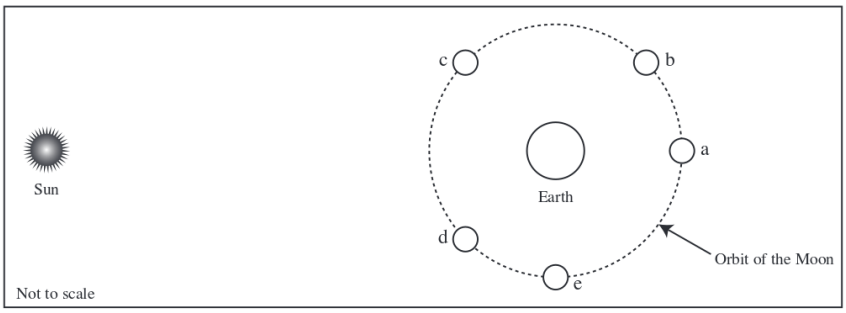
17. The celestial sphere model most accurately describes: *(Thanks to Jescy for the question!)*

    (A) The changes in the sky over many thousands of years
    (B) The changes in the sky over one year
    (C) **The changes in the sky over one day**
    (D) The changes in the sky over one month
    (E) The celestial sphere model doesn't describe the motion of anything very well, since it is founded on the incorrect idea that the Earth is at the center of the Universe.

    The rotation of the celestial sphere is a way of modeling the consequences in the sky due to Earth's rotation, which happens once per day. As we have studied it, it does not attempt to capture the consequences of the Earth's revolution around the Sun, or the motion of the Moon or the planets. These things happen over timescales longer than one day, so the celestial sphere model captures what happens each day rather well, but fails over longer times.

(Question moon-phase-identification)

18. Which of the following positions depicts a *waning crescent moon*?



The answer to this question is (c); draw a diagram to see.

(Question precession)

19. The Earth's rotation axis itself rotates ("precesses") slowly over thousands of years. Which of the following is a consequence of this?

    (A) In a solar calendar, like ours, it will no longer be winter in January

    (B) A different constellation in the Zodiac will be located behind the Sun on your birthday five thousand years from now

    (C) The constellations lying along the path of the Sun in the sky, called the *Zodiac*, will be different in five thousand years

    (D) In five thousand years, Polaris will no longer be near the North Celestial Pole

    (E) **More than one of the above is true.**

    The precession of the Earth's axis has several consequences. One is that the sidereal yearand the solar year are slightly different, as discussed in class (and lab); the positionin the Earth's orbit corresponding to the solstices changes slowly over thousands of years.Also, since the North Celestial Pole is the place in the sky directly along the Earth's rotation axis,if the Earth's rotation axis changes, then so does the position of the NCP.

`(Question apparent-motion-new-zealand)`

20. How do the stars appear to move as seen from Dunedin, New Zealand? (46° S latitutde)

    (A) They appear to rotate counterclockwise around the North Celestial Pole, visible in the northern sky

    (B) **They appear to rotate clockwise around the South Celestial Pole, visible in the southern sky**

    (C) They appear to rotate counterclockwise around the South Celestial Pole, visible in the southern sky

    (D) They appear to rotate clockwise around the North Celestial Pole, visible in the northern sky

    (E) They appear to rotate counterclockwise around the star Polaris, visible in the northern sky

    From the Southern Hemisphere, only the South Celestial Pole is visible; the North Celestial Pole (and the nearby star Polaris) is below the horizon. The rotation of the Earth still causes things to rise in the East and set in the West; facing South, this describesa clockwise rotation.

`(Question celestial-sphere)`

21. Suppose that the celestial sphere model were literally true. That is, instead of the Earth spinning once per day and orbiting the Sun, all of the objects in the sky including the Sun and Moon were fixed to a single spinning ball with the Earth at its center, and did not slip from their positions on the sphere.

    Which of the following would be true?

    (A) The Sun would still move throughout the different constellations of the Zodiac, like it does now

    (B) **The Moon would continue to rise and set like it does now**

    (C) The Moon would continue to have different phases like it does now

    (D) All locations on Earth would see the same constellations in the sky

    (E) The length of the solar and sidereal days would continue to be different by four minutes

    If the celestial sphere were literally the case, then all objects in the sky would still revolve (clockwise / counterclockwise)around the (South / North) celestial pole once per day. This includes the Moon. But the celestial sphere model (where all objects are on the same sphere)does not capturethe motion of the Moon around the Earth (so no moon phases) or the motion of the Earth around the Sun (so no changing alignmentbetween the Sun and the stars, or shorter sidereal days.)

`(Question moon-phase-time)`

22. You look up and see the Moon high in the sky; the Sun is just about to set on the western horizon. The phase of the moon is:

    (A) New moon

    (B) Waning half moon ("third quarter")

    (C) Full moon

    (D) **Waxing half moon ("first quarter")**

    (E) You can't see the Moon while the Sun is in the sky

    In my diagram that I used to answer this question, I've chosen the sunlight to come infrom the left. Since the Earth rotates counterclockwise when seen from above the NorthPole, then the observer is located on the "bottom" of the Earth as seen in this diagram.If the Moon is high overhead, then the Moon is also located "under" the Earth; since itgoes counterclockwise, it is a waxing half moon.

`(Question twelve-hours-later)`

23. While in Syracuse, you see a star low and directly to the North at midnight. Where will you find that star at 2 AM?

    (A) **Slightly higher in the sky, and slightly to the East**

    (B) Slightly lower in the sky, and slightly to the West

    (C) Slightly higher in the sky, and slightly to the West

    (D) Slightly lower in the sky, and slightly to the East

    (E) You won't see it at all; it will have gone below the horizon

    In the Northern Hemisphere, stars appear to circle counterclockwise around the North Star. If it is directly below the North Star, this means that it is at "six o'clock" on a clockface; in order to proceed counterclockwise, it needs to go to the right and up (moving to "four o'clock", since it goes counterclockwise). Looking North, East is to the right.

`(Question cultural-differences)`

24. Imagine that an ancient Greek stargazer and an ancient Zulu stargazer (from what is now South Africa) met each other for the first time. Since one comes from the Northern Hemisphere and the other comes from the Southern Hemisphere, they would have very different experiences with the night sky.

    However, despite their different origins, they would agree on some things about the night sky. Which of the following **would** they agree on?

    (A) The constellations near the pole star, useful for navigation

    (B) The direction that the stars appear to rotate around the pole star

    (C) What season it is in June

    (D) **The constellations in the Zodiac (those that the Sun appears to pass through during the year)**

    (E) None of these

    The constellations that the Sun passes through depend only on the location of the Earth and the Sun. The Zulu and the Greek are pointed in different directions and on different parts of the Earth, but their locations are essentially the same on a cosmicscale. Thus, they would see the Sun lined up with the distant stars in the same way.

`(Question circumpolar-stars)`

25. You look up and see a sky full of stars rotating clockwise around the zenith. Where are you?

    (A) **The South Pole**

    (B) On the Tropic of Capricorn, on the December solstice

    (C) The North Pole

    (D) The Equator

    (E) None of the above

    If you see the celestial pole at the zenith, then you are standing directly under the celestial pole – at either the North or South Poles of the Earth. Since the stars are rotating clockwise, you know you are at the South Pole. I hope you brought warm clothes!

`(Question moon-phase-dune)`

26. In Frank Herbert's classic science-fiction novel *Dune*, the desert planet Arrakis has two moons. For simplicity, assume that both orbit Arrakis in the same way that our Moon orbits the Earth, and Arrakis rotates in the same way as Earth does.

    Suppose that you are standing on the equator of Arrakis. One of these moons is directly overhead, and is a full moon. The other moon is low on the Eastern horizon. What phase is the other moon?

    (A) It is a crescent moon, and the bright part is pointing up (i.e. away from the horizon, toward the sky)

    (B) It is a crescent moon, and the bright part is pointing down (i.e. toward the horizon)

    (C) It is a half moon, and the bright half is pointing up (i.e. away from the horizon, toward the sky)

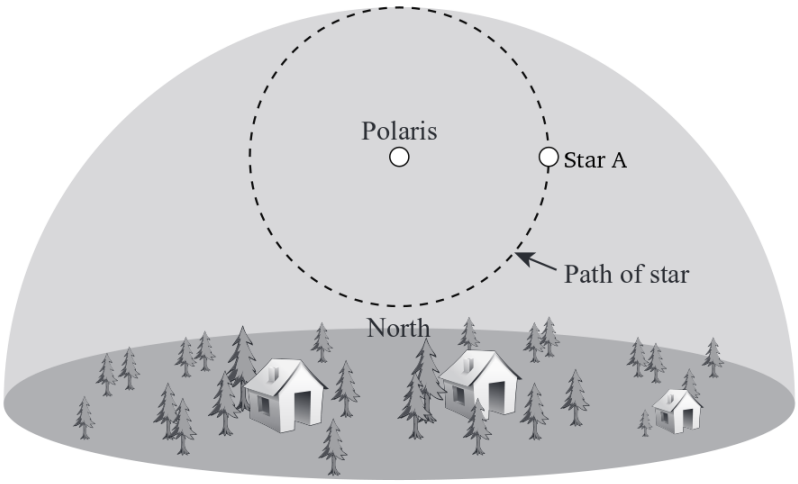
    (D) **It is a half moon, and the bright half is pointing down (i.e. toward the horizon)**

    (E) It is a full moon also.

    This can be easily figured out by drawing a picture. We know that the moon is full when it is opposite the Sun. Thus, the first moon is exactly opposite the Sun. If it is directlyoverhead, the observer is also opposite the Sun (and it is thus midnight for them).The second moon is low on the eastern horizon. If we draw a picture such that the Sun is to the left, Arrakis is in the center, and the first moon is to the right, then the second moonis located above Arrakis, just on the eastern horizon for our observer. Its left face is the one pointed toward the Sun, and is thus bright; its right face is the one pointed away.Our observer will see its bottom half, which is half lit and half dark. Thus, the observer will see a half moon. The bright half – to the left, on the diagram – is nearest the horizon.

`(Question movement-direction)`

27. You look north and see the following in front of you:



In what direction is Star A *moving* at this time?

(A) Downward
(B) **Upward**
(C) South
(D) North
(E) East

It is moving upward, since the star moves counterclockwise around the North Star.

`(Question day-length)`

28. Which of the following locations on Earth experiences the shortest days on the December solstice?

(A) Cape Town, South Africa (latitude 33° S)
(B) **Helsinki, Finland (latitude** 60° **N)**
(C) Chongqing, China (latitude 30° N)
(D) McMurdo Station, Antarctica (latitude 78° S)
(E) All of these places would have days that are the same length on the December solstice.

In December the Northern Hemisphere is tilted away from the Sun. So the shortest days are in the most northerly point: Helsinki.

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(Question light-year)
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29. A "light-year" measures what?

    (A) Speed
    (B) Mass
    (C) Distance
    (D) Time
    (E) Brightness

    A light-year is the distance light travels in one year.

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(Question sun-moon-distance)
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30. The Sun is further away from us than the Moon. About how many times further away is it? (Give the closest answer.)

    (A) Fifty thousand times further away
    (B) Five times further away
    (C) Five million times further away
    (D) Five hundred million times further away
    (E) **Five hundred times further away**

    The Moon is 1/500 AU (or thereabouts) away from Earth.

`(Question sun-course-tropic-capricorn)`

31. Thinking only about the position of the Sun at solar noon, how does the position of the Sun change throughout one year for someone in São Paulo, Brazil (located at 23.5° S latitude, on the Tropic of Capricorn)?

    (A) It is always located in the southern sky; it is highest in the sky on the June solstice and lowest in the sky on the December solstice.

    (B) It is always located in the northern sky; it is highest in the sky on the December solstice and lowest in the sky on the June solstice.

    (C) On the June solstice the sun is at the zenith; later in the year it moves lower in the northern sky, reaching its lowest point on the December solstice.

    (D) On the December solstice the sun is high in the southern sky; later in the year, it gets higher in the sky, passes through the zenith during the March equinox, and then moves intothe northern sky, reaching the lowest point in the northern sky on the June solstice.

    (E) **On the December solstice the sun is at the zenith; later in the year it moves lower in the northern sky, reaching its lowest point on the June solstice.**

    The Tropic of Capricorn is the southern tropic boundary. The tropics are the band around the Equator where the Sun passes through the zenith (alternating between the northern and southernsky); if you are on the boundary of the tropics, you'll see the Sun just barely get to the zenith during the solstice. Since you are in the Southern Hemisphere, the Sun will be in thenorthern sky – but when you are maximally tilted toward the Sun, it'll be directly overhead.

Scratch Paper

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Scratch Paper

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