Astronomy 101 Exam 1 Form Ckey

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.
- You may use only writing materials and one side of one 8.5x11" page of notes. No calculators, smartwatches, or cellphones are allowed.
- 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 exam.

Good luck!

Lab Schedule

Section	Time	Instructor
M024	Monday 8:00AM-9:20AM	Saumik Banerjee
M003	Monday 9:30AM-10:50AM	Saumik Banerjee
M004	Monday 11:00AM-12:20PM	Saumik Banerjee
M005	Monday 12:45PM-2:05PM	Saumik Banerjee
M006	Monday 2:15PM-3:35PM	Vidyesh Rao Anisetti
M007	Monday 3:45PM-5:05PM	Vidyesh Rao Anisetti
M008	Monday 5:15PM-6:35PM	Vidyesh Rao Anisetti
M009	Monday 6:45PM-8:05PM	Fang Wang
M010	Monday 8:15PM-9:35PM	Fang Wang
M027	Tuesday 3:30PM-4:50PM	Vidyesh Rao Anisetti
M028	Tuesday 5:00PM-6:20PM	Jeffrey Frelier
M029	Tuesday 6:30PM-7:50PM	Jeffrey Frelier
M030	Tuesday 8:00PM-9:20PM	Jeffrey Frelier
M025	Wednesday 8:00AM-9:20AM	Evangelos Nastas
M011	Wednesday 9:30AM-10:50AM	Suman Kundu
M012	Wednesday 11:00AM-12:20PM	Mario Olivaras
M013	Wednesday 12:45PM-2:05PM	Mario Olivaras
M014	Wednesday 2:15PM-3:35PM	Evangelos Nastas
M015	Wednesday 3:45PM-5:05PM	Mario Olivaras
M016	Wednesday 5:15PM-6:35PM	Fang Wang
M017	Wednesday 6:45PM-8:05PM	Fang Wang
M018	Wednesday 8:15PM-9:35PM	Evangelos Nastas
M019	Thursday 5:00PM-6:20PM	Pan Dong
M020	Thursday 6:30PM-7:50PM	Pan Dong
M031	Thursday 8:00PM-9:20PM	Jeffrey Frelier
M021	Friday 9:30AM-10:50AM	Pan Dong
M022	Friday 11:00AM-12:20PM	Pan Dong
M023	Friday 12:45PM-2:05PM	Mario Olivaras
M026	Friday 8:00AM-9:20AM	Evangelos Nastas

`(Question formid)`

1. What form is your exam?

   (A) Form A
   (B) Form B
   (C) Form C
   (D) Form D
   (E) Form E

`(Question sunrise-moon-phase)`

2. You look up and see the Moon high in the sky, near the zenith. The Moon is a waning half moon (also called "third quarter"); the bright half of the Moon is facing east.

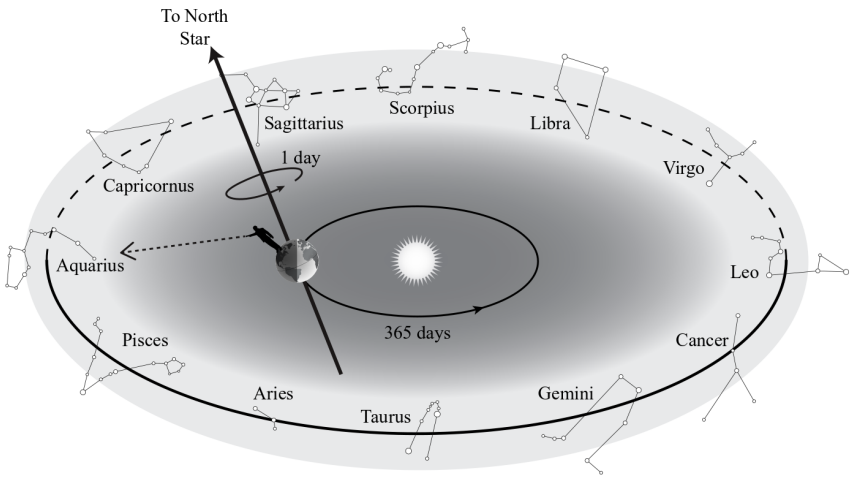
   What time of day is it?

   (A) About sunset
   (B) About midnight
   (C) About noon
   (D) About 3AM
   (E) **About sunrise**

   There are two ways to figure this out. You should draw a diagram of the Earth and Moon, as you practiced on Lab 3, and consider how the horizon changes as the observer rotates around the Earth during a day. The fact that the lit portion of the Moon points East is another clue, since it always points toward the Sun.

(Question zodiac-1)

3. The following diagram will be used in the next three questions:



In the diagram, the observer is pointing to the constellation Aquarius. Where is it in their sky?

(A) Along their eastern horizon
(B) High in their northern sky
(C) Along their southern horizon
(D) **High in their southern sky**
(E) Along their northern horizon

In the diagram, the observer is facing away from the North Pole: southward. The constellation is not along their horizon; it is up in the sky.

(Question zodiac-2)

4. In the diagram of the Earth and the zodiac in the previous question, which constellation will be located behind the Sun one day in the future?

(A) Cancer
(B) Aquarius
(C) Virgo
(D) **Leo**
(E) Pisces

In one day the Earth will not move much, so just draw a line from Earth to the Sun and behind it, to Leo.

`(Question zodiac-3)`

5. In the diagram of the Earth and the zodiac used in the last two questions, which constellation was located behind the Sun one month in the past?

   (A) Virgo
   (B) Pisces
   (C) **Cancer**
   (D) Leo
   (E) Aquarius

   One month ago, Earth will have moved one constellation "backwards": clockwise around the circle. From that location, draw a line through the Sun to see that the constellation behind the Sun will be Cancer.

`(Question star-rise-east-sidereal)`

6. You can see the star Procyon very low on the eastern horizon tonight in Syracuse at 3:00 AM.

   Tomorrow night at 2:56 AM, where will Procyon be located?

   (A) Slightly lower in the sky
   (B) Slightly higher in the sky
   (C) Slightly lower in the sky and slightly to the South
   (D) Slightly higher in the sky and slightly to the South
   (E) **At the exact same place**

   The time interval is four minutes less than 24 hours: one sidereal day. Thus Procyon will be in exactly the same spot.

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(Question star-rise-east-solar)
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7. You can see the star Procyon very low on the eastern horizon tonight in Syracuse at 3:00 AM.

   Tomorrow night at 3:00 AM, where will Procyon be located?

   (A) Slightly lower in the sky
   (B) **Slightly higher in the sky and slightly to the South**
   (C) Slightly higher in the sky
   (D) Slightly lower in the sky and slightly to the South
   (E) At the exact same place

   The time interval is one solar day: four minutes more than a sidereal day. So the star will move completely around Earth once, and then move four minutes more. Since it is rising in the East, and since stars move to high in the southern sky after rising in the East from here, we will see Procyon move upward and to the south.

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(Question tidal-lock)
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8. Suppose that the Earth's rotation on its axis were slowed down dramatically, so that it took the same time to rotate around its axis that it took to orbit the Sun. This would cause the same side of Earth to be always pointing toward the Sun.

   In this scenario, how long would *Earth's solar days* be?

   (A) 23 hours and 56 minutes
   (B) One month
   (C) 24 hours
   (D) **Earth would no longer experience solar days; the Sun would no longer rise in the East or set in the West.**
   (E) 365 days (where a day is a 24-hour period)

   If the same side of Earth was always pointed at the Sun, it would no longer experience solar days, since the Sun would never rise or set.

`(Question tidal-lock-2)`

9. Suppose that the Earth's rotation on its axis were slowed down dramatically, so that it took the same time to rotate around its axis that it took to orbit the Sun. This would cause the same side of Earth to be always pointing toward the Sun.

   In this scenario, how long would *Earth's sidereal days* be?

   (A) Earth would no longer experience sidereal days; the stars would remain in fixed positions in the sky.

   (B) One month

   (C) **Around 365 days (where a day is a 24-hour period)**

   (D) 23 hours and 56 minutes

   (E) 24 hours

   If Earth takes 365 24-hour days to rotate once, that will be the length of its sidereal day, since a sidereal day is just the amount of time required to rotate once.

`(Question tidal-lock-3)`

10. Suppose that the Earth's rotation on its axis were slowed down dramatically, so that it took the same time to rotate around its axis that it took to orbit the Sun. This would cause the same side of Earth to be always pointing toward the Sun.

    In this scenario, how long would *a cycle of the phases of the Moon* be? "Day" here refers to twenty-four hours.

    (A) **Around 29 days (the same as now)**

    (B) The Earth would no longer see different phases of the Moon.

    (C) Around 365 days

    (D) Around 24 hours

    The length of the lunar cycle would not change, since it's caused by the motion of the Moon around the Earth, and has nothing to do with our rotation.

`(Question tidal-lock-4)`

11. Suppose that the Earth's rotation on its axis were slowed down dramatically, so that it took the same time to rotate around its axis that it took to orbit the Sun. This would cause the same side of Earth to be always pointing toward the Sun.

    In this scenario, how long would elapse between the time that the Moon rises and the time that the Moon sets?

    Again, "day" refers to a twenty-four hour period.

    (A) The Moon would no longer rise and set
    (B) Around 24 hours
    (C) **Around 14 days**
    (D) Around 365 days
    (E) Around 29 days

    This one's tricky! If Earth rotated only very slowly, we would see the Moon rise and set as it moved around Earth in its orbit. Moonrise to moonset would then be half of a lunar orbit, or 14 days.

`(Question new-moon-illumination)`

12. How much of the Moon's entire surface is lit by the Sun during a new moon? *(Thanks to Hannah for the question!)*

    (A) More than half, but less than all
    (B) Less than half, but more than none
    (C) None of it
    (D) **Half of it**
    (E) All of it

    During a new moon, the Moon is still just a rock floating in space: half of it faces the Sun and is lit, and half faces away and is dark.

`(Question full-moon-constellation)`

13. You observe that the full moon is located in front of the constellation Capricornus.

    How long will it be before the Sun is located in front of the constellation Capricornus?

    (A) One sidereal day from now
    (B) As soon as the Sun rises
    (C) **Six months from now**
    (D) Six hours from now
    (E) Twelve hours from now

    During a full moon, the Moon is on the opposite side of Earth from the Sun. If the Moon is in front of Capricornus, then this means that Capricornus is also on the opposite side of Earth from the Sun. So, for Capricornus to be behind the Sun, Earth would have to move to the other side of the Sun. This takes half a year – six months.

`(Question southern-hemisphere-motion-change)`

14. We've talked about several of the differences between how the sky would look from the Southern Hemisphere compared to here. Which of the following is true about the sky in Christchurch, New Zealand, which is located at 43° S latitude?

    (Syracuse is located at 43° *N latitude)*

    (A) The North Celestial Pole is visible above the horizon
    (B) **The stars rise in the East and set in the West, just like they do in Syracuse**
    (C) The stars rotate counterclockwise around the visible celestial pole, just like they do in Syracuse
    (D) All of the stars that are visible in Syracuse will also be visible in Christchurch
    (E) More than one of the above is true

    The stars rise in the East always (unless you're at the poles, in which case they just go in circles.) But the others are false: the NCP is below the horizon (since you're in the southern hemisphere); there are different stars visible (since you're on the other side of Earth, you can't see Polaris and stars near it, for instance); and the stars rotate clockwise around the SCP.

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(Question star-motion-day)
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15. You are observing one November night in Syracuse and see the star Kochab low on the northern horizon, directly below Polaris, at midnight.

    Six hours later, you plan to observe Kochab again. Where will it be located?

    (A) Directly below Polaris, in the same position it was before
    (B) At the same elevation as Polaris, to the West
    (C) Directly above Polaris
    (D) **At the same elevation as Polaris, to the East**
    (E) You won't be able to see Kochab six hours from now

    In six hours, the celestial sphere will have rotated about halfway. If Kochab was below the NCP, it will have made a counterclockwise half-circle around it, placing it above the NCP.

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(Question star-motion-year)
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16. You are observing one November night in Syracuse and see the star Kochab low on the northern horizon, directly below Polaris, at midnight.

    Six months later, you plan to observe Kochab again exactly at midnight. Where will it be located?

    Hint: This problem is difficult and is extra credit. Think about how many days are in six months, and what kind of days you should be thinking about.

    (A) At the same elevation as Polaris, to the East
    (B) **Directly above Polaris**
    (C) You won't be able to see Kochab six months from now
    (D) Directly below Polaris, in the same position it was before
    (E) At the same elevation as Polaris, to the West

    This one's tricky! Remember that a solar day requires the Earth to rotate 361° *on its axis. So in six months (about 180 solar days), the Earth will have rotated 180 times, plus an extra 180 degrees – 180 sidereal days, plus 1/2 of a sidereal day extra. This gives you an extra half-turn of the celestial sphere, putting Kochab above Polaris.*

`(Question seasons-sun-zenith)`

17. Where and when could we see the Sun at the zenith?

    (A) In Syracuse (latitude 43° N), in late June

    (B) At the North Pole (latitude $90°N$), in late June

    (C) In Quito, Ecuador (very near the Equator), in late December

    (D) In Havana, Cuba (latitude 23° N), in late September

    (E) **In São Paulo, Brazil (latitude $23.5°$ S), in late December**

    The Sun passes through the zenith at noon on the summer solstice along the tropical lines. The latitude of the Tropic of Capricorn is about $23.5°$ *S. Thus, you can see the Sun there on the summer solstice, which in the Southern Hemisphere is late December.*

`(Question earth-phase)`

18. This photograph, of a crescent Earth rising above the Moon's horizon, was taken by *Apollo 17* astronauts from the surface of the Moon.

What was the phase of the Moon, as seen from Earth, when this photo was taken?

(A) **Gibbous**
(B) New
(C) Half
(D) Full
(E) Crescent

Phases of Earth (as seen from the Moon) are caused by the same principle as the phases of the Moon. For the Earth to be crescent, it would be located on the "Sun side" of the Moon. This would put the Moon on the "night side" of Earth, and give a gibbous moon. By drawing a diagram, you'll see that the phases of Earth (as seen from the lunar surface) are opposite those of the Moon (as seen from Earth).

`(Question south-celestial-pole-location)`

19. As seen from Syracuse (latitude 43° N), where is the South Celestial Pole?

    (A) **Below the southern horizon**
    (B) Straight downward, beneath our feet
    (C) We don't have a South Celestial Pole, only a North one
    (D) 43 degrees above the southern horizon
    (E) Right on the southern horizon

    The SCP is still there – beneath the southern horizon. The only reason we think of the stars rotating around the NCP is because it is above the horizon from Syracuse.

`(Question distance-to-proxima-centauri)`

20. The nearest star to us is the Sun; the second nearest star is Proxima Centauri.

    How much further away from us is Proxima Centauri than the Sun?

    (A) About 2,500 times
    (B) About 25 times
    (C) About 25 million times
    (D) **About 250,000 times**
    (E) The distance to Proxima Centauri varies quite a lot as the Earth and the stars move around; it is currently around 10,000 times further away

    This is one of those "scope and scale" things that you should know. A light-year is around 60,000 AU, and the nearest stars are around 4 light-years away. This gives us a distance of about 250,000 AU for Proxima Centauri.

`(Question latitude-visibility)`

21. Nashville, Tennessee and Naples, Italy have similar latitudes but very different longitudes. What will they see in their night sky tonight? *(Thanks to Paige for the question!)*

    (A) They will see the same stars, but the phase of the Moon might be very different, since the Moon is much closer.

    (B) Since the night sky is the same regardless of location on Earth, the constellations will be the same in both.

    (C) **Since latitude is what impacts the night sky, their night skies will look fairly similar.**

    (D) Since longitude is what impacts the night sky, their night skies will look completely different.

    (E) None of the above are correct.

    As the Earth rotates, places move along longitude lines. In seven hours or so, Nashville will have moved to where Naples is now. So their night skies will be the same.

`(Question seasons-principle-cause)`

22. What is one piece of evidence that demonstrates that changing distance from the Sun **cannot** be the main cause of our seasons?

    (A) It is summer in Argentina when it is winter in Syracuse

    (B) Places near the Equator do not really experience seasons

    (C) The days are longer in the summer and shorter in the winter

    (D) **All of the above demonstrate that changing distance from the Sun doesn't cause the seasons**

    (E) Actually, the changing distance from the Sun *is* what causes our seasons

    If the changing distance from the Sun caused our seasons, then everywhere on Earth would experience seasons at the same time (as would the Equator), and the days would all be the same length. So the answer is all of the above.

`(Question rotation-stop)`

23. Suppose the Earth no longer orbited the Sun, and instead just stayed in one spot. (It still rotates on its axis, and nothing changes about the tilt of that axis.)

    Which of the following would still happen?

    - I. The Sun would rise and set each day
    - II. Earth would experience seasons
    - III. The solar day and sidereal day would be different lengths

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

    (I) would still happen: the rising and setting of the Sun is caused by the rotation of Earth. (II) would not, since the seasons require Earth to move around the Sun to the other side. (III) would not happen either; the solar day is longer than the sidereal day because of the Earth's motion around the Sun. So the answer is (I only).

`(Question moon-phase)`

24. Why do different moon phases rise and set at different times of day?

    (A) **Because each moon phase corresponds to a different location in the Moon's orbit around the Earth relative to the direction to the Sun**
    (B) Because the rise and set times are the same from one sidereal day to another, but we tell time in solar days
    (C) Because the position of the Sun determines which part of the Moon is in Earth's shadow, and the position of the Sun determines the time of day
    (D) Because times of day are different in different places on Earth, and people in different places see different moon phases as the Moon travels around the Earth
    (E) None of the above are good explanations

    The moon phases are caused by the alignment of the Earth, Moon, and Sun. They have nothing to do with Earth's shadow (b), are the same from every place on Earth (c), and have nothing to do with the sidereal days (d).

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(Question lotr-white-face-yellow-face)
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25. In one scene in *The Lord of the Rings*, Frodo, Sam, and Sméagol are trying to sneak into Mordor. They are afraid of being seen, and so don't want to travel when either the Sun or the Moon is visible in the sky, since sunlight or moonlight would help someone see them.

    Suppose that the phase of the Moon is waxing gibbous, and that the moon phases in this world work the same way that ours do. What time of day is it safe for our hobbit heroes to travel?

    (A) Around midnight

    (B) For a few hours after sunset

    (C) All night, except for a few hours after sunset

    (D) All night, except for a few hours before sunrise

    (E) **For a few hours before sunrise**

    By drawing a diagram of the Moon's orbit around the Earth, similar to those in Lab 3, you'll see that a waxing gibbous moon is high in the sky before midnight, and sets after midnight (around 3AM). This means that it is safe for them to travel after it sets, but before the Sun rises.

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(Question polar-day-svalbard)
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26. It is noon in late June in Svalbard, Norway (latitude 78° N). About what time will the sun set?

    (A) **A few months from now**

    (B) Around 6:00 PM (18:00)

    (C) Around 3PM (15:00)

    (D) Around 11:00 PM (23:00)

    (E) The Sun isn't visible at noon in late June in Svalbard

    Late June is near the summer solstice in the northern hemisphere. Svalbard is above the Arctic Circle, so it experiences 24-hour days in the Arctic summer. Thus the Sun won't set for a few months, until the seasons change.

`(Question size-of-earth)`

27. The diameter of Earth is closest to:

    (A) 10 million km
    (B) 1,000 km
    (C) 1 million km
    (D) **10,000 km**
    (E) 100,000 km

    This is just something you should know. 1,000 km is too small (this is less than the distance to the other coast of the USA), and 100,000 km is too big.

`(Question size-of-moon-orbit)`

28. About how far is it from the Earth to the Moon?

    (A) About 1/20 of a light-year
    (B) **About 1/500 of an AU**
    (C) About 1/10 of an AU
    (D) About 1/30,000 of an AU
    (E) About 1 AU

    This is again something you should know. An AU is the average distace from the Earth to the Sun; the Moon is much closer than this. But 1/30,000 of an AU is too close; an AU is 150 million km, so 1/30,000 of this is 5,000 km – less than the size of Earth itself.

`(Question motion-causes-seasons)`

29. What feature of Earth's motion causes the seasons?

    (A) The Earth's orbit around the Sun and the changing distance from the Sun during its orbit
    (B) The Earth's rotation on its axis
    (C) The changing speed of Earth's rotation
    (D) The changing direction of the tilt of Earth's rotation axis
    (E) **The tilt of Earth's rotation axis, combined with its revolution around the Sun**

    The axis of the Earth's rotation changes only very slowly, over thousands of years. So answer (e) is out. Over one year, Earth's rotation axis stays basically the same, but it moves around the Sun, so sometimes we are tilted toward the Sun, and sometimes away from it. Thus the answer is (a).

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(Question motion-causes-rise-set)
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30. What feature of Earth's motion causes the stars to rise and set each day?

    (A) The rotation of the celestial sphere around Earth each day

    (B) The orbit of Earth around the Sun

    (C) **The rotation of Earth on its axis**

    (D) The rotation of Earth on its axis, combined with its orbit around the Sun

    (E) None of the above

    The daily motion of the sky is caused by the Earth's rotation on its axis; this is the fastest motion of the Earth, and the only one that relates to the stars; they are so distant that our small movement around the Sun doesn't change our perspective on them.

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(Question new-moon-cause)
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31. A "new moon" is the phase of the lunar cycle when we can't see the Moon at all. Which is true during a new moon?

    (A) **The sunlit half of the Moon is facing away from us**

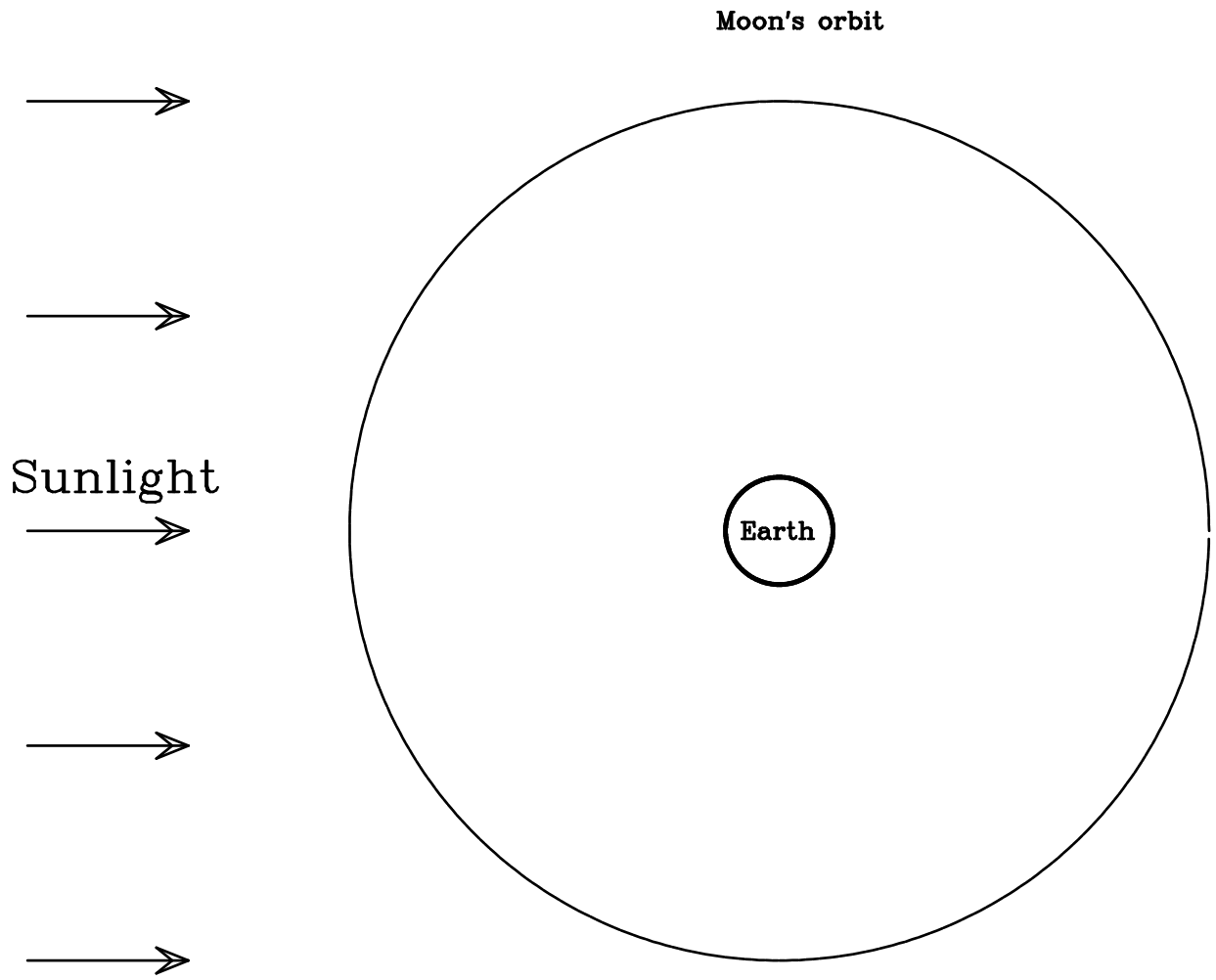
    (B) The Earth's shadow falls on top of the Moon

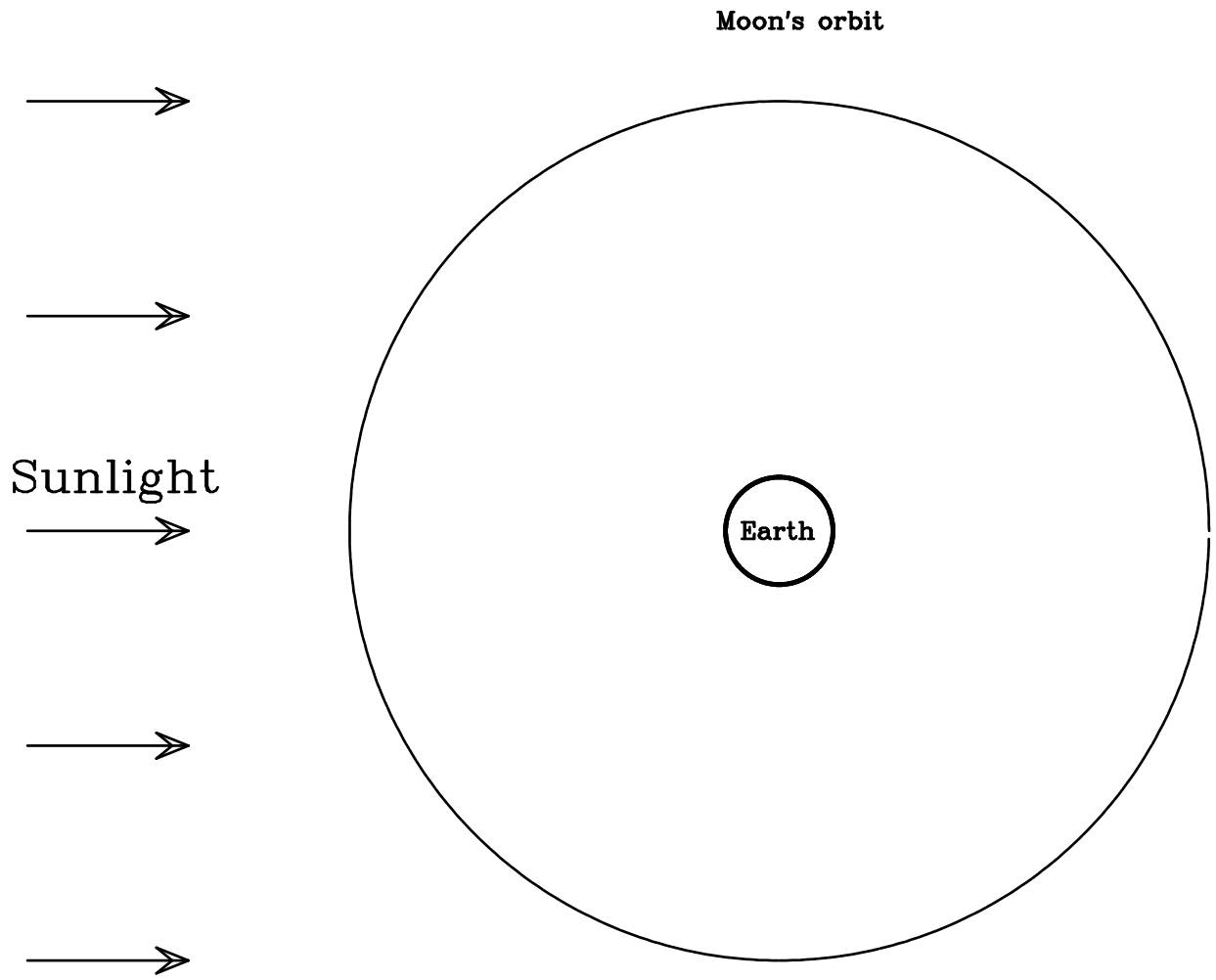
    (C) The Moon is below the horizon all day

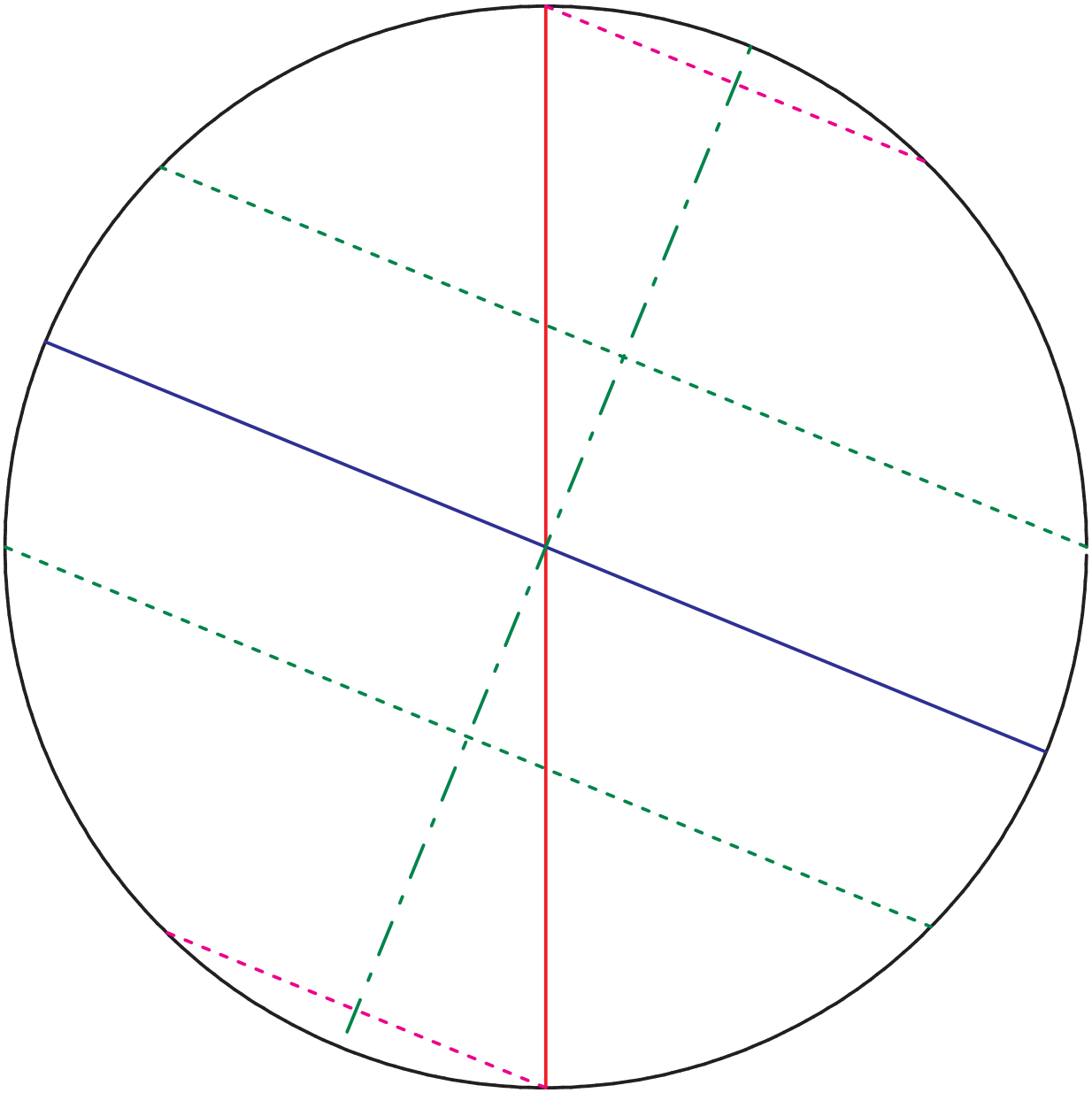
    (D) None of the Moon's surface is illuminated by the Sun

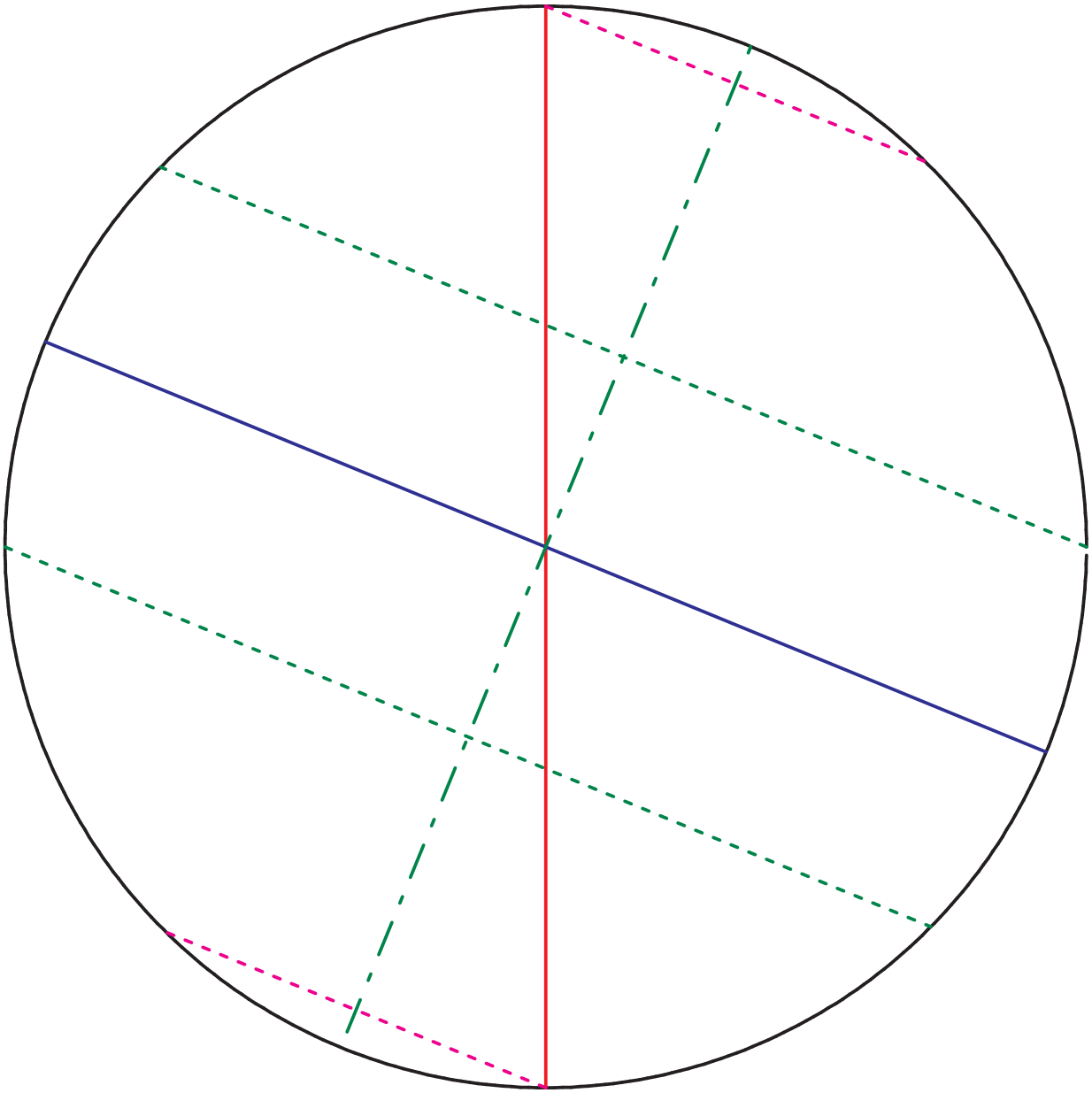
    (E) None of the above

    The phases of the Moon are caused by the fact that we see more or less of the sunlit half of the Moon as it orbits around Earth. During a new moon, the sunlit face of the Moon is facing away from us, so we can't see it.


Moon's orbit
Sunlight
Earth


Moon's orbit
Sunlight
Earth





Scratch Paper

Scratch Paper

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