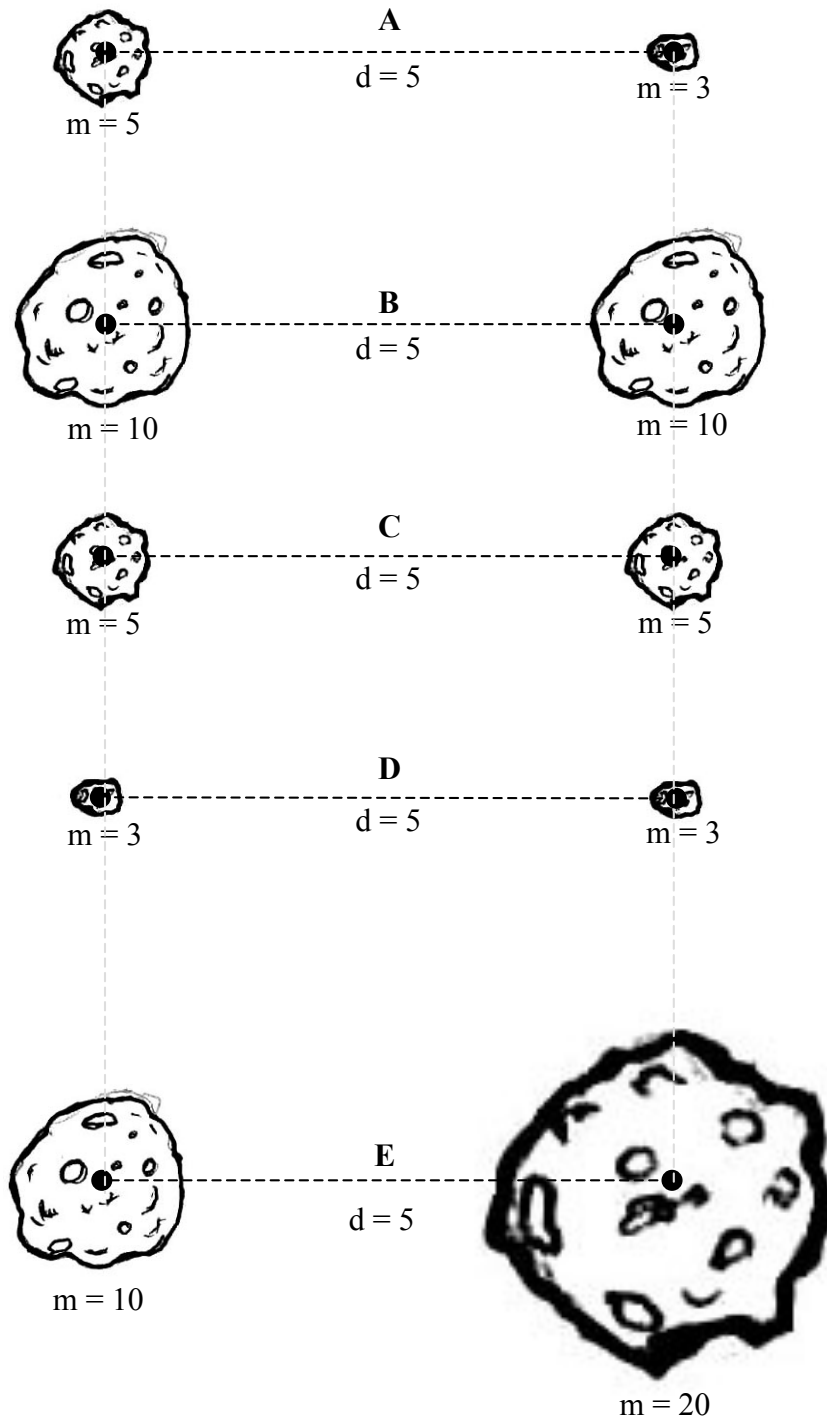


Astronomy Ranking Task: Gravity

Exercise #2

Description: The figures below (A – E) each show two rocky asteroids with masses (m), expressed in arbitrary units, separated by a distance (d), also expressed in arbitrary units.



A. Ranking Instructions: Rank (from greatest to least) the strength of the gravitational force exerted on the asteroid located on the left side of each pair.

Ranking Order: Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ Least

Or, the strength of the gravitational force exerted in each case is the same. _____
(indicate with a check mark)

Carefully explain your reasoning for ranking this way:

B. Ranking Instructions: Rank (from greatest to least) the strength of the gravitational force exerted on the asteroid located on the right side of each pair.

Ranking Order: Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ Least

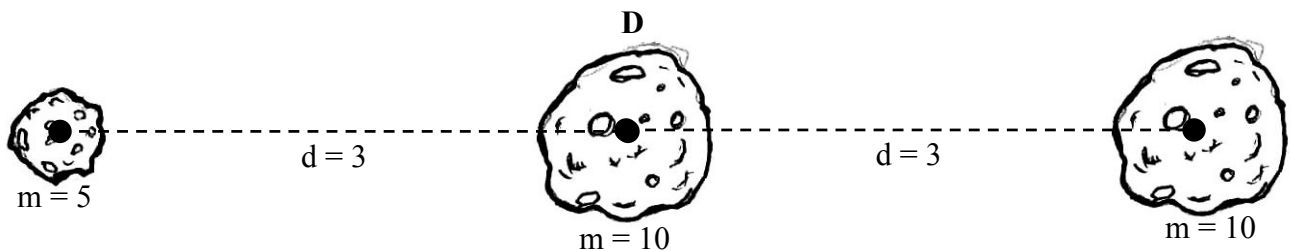
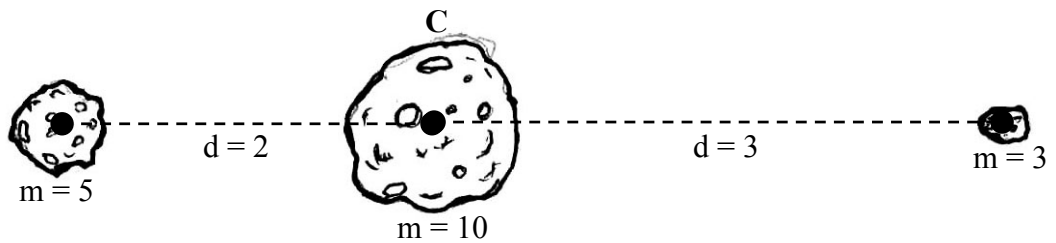
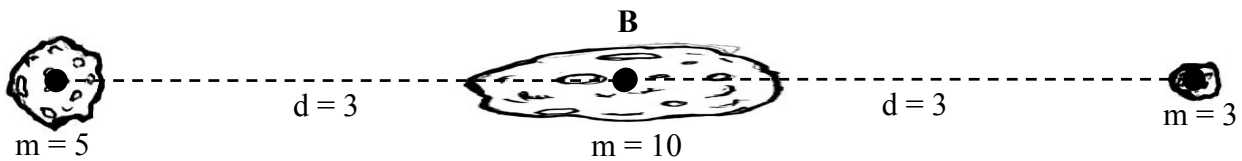
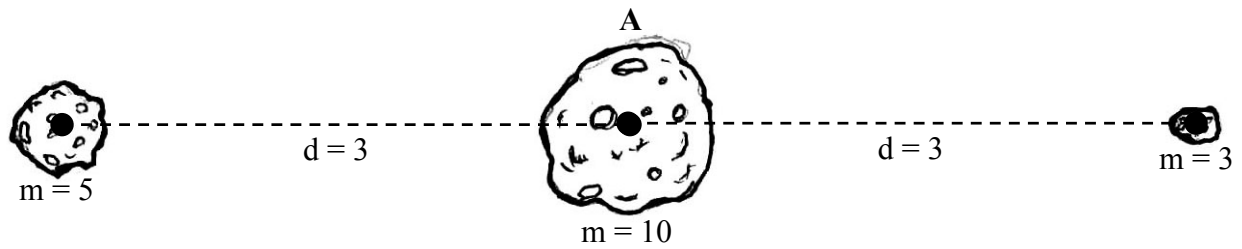
Or, the strength of the gravitational force exerted in each case is the same. _____
(indicate with a check mark)

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Gravity

Exercise #5

Description: The figures below (A – D) each show a large central asteroid along with two other asteroids located to the right and left of the central asteroid. The masses (m) of the asteroids are expressed in arbitrary units, and the distance (d) from the center asteroid is also expressed in arbitrary units.



Ranking Instructions: Rank (from greatest to least) the strength of the net (or total) gravitational force exerted on the center asteroid by its two neighboring asteroids.

Ranking Order: Greatest 1 _____ 2 _____ 3 _____ 4 _____ Least

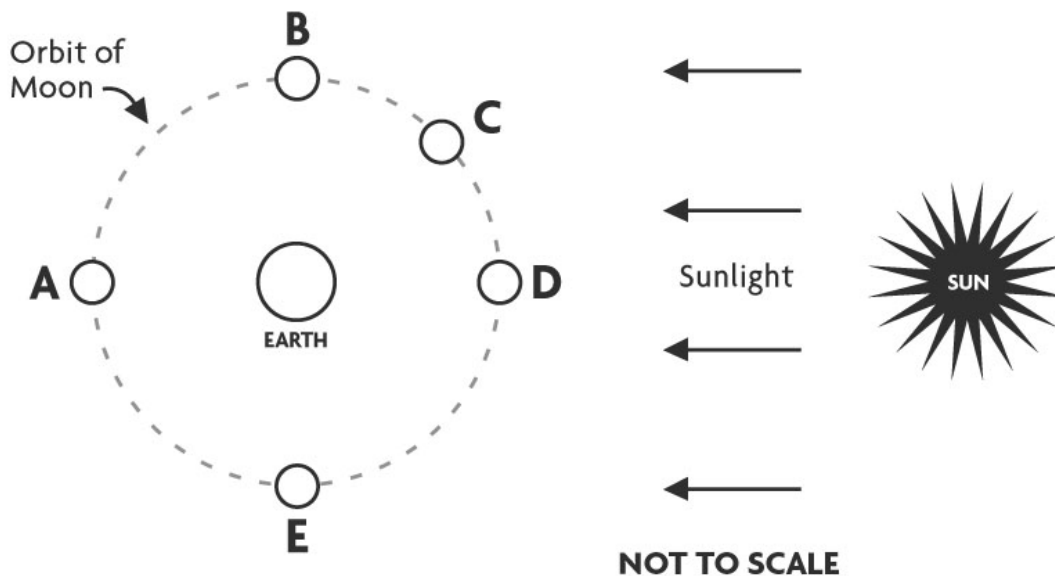
Or, gravitational forces are all the same strength. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Phases of the Moon

Exercise #1

Description: The figure below shows a “top view” of the Sun, Earth, and five different positions (A - E) of the Moon during one orbit of Earth. Note that the distances shown for the Sun to Earth and for Earth to the Moon are not drawn to scale.



Ranking Instructions: Rank (from greatest to least) the amount of the Moon’s entire surface that is illuminated by sunlight for the five positions (A-E) shown.

Ranking Order: Greatest 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ Least

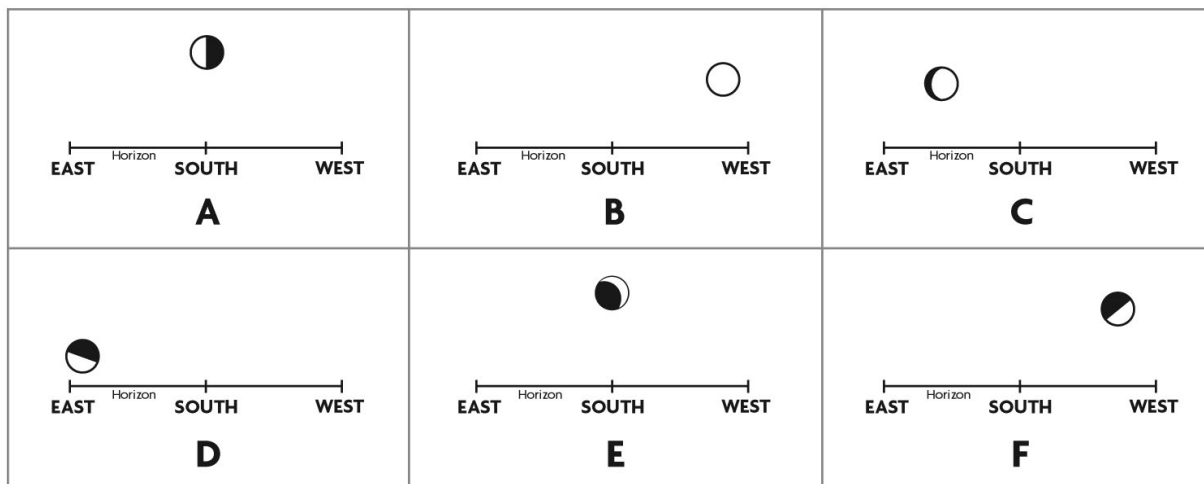
Or, the amount of the entire surface of the Moon illuminated by sunlight is the same at all the positions. ____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Phases of the Moon

Exercise #5

Description: In each figure below (A – F) the Moon is shown in a particular phase along with the position in the sky that the Moon would have at one time during the day (or night). The dark areas on each moon figure show the unlit portions of the Moon visible from Earth at that time. Assume that sunset occurs at 6 pm and that sunrise occurs at 6 am.



Ranking Instructions: Use the time each Moon phase (A – F) would appear as shown to rank the figures (from earliest to latest), starting from sunrise (6 am).

Ranking Order:

Earliest (about 6 am) 1 ____ 2 ____ 3 ____ 4 ____ 5 ____ 6 ____ Latest

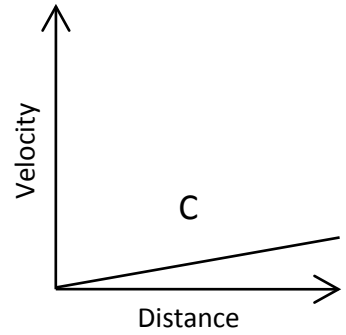
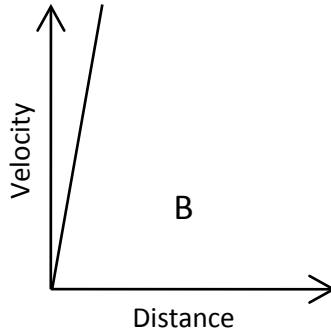
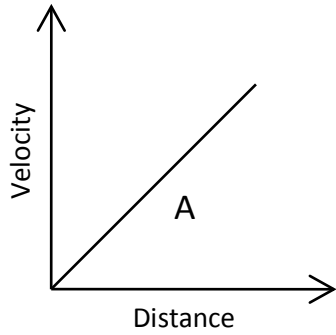
Or, the time of day or night are the same for all the phases shown. ____ (indicate with check mark).

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Hubble's Law

Exercise #2

Description: A series of Hubble plots is shown, each depicting a different possible universe. The axes on each are identical.



A. Ranking instructions: Rank the slopes of the lines on each Hubble plot.

Ranking Order: Steepest 1 _____ 2 _____ 3 _____ Shallowest

Or, the slopes of the lines on the Hubble plots are all the same. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

B. Ranking instructions: Rank the expansion rates the universes experience.

Ranking Order: Slowest 1 _____ 2 _____ 3 _____ Fastest

Or, all the universes experience the same expansion rate. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

C. Ranking instructions: Rank the sizes of the universes, assuming they all came into existence at the same time.

Ranking Order: Largest 1 _____ 2 _____ 3 _____ Smallest

Or, the universes are all the same size. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

D. Ranking instructions: Rank the ages of the universes, assuming they are all the same size.

Ranking Order: Oldest 1 _____ 2 _____ 3 _____ Youngest

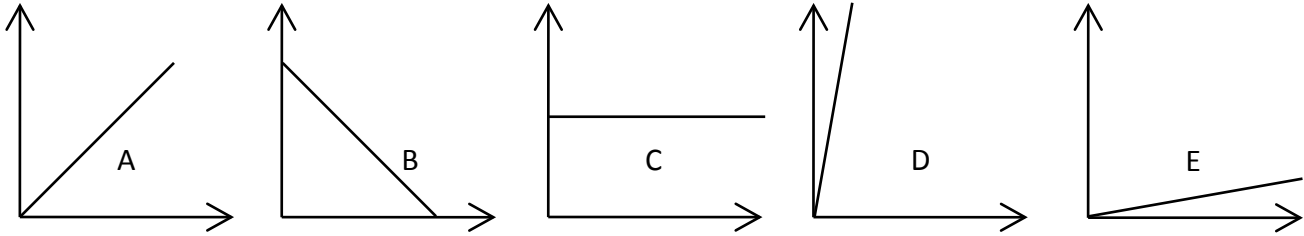
Or, the universes are all the same age. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Hubble's Law

Exercise #1

Description: A series of linear graphs is shown, each in arbitrary units with identical axes.



A. Ranking instructions: Rank the values of the slopes of the lines on each graph.

Ranking Order: Highest 1 _____ 2 _____ 3 _____ 4 _____ 5 _____ Lowest

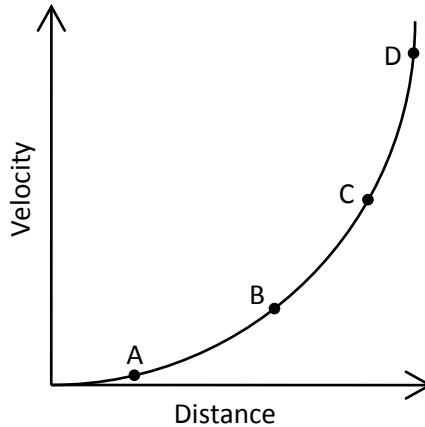
Or, the values of the slopes of the lines on the graphs are all the same. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

Astronomy Ranking Task: Hubble's Law

Exercise #3

Description: A Hubble plot is shown with dots marking four positions on the curve (A, B, C, & D).



A. Ranking instructions: Rank the speeds at each of the points.

Ranking Order: Slowest 1 _____ 2 _____ 3 _____ 4 _____ Fastest

Or, all points indicate the same speed. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

B. Ranking instructions: Rank the distances at each of the points.

Ranking Order: Closest 1 _____ 2 _____ 3 _____ 4 _____ Farthest

Or, all points indicate the same distance. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

C. Ranking instructions: Rank the slopes of the graph at each of the points.

Ranking Order: Shallowest 1 _____ 2 _____ 3 _____ 4 _____ Steepest

Or, the slope of the graph at each point is the same. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

D. Ranking instructions: Rank the expansion rates at each of the points.

Ranking Order: Slowest 1 _____ 2 _____ 3 _____ 4 _____ Fastest

Or, all points indicate the same expansion rate. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

E. Ranking instructions: Rank the times in the universe at each of the points.

Ranking Order: Earliest 1 _____ 2 _____ 3 _____ 4 _____ Latest

Or, all points indicate the same moment in time. _____ (indicate with a check mark)

Carefully explain your reasoning for ranking this way:

F. Does this Hubble plot accurately represent the behavior of our universe? Explain your reasoning.