

# Examination 1

## Practice version

Name: \_\_\_\_\_

Signature: \_\_\_\_\_

Student ID number: \_\_\_\_\_

Section: \_\_\_\_\_

### Instructions:

On the scannable answer sheet:

- Fill in your name (last name first!) and ID number (in col. A-J).
- Put your section number in columns K-M
- Identify the form in Special Codes column P.
- Answer all 40 questions using a number 2 pencil.

In addition:

- Do not open your exam until instructed to do so.
- Be sure to also answer each question in the blanks provided on this exam.
- The exam ends at 12:00.
- When done, raise your hand and a TA will collect your exam.
- No one may leave between 11:50 and 12:00.

And of course:

- You may not use any notes, texts, calculators or communications devices.
- All work must be your own.

Score: \_\_\_\_\_ out of 40 = \_\_\_\_\_ %.

Useful equations:

$$p^2 \propto a^3$$

$$F = ma$$

$$F = G m_1 m_2 / r^2$$

(Yes, that's it!)

Pick the best answer to each question.

\_\_\_\_\_ 1. Why are there seasons on Earth?

- a. Because the Earth's rotation axis is not perpendicular to the ecliptic.
- b. Because the Earth's rotation axis precesses with a one-year period.
- c. Because the Earth's orbit is elliptical, leading to small changes in the distance to the Sun.
- d. Because the orbits of Earth and other planets interact.
- e. So that football, baseball, and basketball don't happen at the same time.

\_\_\_\_\_ 2. In the heliocentric model of Copernicus, Venus never moves further than 47 degrees from the Sun because ...

- a. its orbit is interior to the Earth's.
- b. it's a superior planet.
- c. its deferent must move around the Earth at the same angular rate as the Sun's.
- d. its rotation axis has a smaller inclination to its orbit than the Earth's.
- e. its rotation axis does not precess like the Earth's.

\_\_\_\_\_ 3. If the Sun is on the Autumnal Equinox, what month is it?

- a. March.
- b. May.
- c. June.
- d. September.
- e. December.

\_\_\_\_\_ 4. Which of the following was NOT observed by Galileo?

- a. Mountains, valleys and craters on the Moon.
- b. Four moons orbiting Jupiter.
- c. The phases of Venus.
- d. Stellar parallax.
- e. Galileo observed all of the above.

\_\_\_\_\_ 5. Captain Kirk halts the U.S.S. Enterprise at a distance of 15 AU from a black hole. He then orders the Enterprise to close the distance to only 1.5 AU. How much stronger is the force of gravity from the black hole?

- a. Ten times stronger.
- b. Twenty times stronger.
- c. One hundred times stronger.
- d. 225 times stronger.
- e. The force goes to zero at the event horizon.

\_\_\_\_\_ 6. Why was the Ptolemaic model of the Solar System discarded in favor of the Copernican model?

- a. It made less accurate predictions.
- b. Calculations with it were more complex.
- c. New observations contradicted it.
- d. To abandon epicycles and deferents.
- e. All of the above.

\_\_\_\_\_ 7. The length of time from one full moon to the next is ...

- a. 34.2 days.
- b. a sidereal month.
- c. a synodic month.
- d. exactly one twelfth of a year.
- e. exactly four weeks.

\_\_\_\_\_ 8. If you push a couch across the floor, it stops as soon as you stop pushing. Aristotle would say that you always need a force to keep something in motion, while Newton would say that the couch would continue moving in a straight line forever, except that the force of friction slows it down. An appeal to Occam's Razor might suggest Aristotle is right, since his explanation requires fewer forces. Then why is Newton's explanation accepted?

- a. We know that Aristotle's model of the Solar System is wrong, so it is likely that his other ideas are wrong as well.
- b. Science always progresses. Newton lived centuries after Aristotle so he must know better.
- c. Newton's laws of motion only apply in ideal situations not involving friction.
- d. Complex ideas are usually the correct ones.
- e. Experiments have disproven Aristotle's physics.

\_\_\_\_\_ 9. For the first time, the Copernican model explained why ...

- a. planets were brighter when in retrograde.
- b. planets were in opposition when in retrograde.
- c. why planets sped up and slowed down in their orbits.
- d. All of the above.
- e. None of the above.

\_\_\_\_\_ 10. Kepler's discovery that the planets had elliptical orbits improved the Copernican model by ...

- a. moving the Earth from the center of the Solar System.
- b. eliminating epicycles, deferents, and eccentrics.
- c. treating Venus and Mercury as superior planets.
- d. explaining retrograde loops without using relative motion.
- e. None of the above.

\_\_\_\_\_ 11. Certain constellations are only visible to us in Ithaca at certain times of the year because

- a. Sometimes they are above the horizon in the daytime.
- b. They lie on the ecliptic.
- c. They are circumpolar.
- d. Sometimes they drop below the southern horizon.
- e. They are in the southern hemisphere.

\_\_\_\_\_ 12. If you launch a satellite from the Earth's surface to an orbit 6400 km high, how much has the force of Earth's gravity changed? (The radius of the Earth is 6400 km).

- a. It is now twice as strong.
- b. It is now half as strong.
- c. It is now four times stronger.
- d. It is one quarter the strength.
- e. None of the above.

\_\_\_\_\_ 13. A person in Boulder, Colorado observes the planet Jupiter on the eastern horizon right after sunset. Six hours later Jupiter will be ...

- a. low in the south.
- b. high in the south.
- c. directly overhead.
- d. low in the west.
- e. not visible.

\_\_\_\_\_ 14. The introduction of classical knowledge to Europe led to ...

- a. a fusion of the geocentric model with Roman Catholic dogma.
- b. the establishment of universities.
- c. new rationalism and skepticism.
- d. ultimately, the Renaissance.
- e. All of the above.

\_\_\_\_\_ 15. What's different about an astronaut standing on the surface of the Moon and the surface of the Earth?

- a. Her mass.
- b. Her weight.
- c. Her height.
- d. Her volume.
- e. None of the above change.

\_\_\_\_\_ 16. What observations of Tycho were essential to Kepler's First and Second Laws of Planetary Motion?

- a. The positions of Mars.
- b. The parallax to comets.
- c. New stars in the sky.
- d. The parallax to the Moon.
- e. None of the above.

\_\_\_\_\_ 17. The best estimate of the age of the Universe from cosmology is ...

- a. 6,000 years.
- b. 65 million years.
- c. 1.2 billion years.
- d. 13.7 billion years.
- e. 48 billion years.

\_\_\_\_\_ 18. Both of your instructors disagree with the textbook's claim that ...

- a. astrology and astronomy have common roots.
- b. Aristotle's worldview was dogma by the time Kepler was born.
- c. Galileo's troubles with the Vatican stemmed from his arrogance.
- d. Tycho's observations of Mars were the key to Kepler's success.
- e. watching the fall of an apple inspired Newton.

\_\_\_\_\_ 19. Which of the following observations by Tycho and Galileo showed that the heavens are not perfect and unchanging?

- a. The mountains, valleys, and craters of the Moon.
- b. The supernova of 1572.
- c. The parallax to a comet.
- d. Sunspots.
- e. All of the above.

\_\_\_\_\_ 20. Kepler stated that the planets orbit the Sun on ellipses. Where is the Sun?

- a. At the center.
- b. At one focus.
- c. At both foci.
- d. On the ellipse with the planet, but always at perihelion.
- e. None of the above.

\_\_\_\_\_ 21. According to Newton's Second Law of Motion, if Object 1 exerts a force on Object 2, then Object 2 ...

- a. resists that force until it is dissipated.
- b. converts that force to friction.
- c. exerts a frictional force on Object 1.
- d. accelerates in the direction of the force.
- e. exerts an equal and opposite force on Object 1.

\_\_\_\_\_ 22. Havana, Cuba has a latitude of 23 degrees North. Sirius has a declination of 16 degrees South of the celestial equator. From Havana, Sirius ...

- a. is circumpolar.
- b. rises and sets each day (or night).
- c. never rises.
- d. Sirius is the Dog star, which means there is not enough information to answer the question.
- e. None of the above.

\_\_\_\_\_ 23. The Copernican model of the Solar System ...

- a. retained the Ptolemaic devices of epicycles, deferents, and eccentrics.
- b. made it possible to determine the semi-major axes of all of the planetary orbits.
- c. was criticized in both Protestant and Catholic Europe.
- d. All of the above.
- e. None of the above.

\_\_\_\_\_ 24. As one travels north from the equator, what happens to the North Star?

- a. It grows dimmer.
- b. It grows brighter.
- c. It moves higher in the sky.
- d. It moves lower in the sky.
- e. None of the above.

\_\_\_\_\_ 25. How do scientific theories become laws?

- a. By a vote of the National Academy of Sciences.
- b. By decisions made by the United Nations Council of Scientific Edicts.
- c. They are tested and proven to be true.
- d. By an appeal to the authority of respected scientists.
- e. They don't.

\_\_\_\_\_ 26. Kepler's Second Law of Planetary Motion states that the line joining the Sun to a planet sweeps out equal areas in equal times. What does this law imply for the orbital speed of a planet?

- a. The planet moves at constant speed.
- b. The planet moves fastest at aphelion (maximum distance from the Sun).
- c. The planet moves fastest at perihelion (minimum distance from the Sun).
- d. The planet moves fastest between perihelion and aphelion.
- e. We cannot draw a conclusion about the orbital speed of a planet based on Kepler's Second Law of Planetary Motion.

\_\_\_\_\_ 27. Which of the following quantities is constant throughout a year on Earth?

- a. The distance from the Earth to the Sun.
- b. The angular speed at which the Earth revolves the Sun.
- c. The hours of daylight at the Earth's equator.
- d. The distance from the Earth to the Moon.
- e. None of the above.

\_\_\_\_\_ 28. What questions did astronomy answer in ancient civilizations?

- a. When should crops be planted?
- b. When will rivers flood?
- c. When should religious festivals be held?
- d. When do the seasons change?
- e. All of the above.

\_\_\_\_\_ 29. How do we know the Earth is round?

- a. Because new constellations become visible as one travels north or south.
- b. Because local noon does not occur simultaneously everywhere.
- c. Because the shadow of the Earth during lunar eclipses is always circular.
- d. Because the hull of a ship sailing away disappears before its sails do.
- e. All of the above.

\_\_\_\_\_ 30. Why did Aristotle reject the idea that the Earth revolved around the Sun?

- a. Stellar parallax could not be detected at the time.
- b. The Earth is composed of the heaviest element, which would sink to the center of the Universe.
- c. The Earth was imperfect and unpure and thus could not be moving in the heavens with other bodies.
- d. All of the above.
- e. None of the above.

\_\_\_\_\_ 31. What is an Astronomical Unit (AU)?

- a. The average distance between the Earth and the Sun.
- b. The distance that light travels in one year.
- c. The distance between the Sun and the nearest star (Proxima Centauri).
- d. The amount of time that it takes for the Sun to move around the celestial sphere.
- e. The average orbital speed of the Earth.

\_\_\_\_\_ 32. How did the Ptolemaic model improve on the model using homocentric spheres to explain the motions in the heavens?

- a. It explained the phases of the moon for the first time.
- b. It explained why planets were brightest while in retrograde.
- c. It explained why Venus and Mercury stayed close to the Sun.
- d. It explained why planets were at opposition when in retrograde.
- e. All of the above.

\_\_\_\_\_ 33. During a solar eclipse, the phase of the Moon is ...

- a. new.
- b. first quarter.
- c. full.
- d. third quarter.
- e. waning gibbous.

\_\_\_\_\_ 34. Suppose that a scientist has discovered a new kind of radiation, called N-rays, in his laboratory, but others using the same laboratory set-up failed to corroborate the discovery. The first scientist then explains that the others failed because they did not believe hard enough. Is that explanation scientifically valid?

- a. No, because N-rays really don't exist.
- b. No, because it is untestable.
- c. Yes, provided other scientists agree.
- d. Yes, provided the public agrees.
- e. This course has nothing to do with N-rays, so the whole question is invalid.

\_\_\_\_\_ 35. Aristotle believed that ...

- a. the Earth was spherical.
- b. the heavens moved in perfect uniform circles and were pure and eternal.
- c. all strife, change, and corruption on Earth were due to the motions of the heavens.
- d. All of the above.
- e. None of the above.

\_\_\_\_\_ 36. The Ptolemaic model did NOT use which of the following?

- a. Epicycles.
- b. Ellipses.
- c. Deferents.
- d. Equants.
- e. Eccentrics.

\_\_\_\_\_ 37. It's July in Antarctica. The Sun ...

- a. is below the horizon all day.
- b. is above the horizon all day.
- c. rises in the east and sets in the west.
- d. rises in the west and sets in the east.
- e. None of the above.

\_\_\_\_\_ 38. What was the significance of Jean Buridan, Nicole Oresme, George Purbach, and Johannes Mueller (Regiomontanus)?

- a. They helped fuse the physics and cosmology of Aristotle with Scripture.
- b. Their travels to the East helped introduce the classics to Europe.
- c. They were great observers and inventors of astronomical instruments.
- d. They showed that Aristotle made errors and drew incorrect conclusions.
- e. They improved mathematics by inventing algebra and improving trigonometry.

\_\_\_\_\_ 39. When Copernicus first created his model of the Solar System, it did not lead to substantially better predictions of planetary positions than the Ptolemaic model. Why not?

- a. Copernicus used perfect circles for the orbits of the planets.
- b. Copernicus placed the Sun at the center, but did not realize that the Moon orbits the Earth.
- c. Copernicus misjudged the distances between the planets.
- d. Copernicus placed the planets in the wrong order going outward from the Sun.
- e. All of the above.

\_\_\_\_\_ 40. Lunar eclipses do not happen every month because ...

- a. the Moon's orbit is not circular.
- b. the Moon's orbit is tilted with respect to the ecliptic.
- c. the synodic and sidereal months have different lengths.
- d. the Moon and Sun have roughly the same angular diameter.
- e. werewolves would be really confused.