1 The atmospheric pressure at the surface of Venus is
   a. about the same as at the surface of the Earth.
   b. close to zero.
   c. about 1% of the pressure at the surface of the Earth.
   d. many times the pressure at the surface of the Earth.

2 Newton’s explanation of Kepler’s Laws relied upon a force that
   a. acts only on inorganic matter.
   b. acts on planets but not on comets.
   c. acts only on planets.
   d. acts on all objects.
   e. acts only on heavenly bodies.

3 The first human landing on the Moon was Apollo 11 in
   a. 1969.
   b. 1982.
   c. 1966.
   d. 1972.
   e. 1976.

4 The largest four moons of Jupiter are referred to as the
   a. Heracletian satellites.
   b. Ganymedian satellites.
   c. Shakespearian satellites.
   d. Trojan satellites.
   e. Galilean satellites.

5 According to Newton’s Law of Gravity, the gravitational attraction of the Earth for other objects, such as the
   Moon, apples on trees and space shuttles in low earth orbit,
   a. is smaller for objects farther from the Earth but never vanishes entirely.
   b. is larger for objects farther from the Earth.
   c. extends only as far as the Earth’s atmosphere and vanishes for objects like an orbiting space shuttle.
   d. is the same no matter where those objects are.

6 Which of the following planets or moons is blue in color because of the presence of methane in its atmosphere?
   a. Saturn
   b. Venus
   c. Uranus
   d. Titan
   e. Earth

7 It is currently thought that moons typically do not form near
   a. Any planets of binary star systems.
   b. Jovian planets such as Jupiter and Saturn.
   c. Any planets of isolated stars.
   d. Terrestrial planets such as Earth and Mars.
8 The current model for the way that planets acquire magnetic fields requires which of the following combinations of things?
   a. rotation and a core that contains liquid iron.
   b. only an iron core.
   c. only a core that contains a liquid electrical conductor.
   d. rotation and a core that contains a liquid electrical conductor.
   e. rotation and an iron core.

9 Changes in the intensity of sunlight due to shifts in both the Earth’s orbit and rotation axis
   a. are too small to explain Earth’s long-term climate shifts.
   b. explain Earth’s long-term climate shifts such as ice ages.
   c. do not actually happen since the intensity of sunlight is constant.
   d. do not seem to explain Earth’s long-term climate shifts.

10 Which of the following space probes made the first maps of the surface of Venus?
   a. Magellan
   b. Mariner 10
   c. Pioneer 11
   d. Pioneer Venus Orbiter
   e. MESSENGER

11 The Law of Inertia says that if an object is not acted on by any outside force, its acceleration
   a. will always be zero.
   b. can have any value at all.
   c. will be zero if the object is at rest and not zero if the object is moving.
   d. will always be a constant.

12 Satellites such as the International Space Station orbit above most of the Earth’s atmosphere because
   a. gravity does not extend beyond the atmosphere, so there is no gravity to pull the satellite down.
   b. then the top of the atmosphere can support the satellite.
   c. there is no air friction to slow the satellite down.
   d. it avoids creating sonic booms that would annoy people.

13 Pioneer 10 was an early space probe sent to fly past
   a. Earth’s Moon.
   b. Jupiter.
   c. Venus.
   d. Mercury.
   e. Mars.

14 A rocket that leaves the Earth’s atmosphere at a speed of 8 miles per second will
   a. go into a circular orbit above the surface of the Earth.
   b. escape from the Earth’s gravity forever.
   c. follow an elliptical path that is partly below the surface of the Earth.
15 The moon Miranda is peculiar because it
   a. orbits the wrong way.
   b. is black on one side and white on the other.
   c. square dances with another moon.
   d. has a surface feature that looks like a giant check mark.
   e. has a dense atmosphere.

16 The number of moons of Uranus that are larger than Earth’s Moon is
   a. 3.
   b. 0.
   c. 1.
   d. 2.
   e. 4.

17 Galileo was the original discoverer of
   a. The Planet Uranus.
   b. Kepler’s First Law of Planetary Motion
   c. Galileo’s First Law of Motion.
   d. The reflecting telescope.
   e. Newton’s First Law of Motion.

18 Saturn is about
   a. half as far from the Sun as Jupiter.
   b. twice as far from the Sun as Jupiter
   c. five times as far from the Sun as Jupiter.
   d. 50% farther from the Sun than Jupiter.
   e. the same distance from the Sun as Jupiter

19 The magnetic field of Mars is
   a. present globally at about 1% of the intensity of the Earth’s magnetic field.
   b. present only locally, near magnetized ore deposits.
   c. about 10 times the intensity of the Earth’s magnetic field.
   d. exactly zero everywhere on Mars.
   e. about 100 times the intensity of the Earth’s magnetic field.

20 The Earth’s magnetic field plays an essential role in
   a. keeping the Moon in orbit.
   b. maintaining the Earth’s rotation.
   c. the manufacture of refrigerator magnets.
   d. protecting the Earth from charged particles from the Sun.
   e. protecting the Earth from ultraviolet light from the Sun.
21 Which of the following objects has a magnetic field with about ten times the intensity of the Earth’s field?
   a. Saturn  
   b. Earth’s Moon  
   c. Jupiter  
   d. Mars  
   e. Mercury  

22 The Moon’s orbit around the Earth
   a. is elliptical enough to give us an annular lunar eclipse when the Moon is near its apogee.  
   b. is elliptical enough to give us an annular solar eclipse when the Moon is near its apogee.  
   c. is exactly circular.  
   d. is somewhat elliptical but not enough to affect eclipses.  

23 The density of water is 1000kg/m$^3$, the density of rock is about 3000kg/m$^3$, and the density of iron is 7800kg/m$^3$. Which of the following densities is closest to the average density of Jupiter?
   a. 5200kg/m$^3$  
   b. 10,000kg/m$^3$  
   c. 3900kg/m$^3$  
   d. 700kg/m$^3$  
   e. 1200kg/m$^3$  

24 Voyager 2 is the only space probe so far to have visited
   a. Neptune  
   b. Venus  
   c. Saturn  
   d. Jupiter  
   e. Mercury  

25 Which of the following objects has a magnetic field whose origin is not explained by any currently accepted model?
   a. Uranus  
   b. Jupiter  
   c. Venus  
   d. Saturn  
   e. Mercury  

26 Freely falling objects with different masses fall with the same acceleration because
   a. they have the same amount of inertia.  
   b. gravity exerts more force on the more massive object.  
   c. gravity acts with less force on the more massive object.  
   d. there is no air resistance.  
   e. gravity acts with the same force on both objects.  

27 The range of temperatures on Mars is
   a. Much colder than anywhere on Earth.  
   b. Similar to those in Rochester New York.  
   c. Similar to those in Antarctica.  
   d. much hotter than anywhere on Earth.
28 Which of the following temperatures is closest to what you might expect on the planet Jupiter?
   a. -250F.
   b. -350F.
   c. 50F.
   d. 100F.
   e. -150F.

29 The rotation axis of Uranus is
   a. almost in the plane of its orbit so that its ring system can sometimes be seen as near-circles.
   b. nearly perpendicular to the plane of its orbit, so it has no seasons.
   c. inclined at an angle to the perpendicular that is similar to Earth’s rotation axis.

30 Viking 1 and 2 were sent to explore
   a. Earth’s Moon.
   b. the planet Mars.
   c. the planet Venus.
   d. the planet Neptune.
   e. the planet Jupiter.

31 Which of the following types of object could reasonably be described as “dirty snowballs” or, for the larger ones, “flying icebergs?”
   a. Meteors.
   b. Stars.
   c. Comets.
   d. Terrestrial Planets.
   e. Asteroids.

32 Suppose that you drop two objects from the same height at the same time. Both objects are heavy enough to be unaffected by air resistance. If one object is twice as heavy as the other, Aristotle predicted that
   a. the heavier object would hit the ground long before the lighter one.
   b. the lighter object would hit the ground long before the heavier one.
   c. both objects would hit the ground at the same time.

33 You are standing in an elevator that is accelerating upward at 1m/s^2. Which of the following pairs of forces is an action-reaction pair that has to be exactly equal and opposite to each other?
   a. The force that the floor of the elevator exerts on you and the force that you exert on the floor of the elevator.
   b. None of these pairs because acceleration requires an unbalanced force.
   c. The force of gravity on you and the force that you exert on the floor of the elevator.
   d. The force of gravity on you and the force that the floor of the elevator exerts on you.

34 According to our current model of how magnetic fields arise, the magnetic field of Earth’s Moon is
   a. understandable since the Moon rotates slowly but probably has a large iron core.
   b. understandable since the Moon rotates slowly and probably has no iron core.
   c. difficult to understand since the Moon rotates rapidly.
   d. difficult to understand since the Moon rotates slowly and probably has no iron core.
35 The angle between the rotation axis of a planet and the perpendicular to the plane of its orbit is called its “axial tilt.” Which of these planets has an axial tilt that is less than one degree?
   a. Mars.
   b. Saturn.
   c. Mercury.
   d. Earth.
   e. Uranus.

36 An astronomical unit is defined to be
   a. the distance to a star that shows one arc-second of parallax shift.
   b. the average distance from the Earth to the Moon.
   c. the average distance from the Earth to the Sun.
   d. the average amount of time it takes the Earth to complete one orbit around the Sun.
   e. the distance that light travels in a year.

37 Most Kuiper Belt objects can best be described as
   a. small stars or possibly large moons.
   b. flying lakes or possibly flying oceans.
   c. flying rocks or possibly flying mountains.
   d. dirty snowballs or possibly flying icebergs.

38 The Earth’s Moon
   a. is 1/25 the size of the Earth, which is a normal size for a moon.
   b. is 1/500 the size of the Earth, which is unusually small for a moon.
   c. is 1/4 the size of the Earth, which is unusually large for a moon.
   d. is 1/4 the size of the Earth, which is a normal size for a moon.
   e. is 1/25 the size of the Earth, which is small for a moon.

39 Which of the following planets can be said to have almost no atmosphere?
   a. Earth
   b. Venus
   c. Mars
   d. Mercury

40 When Newton’s Laws were applied to predict the exact motion of the planet Uranus, the prediction failed to agree with very precise measurements. This failure led to the discovery
   a. an invisible moon of Uranus.
   b. that Newton’s Theory of Gravity is not correct.
   c. of the Planet Pluto.
   d. that the Sun wobbles.
   e. of the Planet Neptune.

41 Which of the following planets is 11 times the size of the Earth?
   a. Neptune
   b. Venus
   c. Uranus
   d. Mars
   e. Jupiter
42 Which of these planets has a rotation axis that is inclined in much the same way as that of Earth?
   a. Mercury
   b. Saturn
   c. Uranus
   d. Jupiter

43 At present (within the last few hundred years), the distance from the Earth to the Sun
   a. changes enough to make the intensity of sunlight vary by 6 percent.
   b. changes enough to make the intensity of sunlight vary by 40 percent.
   c. changes a little, but not enough to affect the intensity of sunlight.
   d. never changes.

44 The moons of Mars are
   a. large enough to be spherical.
   b. not large enough to be spherical.
   c. each about the size of Earth’s Moon.

45 Galileo said that a moving object with nothing pushing or pulling on it will always
   a. speed up.
   b. keep moving at the same speed.
   c. slow down and stop.
   d. follow a circular path.

46 The statement that lunar material is much ”dryer” than Earth material refers to the absence of
   a. ice.
   b. hydrated minerals.
   c. mud.
   d. liquid water.

47 An ion rocket engine produces 5 Newtons of thrust. What acceleration can it give to a space probe with a mass of 10,000kg?
   a. 0.05 m/s².
   b. 10,000 m/s².
   c. 50000 m/s².
   d. 5 m/s².
   e. 0.0005 m/s².

48 Mars
   a. has a solar day that last for two complete orbits around the Sun.
   b. rotates backwards so that the Sun rises in the West.
   c. has a solar day that is very close to an Earth day in length.
   d. always keeps the same side toward the Sun so that solar time never changes.
   e. has a solar day that last for three complete orbits around the Sun.
49 Which of these planets is the farthest from the Sun?
   a. Venus
   b. Mercury
   c. Mars
   d. Earth

50 So far (as of 2008), the planet Venus has been visited by
   a. about 48 successful space probes.
   b. two or three successful space probes.
   c. about 20 successful space probes.
   d. no successful space probes.
   e. just one successful space probe.
Answer Key: Spring 2017 HX2A

1 Choice d. (many times the pressure at the surface of the Earth.)
2 Choice d. (acts on all objects.)
3 Choice a. (1969.)
4 Choice e. (Galilean satellites.)
5 Choice a. (is smaller for objects farther from the Earth but never vanishes entirely.)
6 Choice c. (Uranus)
7 Choice d. (Terrestrial planets such as Earth and Mars.)
8 Choice d. (rotation and a core that contains a liquid electrical conductor.)
9 Choice d. (do not seem to explain Earth’s long-term climate shifts.)
10 Choice d. (Pioneer Venus Orbiter)
11 Choice a. (will always be zero.)
12 Choice c. (there is no air friction to slow the satellite down.)
13 Choice b. (Jupiter.)
14 Choice b. (escape from the Earth’s gravity forever.)
15 Choice d. (has a surface feature that looks like a giant check mark.)
16 Choice b. (0.)
17 Choice e. (Newton's First Law of Motion.)
18 Choice b. (twice as far from the Sun as Jupiter)
19 Choice b. (present only locally, near magnetized ore deposits.)
20 Choice d. (protecting the Earth from charged particles from the Sun.)
21 Choice c. (Jupiter)
22 Choice b. (is elliptical enough to give us an annular solar eclipse when the Moon is near its apogee.)
23 Choice e. (1200kg/m$^3$)
24 Choice a. (Neptune)
25 Choice a. (Uranus)
26 Choice b. (gravity exerts more force on the more massive object.)
27 Choice c. (Similar to those in Antarctica.)
28 Choice a. (-250F.)
29 Choice a. (almost in the plane of its orbit so that its ring system can sometimes be seen as near-circles.)
30 Choice b. (the planet Mars.)
31 Choice c. (Comets.)
32 Choice a. (the heavier object would hit the ground long before the lighter one.)
33 Choice a. (The force that the floor of the elevator exerts on you and the force that you exert on the floor of the elevator.)
34 Choice b. (understandable since the Moon rotates slowly and probably has no iron core.)
35 Choice c. (Mercury.)
36 Choice c. (the average distance from the Earth to the Sun.)
37 Choice d. (dirty snowballs or possibly flying icebergs.)
38 Choice c. (is 1/4 the size of the Earth, which is unusually large for a moon.)
39 Choice d. (Mercury)
40 Choice e. (of the Planet Neptune.)
41 Choice e. (Jupiter)
42 Choice b. (Saturn)
43 Choice a. (changes enough to make the intensity of sunlight vary by 6 percent.)
44 Choice b. (not large enough to be spherical.)
45 Choice b. (keep moving at the same speed.)
46 Choice b. (hydrated minerals.)
47 Choice e. (0.0005 m/s².)
48 Choice c. (has a solar day that is very close to an Earth day in length.)
49 Choice c. (Mars)
50 Choice c. (about 20 successful space probes.)
Where to find these questions in the notes

1. Module 011.201-g01 The Terrestrial Planets Venus Surface
2. Module 009.402 Science Models of Gravity Unifying Physical Law
3. Module 011.423 The Terrestrial Planets Moon Space Probes
4. Module 012.117-g01 The Jovian Planets Jupiter Moons
5. EModule 009.302 Science Models of Gravity Universal Gravitation (F2013:71%,70%,83%,78%,87%)
6. Module 012.302-g01 The Jovian Planets Uranus Surface
7. Module 010.203-g01 Solar System Overview The Terrestrial Planets
8. Module 011.109 The Terrestrial Planets Mercury Magnetic Field
9. ***Module 011.305-g01 The Terrestrial Planets Earth Orbit and Rotation (18%)
10. ****Module 011.213-g01 The Terrestrial Planets Venus Space Probes (13%)
11. Module 008.303 Science Models of Motion Acceleration
12. Module 009.606-g01 Science Models of Gravity Artificial Satellites
13. Module 012.124 The Jovian Planets Jupiter Space Probes
14. Module 009.604-g02 Science Models of Gravity Artificial Satellites
15. Module 012.315 The Jovian Planets Uranus Moons
16. *Module 012.315-g01 The Jovian Planets Uranus Moons (40%)
17. Module 008.501-g01 Science Models of Motion Force and Mass
18. Module 012.203-g01 The Jovian Planets Saturn Surface
19. ***Module 011.511-g01 The Terrestrial Planets Mars Magnetic Field(22%)
20. Module 011.307 The Terrestrial Planets Earth Magnetic Field
21. Module 012.112 The Jovian Planets Jupiter Magnetic Field
22. Module 011.411 The Terrestrial Planets Moon Orbit and Rotation
23. Module 010.302-g01 Solar System Overview The Jovian Planets
24. Module 012.412 The Jovian Planets Neptune Space Probes
25. Module 012.314 The Jovian Planets Uranus Magnetic Field
26. *Module 009.405 Science Models of Gravity Unifying Physical Law (40%)
27. Module 011.503 The Terrestrial Planets Mars Surface
28. Module 012.104 The Jovian Planets Jupiter Surface
29. Module 012.309 The Jovian Planets Uranus Orbit and Rotation
30. Module 011.520 The Terrestrial Planets Mars Space Probes
31. Module 010.502-g01 Solar System Overview Comets
32. Module 008.402 Science Models of Motion The Universality of Free Fall
33. Module 008.601-g01 Science Models of Motion Action and Reaction
34. ***Module 011.412-g01 The Terrestrial Planets Moon Magnetic Field(24%)
35. *Module 011.104-g01 The Terrestrial Planets Mercury Surface (38%)
36. Module 010.102-g01 Solar System Overview The Big Picture
37 Module 010.602 Solar System Overview The Kuiper Belt
38 Module 011.309 The Terrestrial Planets Earth Moon
39 Module 011.102 The Terrestrial Planets Mercury Surface
40 Module 009.504-g01 Science Models of Gravity Making New Predictions
41 Module 012.108 The Jovian Planets Jupiter Surface
42 Module 012.210 The Jovian Planets Saturn Orbit and Rotation
43 Module 011.304 The Terrestrial Planets Earth Orbit and Rotation
44 Module 011.513-g01 The Terrestrial Planets Mars Moons
45 Module 008.201 Science Models of Motion The Law of Inertia
46 Module 011.416 The Terrestrial Planets Moon Oddities of the Moon Formation of the Moon
47 EModule 008.517-g01 Science Models of Motion Force and Mass a = F/m
48 Module 011.507 The Terrestrial Planets Mars Orbit and Rotation
49 Module 010.105 Solar System Overview The Big Picture
50 Module 011.214 The Terrestrial Planets Venus Space Probes (42%)