**Newton Einstein and Gravity**

**Multiple Choice**

*Identify the letter of the choice that best completes the statement or answers the question.*

\_\_\_\_ 1. Perigee is

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| --- | --- |
| a. | the point in the moon's orbit when the moon is farthest from Earth. |
| b. | the point in a planet's orbit when the planet is farthest from the sun. |
| c. | the point in an object's orbit around Earth, when the object is closest to Earth. |
| d. | the point in a planet's orbit when the planet is closest to the sun. |
| e. | the time it takes a celestial object to complete one orbit around the object it is orbiting. |

\_\_\_\_ 2. According to Aristotle, which of the following would be an example of violent motion?

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| --- | --- |
| a. | an apple falling from a tree |
| b. | a person pushing a car along the street |
| c. | an arrow moving through the air after it left the bow |
| d. | warm air rising above hot pavement |
| e. | a barrel rolling down a ramp |

\_\_\_\_ 3. A comet near the sun whose orbit is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ would never be near the sun again.

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| --- | --- |
| a. | elliptical |
| b. | circular |
| c. | hyperbolic |
| d. | apogee |
| e. | following an inverse square law |

\_\_\_\_ 4. Newtonian physics tells us that Kepler's second law

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| --- | --- |
| a. | is a result of the conservation of angular momentum. |
| b. | is a result of the conservation of energy. |
| c. | is a result of the conservation of mass. |
| d. | is a consequence of the inverse square law. |
| e. | is incorrect and needs to be modified. |

\_\_\_\_ 5. When we say that gravitation is universal we mean that

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| a. | it is important in all aspects of science. |
| b. | it could be deduced from the appearance of the universe. |
| c. | for every force there is an equal and opposite force. |
| d. | the force of gravity from one object extends to infinity. |
| e. | it is a property of all matter. |

\_\_\_\_ 6. Newton concluded that some force had to act on the moon because

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| --- | --- |
| a. | a force is needed to keep the moon in motion. |
| b. | a force is needed to pull the moon outward. |
| c. | a force is needed to pull the moon away from straight-line motion. |
| d. | the moon moved at a constant velocity. |
| e. | all of the above |

\_\_\_\_ 7. Galileo found that

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| a. | falling objects fall at a constant speed. |
| b. | heavy and light objects fall at the same rate. |
| c. | heavy objects fall faster than lighter objects. |
| d. | the moon's orbit is elliptical. |
| e. | only objects made of earth and water fell to the ground. |

\_\_\_\_ 8. When two objects of unequal mass orbit each other, the center of mass is

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| --- | --- |
| a. | at the center of the more massive object. |
| b. | at the center of the least massive object. |
| c. | half way between the centers of each object. |
| d. | always closer to the less massive of the two objects. |
| e. | always closer to the more massive of the two objects. |

\_\_\_\_ 9. The circular velocity of satellite orbiting Earth is given by ****. In this equation,

|  |  |
| --- | --- |
| a. | M represents the mass of the satellite and r is its radius. |
| b. | M represents the mass of Earth, and r the radius of Earth. |
| c. | M represents the mass of the satellite and r the distance from Earth to the satellite. |
| d. | M represents the mass of Earth and r the distance from Earth to the satellite. |
| e. | M represents the mass of the satellite and r the distance from Earth's surface to the satellite. |

\_\_\_\_ 10. The equivalence principle can be illustrated by

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| a. | a person riding in an elevator. |
| b. | a space capsule coasting through space at constant velocity. |
| c. | the change in mass of a moving body. |
| d. | the formation of energy by nuclear fusion. |
| e. | the increase in the speed of light from a star as the light moves past the sun during a solar eclipse. |

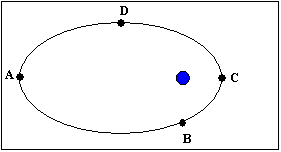
\_\_\_\_ 11. According to the theory of general relativity, gravity is caused by

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| --- | --- |
| a. | the equivalence principle. |
| b. | the change in mass of a moving body. |
| c. | the curvature of space-time. |
| d. | the constant speed of light. |
| e. | none of the above |

\_\_\_\_ 12. One of the first tests of the general theory of relativity was

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| --- | --- |
| a. | the description of the orbit of the moon. |
| b. | the determination of the speed of light to be constant. |
| c. | the change in mass of a particle moving at a high speed. |
| d. | the demonstration of a hammer and a feather falling at the same rate on the moon. |
| e. | the determination of the rate of advance of the perihelion of Mercury's orbit. |

\_\_\_\_ 13. The diagram below illustrates the orbit of a satellite around Earth. Which letter indicates the location of perigee?



|  |  |
| --- | --- |
| a. | A |
| b. | B |
| c. | C |
| d. | D |
| e. | Perigee is the time to complete an orbit. |

\_\_\_\_ 14. Due to the curvature of space-time by the sun, light from stars that passes near the edge of the sun will

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| a. | be bent so that the stars appear further from the edge of the sun than if space-time was not curved. |
| b. | be bent so that the stars appear closer to the edge of the sun than if space-time was not curved. |
| c. | be bent so that the stars are no longer visible. |
| d. | not be affected by the curvature of space-time. |
| e. | be focused so that the stars appear brighter than if space-time was not curved. |

\_\_\_\_ 15. The second postulate of special relativity states that

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| --- | --- |
| a. | observers cannot detect their uniform motion except relative to other objects. |
| b. | observers cannot distinguish locally between inertial forces due to acceleration and uniform gravitational forces due to the presence of a massive body. |
| c. | the laws of physics are the same for all observers, no matter what their motion, as long as they are not accelerating. |
| d. | the speed of light is constant and will be the same for all observers independent of their motion relative to the light source. |
| e. | the acceleration of an object is proportional to the applied force and inversely proportional to its mass. |

\_\_\_\_ 16. A(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ orbit is one where the orbiting object is always above the same location on Earth's surface.

|  |  |
| --- | --- |
| a. | elliptical |
| b. | geosynchronous |
| c. | closed |
| d. | hyperbolic |
| e. | parabolic |

\_\_\_\_ 17. The apogee of a(n) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ orbit does not exist.

|  |  |
| --- | --- |
| a. | elliptical |
| b. | closed |
| c. | parabolic |
| d. | geosynchronous |
| e. | All orbits have both a perigee and an apogee. |

\_\_\_\_ 18. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an object is a measure of the amount of matter it contains. On the other hand \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a measure of the gravitational force on an object.

|  |  |
| --- | --- |
| a. | weight; mass |
| b. | mass; weight |
| c. | energy; force |
| d. | force; energy |
| e. | momentum; energy |

\_\_\_\_ 19. The brightness of a light obeys the inverse square law. This statement implies that

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| --- | --- |
| a. | a light source will appear two times brighter at 2 meters than it does at 6 meters. |
| b. | a light source will appear three times brighter at 2 meters than it does at 6 meters. |
| c. | a light source will appear six times fainter at 2 meters than it does at 6 meters. |
| d. | a light source will appear nine times brighter at 2 meters than it does at 6 meters. |
| e. | the brightness of the light source will not change with distance from the light source |

\_\_\_\_ 20. Which of the following is not an example of conservation of angular momentum?

|  |  |
| --- | --- |
| a. | A diver slowing his somersault by moving from a tuck, or curled, position to a layout, or open, position. |
| b. | A skater speeding up a spin by pulling her arms and legs closer to her body. |
| c. | An artificial satellite moving faster at perigee than at apogee. |
| d. | A basketball that spins slower and slower as it spins on your finger. |
| e. | A man spinning on a stool and extending weights outward from his body and then pulling them in again. |

\_\_\_\_ 21. How much energy is released if 2 kg of matter is converted into pure energy?

|  |  |
| --- | --- |
| a. | 2 joules |
| b. | 6108 joules |
| c. | 1.2109 joules |
| d. | 91016 joules |
| e. | 1.81017 joules |

\_\_\_\_ 22. The radius of Earth is 6378 km. The force of gravity on a 1 kg ball at Earth's surface is 9.8 kg m s-2. What is the force of gravity on this same ball when the ball is located 12,756 km from Earth's center?

|  |  |
| --- | --- |
| a. | 2.45 kg m s-2 |
| b. | 39.2 kg m s-2 |
| c. | 4.9 kg m s-2 |
| d. | 19.6 kg m s-2 |
| e. | 9.8 kg m s-2 |

\_\_\_\_ 23. If the orbital velocity of the moon is 1.0 km/s, what is the orbital velocity of satellite that is 1/16th as far from Earth as the moon?

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| --- | --- |
| a. | 1/16 km/s |
| b. | 16 km/s |
| c. | 8 km/s |
| d. | 1/8 km/s |
| e. | 4 km/s |

\_\_\_\_ 24. What is the escape velocity from the moon for a lunar landing module sitting on the moon's surface? The mass of the moon is 7.21022 kg, its radius is 1738 km.

|  |  |
| --- | --- |
| a. | 2.3 m/s |
| b. | 23 m/s |
| c. | 2.3 km/s |
| d. | 23 km/s |
| e. | 11 km/s |

\_\_\_\_ 25. What is the circular velocity of an object orbiting Earth at a distance of 100,000 km from Earth's center?

|  |  |
| --- | --- |
| a. | 2 m/s |
| b. | 20 m/s |
| c. | 200 m/s |
| d. | 2000 m/s |
| e. | 20,000 m/s |

**True/False**

*Indicate whether the sentence or statement is true or false.*

\_\_\_\_ 26. Galileo developed three theories of motion that became laws of motion when Newton proved Galileo's theories correct.

\_\_\_\_ 27. The force due to gravity has the mathematical form: 

\_\_\_\_ 28. Aristotle believed that objects falling to the ground fell at a constant speed.

\_\_\_\_ 29. The apparent positions of stars around the sun during an eclipse have been used to prove the general theory of relativity.

\_\_\_\_ 30. The escape velocity at a given distance from a planet is less than the circular velocity of an orbit around that planet at the same distance.

\_\_\_\_ 31. The law of gravitation is termed universal because it is a property of all material objects.

\_\_\_\_ 32. Galileo believed that motion stopped in the absence of a force.

\_\_\_\_ 33. A scientific model can never be exactly correct.

\_\_\_\_ 34. Aristotle believed that motion continued in the absence of a force.

\_\_\_\_ 35. Changing the direction of a moving body does not change its velocity.

**Answer Section**

**MULTIPLE CHOICE**

1. ANS: C

2. ANS: B

3. ANS: C

4. ANS: A

5. ANS: E

6. ANS: C

7. ANS: B

8. ANS: E

9. ANS: D

10. ANS: A

11. ANS: C

12. ANS: E

13. ANS: C

14. ANS: A

15. ANS: D

16. ANS: B

17. ANS: C

18. ANS: B

19. ANS: D

20. ANS: D

21. ANS: E

***Note to the Instructor***: This question requires calculations. You may want to provide students with the value of G = 6.6710-11 N m2 kg-2.

22. ANS: A

***Note to the Instructor***: This question requires calculations. You may want to provide students with the value of G = 6.6710-11 N m2 kg-2.

23. ANS: E

***Note to the Instructor***: This question requires calculations. You may want to provide students with the value of G = 6.6710-11 N m2 kg-2.

24. ANS: C

***Note to the Instructor***: This question requires calculations. You may want to provide students with the value of G = 6.6710-11 N m2 kg-2.

25. ANS: D

***Note to the Instructor***: This question requires calculations. You may want to provide students with the value of G = 6.6710-11 N m2 kg-2.

**TRUE/FALSE**

26. ANS: F

27. ANS: T

28. ANS: T

29. ANS: T

30. ANS: F

31. ANS: T

32. ANS: F

33. ANS: T

34. ANS: T

35. ANS: F