Unit 11 (Circular Motion & Gravitation) Practice Exam

Identify the letter of the choice that best completes the statement or answers the question. In the space next to the question, indicate how much confidence you have in your answer (C = Confident; S = So-so; G = Guessed).

1. One radian equals
   a. 60°     b. 58°   c. 57.3°   d. 56°

2. A child sits on a carousel at a distance of 3.5 m from the center and rotates through an arc length of 6.5 m. What is the angular displacement of the child?
   a. 1.9 rad  b. 0.93 rad  c. 3.0 rad  d. 5.0 rad

3. When an object is moving in uniform circular motion, the object’s velocity and acceleration are
   a. both zero.
   b. are both perpendicular to the plane of motion.
   c. are tangent and radially inward, respectively.
   d. are both radially inward.

4. What term describes a change in the speed of an object in circular motion?
   a. tangential speed
   b. tangential acceleration
   c. centripetal acceleration
   d. centripetal force

5. The centripetal force on an object in circular motion is
   a. perpendicular to the plane of the object’s motion.
   b. in the plane of the object’s motion and perpendicular to the tangential speed.
   c. in the plane of the object’s motion and in the same direction as the tangential speed.
   d. in the plane of the object’s motion and in the direction opposite the tangential speed.

6. A child rides a bicycle in a circular path with a radius of 2.0 m. The tangential speed of the bicycle is 2.0 m/s. The combined mass of the bicycle and the child is 43 kg. What kind of force provides the centripetal force on the bicycle?
   a. gravitational force
   b. friction
   c. air resistance
   d. normal force

7. A child rides a bicycle in a circular path with a radius of 2.0 m. The tangential speed of the bicycle is 2.0 m/s. The combined mass of the bicycle and the child is 43 kg. What is the centripetal acceleration of the pair?
   a. 2 m/s²  b. 4 m/s²  c. 86 m/s²  d. 172 m/s²

8. A child rides a bicycle in a circular path with a radius of 2.0 m. The tangential speed of the bicycle is 2.0 m/s. The combined mass of the bicycle and the child is 43 kg. What is the centripetal force on the pair?
   a. 2 N  b. 4 N  c. 86 N  d. 172 N

9. A ball is whirled on a string, then the string breaks. What causes the ball to move off in a straight line?
   a. centripetal acceleration
   b. centripetal force
   c. centrifugal force
   d. inertia

10. The mass that determines an object’s attraction to another object is determined by its:
    a. gravitational mass.
    b. inertial mass.
    c. gravitational field strength.
    d. weight.
11. An object’s tendency to resist acceleration is measured by the object’s
   a. gravitational mass.
   b. inertial mass.
   c. gravitational field strength.
   d. weight.

12. One fighter jet makes the same radius turn as another, but at twice the speed. Compared to the slower jet, the centripetal acceleration of the faster jet is:
   a. half as much
   b. twice as much
   c. the same amount
   d. four times as much.

13. One fighter jet makes the same radius turn as another, but at twice the speed. Compared to the slower jet, the centripetal force on the faster jet is:
   a. half as much
   b. twice as much
   c. the same amount
   d. four times as much.

14. One fighter jet makes a turn. Later, the same jet makes a turn with half the radius at the same speed. Compared to the first turn, the jet’s centripetal acceleration around the 2nd turn is:
   a. half as much
   b. twice as much
   c. the same amount
   d. four times as much.

15. When simulating gravity by rotating a space station, the effect of gravity is caused by:
   a. an outward pulling centrifugal force.
   b. the wall of the space station pushing inward on the astronauts.
   c. the force of attraction between 2 masses.
   d. It is impossible to simulate gravity through rotation.

16. The degree to which an object attracts other objects is measured by the object’s
   a. gravitational mass.
   b. inertial mass.
   c. gravitational field strength.
   d. weight.

17. Squeezing due to differences in the gravitational force of the moon at different points on Earth cause:
   a. tsunamis.
   b. tides.
   c. earthquakes.
   d. satellite motion.

18. How did Newton show that gravity as a force is universal?
   a. He showed that all objects on Earth accelerate downward at the same rate regardless of mass.
   b. He showed that the moon “falls” 1/20 of an inch each second, but does not get closer to the Earth.
   c. He showed that the orbits of planets are elliptical.
   d. He showed that g is constant and that g on the moon is 1/6 the value of g on the Earth.

19. In this text, which of the following symbols represents the constant of universal gravitation?
   a. $F_g$
   b. $G$
   c. $g$
   d. $F_c$
20. Newton’s law of universal gravitation
   a. is equivalent to Kepler’s first law of planetary motion.
   b. can be used to derive Kepler’s third law of planetary motion.
   c. can be used to disprove Kepler’s laws of planetary motion.
   d. does not apply to Kepler’s laws of planetary motion.

21. Which of the following equations expresses Newton’s law of universal gravitation?
   a. \( F_g = \frac{mv^2}{r} \)
   b. \( F_g = \frac{m_1 m_2}{r^2} \)
   c. \( g = G \frac{M}{r^2} \)
   d. \( F_g = G \frac{m_1 m_2}{r^2} \)

22. The gravitational force between two masses is 36 N. What is the gravitational force if the distance between them is tripled?
   a. 4 N  
   b. 9 N  
   c. 18 N  
   d. 27 N

23. The gravitational force between two masses is 36 N. What is the gravitational force if both masses are cut in half?
   a. 4 N  
   b. 9 N  
   c. 18 N  
   d. 27 N

24. The gravitational force between two masses is 36 N. What is the gravitational force if one mass is doubled and the distance between the masses is doubled?
   a. 4 N  
   b. 9 N  
   c. 18 N  
   d. 27 N

25. The equation for the speed of an object in circular orbit is \( v_t = \sqrt{\frac{G m}{r}} \). What does \( m \) represent in this equation?
   a. the mass of the sun  
   b. the mass of Earth  
   c. the mass of the central object  
   d. the mass of the orbiting object

26. How would the speed of Earth’s orbit around the sun change if Earth’s distance from the sun increased by 4 times?
   a. It would increase by a factor of 2.  
   b. It would increase by a factor of 4.  
   c. It would decrease by a factor of 2.  
   d. The speed would not change.

27. How would the speed of Earth’s orbit around the sun change if sun’s mass increased by 4 times?
   a. It would increase by a factor of 2.  
   b. It would increase by a factor of 4.  
   c. It would decrease by a factor of 2.  
   d. The speed would not change.

28. When an astronaut in orbit experiences apparent weightlessness,
   a. no forces act on the astronaut.  
   b. no gravitational forces act on the astronaut.  
   c. the net gravitational force on the astronaut is zero.  
   d. the net gravitational force on the astronaut is not balanced by a normal force.

29. Which of the following is not one of Kepler’s laws of planetary motion,
   a. Planets orbit the sun in elliptical paths.  
   b. Planets orbits will sweep out equal areas in equal times  
   c. The square of the orbital period is proportional to the semi-major axis cubed.  
   d. All of the above are true.
30. In the figure above, according to Kepler’s laws of planetary motion,
   a. the orbit is elliptical.
   b. \((v_1 \text{ during } \Delta t_1) > (v_2 \text{ during } \Delta t_2)\).
   c. if \(\Delta t_1 = \Delta t_2\), then \(A_1 = A_2\).
   d. All of the above.