Date ____________ Period ____________ Name ____________________

CHAPTER 7

Pre-AP/Critical Thinking

Gravitation

1. According to Kepler's second law of planetary motion,

a. planets maintain constant speed around the Sun.

b. planets maintain constant acceleration around the Sun.

c. the speed of a planet is greatest when it is closest to the Sun.

d. the area swept out by the orbit per time unit keeps changing.

2. A space probe is directly between two moons of a planet. If it is twice as far from moon A as it is from moon B, but the net force on the probe is zero, what can be said about the relative masses of the moons?

a. Moon A is twice as massive as moon B.

b. Moon A has the same mass as moon B.

c. Moon A is four times as massive as moon B.

d. Moon A is half as massive as moon B.

3. The Moon is receding from Earth by approximately 3.8 cm per year. Earth's mass is 5.98×10^{24} kg, and its radius is 6.38×10^{6} m. The Moon's mass is 7.3×10^{22} kg, its radius is 1.79×10^{6} m, and its orbital period around Earth is 27.3 days. The current average distance between the two surfaces is 3.85×10^{8} m. Assume that neither body gains or loses mass and that the recession continues at a rate of 3.8 cm per year.

a. Approximately how much will the gravitational attraction between the Moon and Earth change between now and 499 million years from now?

b. Approximately how long, in present Earth-days, will it take the Moon to orbit Earth 499 million years from now?

4. The mean distance of the planet Neptune from the Sun is 30.05 times the mean distance of Earth from the Sun.

a. Determine how many Earth-years it takes Neptune to orbit the Sun.

b. The mass of the Sun is 1.99×10^{30} kg, and the closest distance of Neptune from the Sun is 4.44×10^{9} km. What is the orbital speed of Neptune in km/s at this point?

c. Without doing any numerical calculations, answer the following. Is the orbital speed of Earth less than, equal to, or greater than the orbital speed of Neptune? Explain your reasoning.

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d. The radius of Neptune is 3.883 times that of Earth, and the mass of Neptune is 17.147 times that of Earth. From the surface of which planet (Earth or Neptune) would it be easier to launch a satellite? Explain your reasoning.

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CHAPTER 9

Pre-AP/Critical Thinking

Momentum and Its Conservation

1. A freight car with a mass of 10 metric tons is rolling at 108 km/h along a level track when it collides with another freight car, which is initially at rest. If the speed of the cars after they couple together is 36 km/h, what is the mass of the second car?

a. 40 metric tons

b. 20 metric tons

c. 10 metric tons

d. 5 metric tons

2. A rod of length r and mass m is pivoted at its center, and given an angular velocity, ω_1. What would be the angular velocity of a second rod, which has the same angular momentum as the first, but whose length is $3r$ and whose mass is $2m$?

a. $\frac{\omega_1}{5}$

b. $\frac{\omega_1}{6}$

c. $\frac{\omega_1}{12}$

d. $\frac{\omega_1}{18}$

3. A 5.0-g bullet with an initial velocity of 95.0 m/s lodges in a block of wood and comes to rest at a distance of 6.0 cm. Assume the bullet undergoes a constant negative acceleration; it slows at a constant rate.

a. How much time does it take for the bullet to stop?

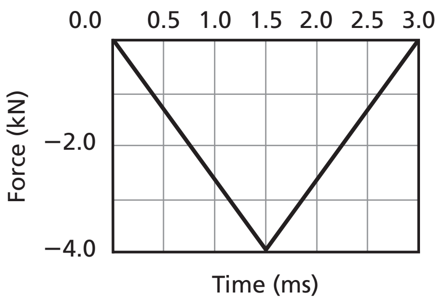
b. What is the impulse on the wood block?

c. What is the average force experienced by the block?

4. The following collisions take place on a flat, horizontal tabletop with negligible friction.

a. 

A 2.1-kg cart, A, with frictionless wheels is moving at a constant speed of 3.4 m/s to the right on the tabletop, as shown above, when it collides with a second cart, B, that is initially at rest. The force acting on cart A during the collision is shown as a function of time in the graph below, where $t = 0$ is the instant of initial contact. Assume that friction is negligible. Calculate the magnitude and direction of the velocity of cart A after the collision.



b. In another experiment on the same table, an incident ball, C, of mass 0.15 kg is rolling at 1.3 m/s to the right on the tabletop. It makes a head-on collision with a target ball, D, of mass 0.50 kg at rest on the table. As a result of the collision, the incident ball rebounds, rolling backward at 0.80 m/s immediately after the collision. Calculate the velocity of ball D immediately after the collision. (Ignore friction in your calculations.)

c. In a third experiment on the same table, an incident ball, E, of mass 0.250 kg rolls at 5.00 m/s toward a target ball, F, of mass 0.250 kg. The incident ball rolls to the right along the x-axis, and makes a glancing collision with a target ball, F, that is at rest on the table. The velocity of incident ball E immediately after the collision is 4.33 m/s at an angle of 30.0° above the x-axis. Calculate the magnitude and direction of target ball F's velocity immediately after the collision. (Ignore friction.)