

## Exam 2

### Study Strategy

Doing is better than reviewing. A couple of hours of practicing problems from scratch (quizzes and homework) and working to correct the “sticky spots” is much more efficient and effective than spending hours reviewing.

### Learning Goals

#### Students will be able to:

Identify the action reaction pairs of forces acting in a situation

Sum the components of two or more forces to find the net force on an object.

Use net force to determine the acceleration of an object.

Create a free body diagram of the forces acting on an object/system of interest.

Describe the difference between action reaction pairs of forces and the forces that are used in a free body diagram.

Describe the normal force, identify if a normal force exists. If so, identify the direction of the normal force and use it appropriately in a free body diagram.

Apply Newton’s Second Law (write up the sum of forces in component form) to any free body diagram

Describe and calculate mass and weight and use weight appropriately in a free body diagram.

Describe and calculate apparent weight vs. actual weight of an object in linear or uniform circular motion.

Describe drag and be able to use it appropriately in a free body diagram

Describe causes of friction and identify when static friction or kinetic friction is involved and use appropriately in a free body diagram.

Describe terminal speed and how the size (surface area and mass) of an object affects its terminal speed. You do not have to be able to calculate terminal speed.

Define uniform circular motion and the behavior of speed, velocity, acceleration, angular position and angular velocity while an object is in uniform circular motion.

Solve problems relating the centripetal acceleration of an object in uniform circular motion to its speed and angular velocity.

Determine the force of gravity (weight) using Newton’s Law of gravity.

Solve circular orbit problems in terms of speed, period and mass.

Solve a variety of problems in mechanics using the recommended strategy in the next learning goal. This variety of problems includes: individual objects undergoing a force, objects suspended by one or two ropes/strings, individual objects acted upon by gravity, drag, friction and/or normal force on a horizontal or sloped surface, two connected objects, simple pulleys and uniform circular motion.

Solve a variety of problems in mechanics (as described above) using Newton’s second law in component form following the recommended strategy of:

1. Identify the givens,
2. Draw the situation and identify the object of interest and then any forces ON the object of interest.,
3. Draw a Free Body Diagram (FBD) with an appropriate coordinate system,
4. Identify if the situation is in equilibrium or dynamic. Does  $\Sigma F = ma$  or  $\Sigma F = 0$ ?
5. Apply Newton’s 2<sup>nd</sup> Law to the FBD  $\Sigma F_x = ma_x$  and  $\Sigma F_y = ma_y$
6. Solve above equations for the unknown(s)
7. Assess

$$G = 6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$$

$$T^2 = \frac{4\pi^2}{GM} r^3$$

$$v = \omega r$$

$$w = mg$$

$$v_x = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{\Delta t}$$

$$x_f = x_i + v_{xi}\Delta t + \frac{1}{2} a_x(\Delta t)^2$$

$$\sin \theta = \text{opp/hyp}$$

$$F_G = \frac{Gm_1m_2}{r^2}$$

$$v = \frac{2\pi r}{T} = \sqrt{\frac{GM}{r}}$$

$$a = \frac{v^2}{r} = \omega^2 r$$

$$\Sigma \vec{F} = m\vec{a}$$

$$a_x = \frac{\Delta v_x}{\Delta t} = \frac{v_{xf} - v_{xi}}{\Delta t}$$

$$v_{xf} = v_{xi} + a_x \Delta t$$

$$\cos \theta = \text{adj/hyp}$$

$$1 \text{ radian} = 57.3^\circ$$

$$f = \frac{1}{T}$$

$$g = 9.8 \text{ m/s}^2$$

$$v_{xf}^2 = v_{xi}^2 + 2a_x(\Delta x)$$

$$\tan \theta = \text{opp/adj}$$

$$a^2 + b^2 = c^2$$

## Linear

$\Delta x$  – displacement

$v$  – velocity

$$v = \Delta x / \Delta t$$

$$F = ma$$

## Angular

$\Delta \theta$  - angular displacement

$\omega$  – angular velocity (omega)

$$\omega = \Delta \theta / \Delta t$$

$$a = v^2/r = \omega^2 r$$

$$F = ma = m v^2/r = m \omega^2 r$$

$$\text{————— } v = \omega r \text{ —————}$$