**Unit 3 Forces Study Guide**

**Vocabulary to know**

Force

Mass

Weight

Normal force

Reaction force

Lift force

Friction force

Tension

Spring force

Drag force

Newton’s first law

Newton’s second law

Newton’s third law

Action-reaction pair

Free body diagram

Equilibrium

Static friction

Dynamic friction

Coefficient of friction

**Skills**

Identify types of forces

Draw Free Body Diagrams (including rotating axes and finding components)

Apply Newton’s 1st law

Apply Newton’s 3rd law and identify action-reaction pairs

Solve simple 2nd law problems in one dimension

Solve 2nd law problems interfaced with kinematics

Solve 2nd law problems in two dimensions

Solve 2nd law problems in two dimensions with angles (day 2)

Solve 2nd law problems with friction

Solve 2nd law problems with multiple bodies of interest (day 2)

Solve 2nd law problems with friction on an incline (day 2)

**Memory items**

Formulas for using vectors (going from mag/dir to components and from components to mag/dir)

Method of solving second law problems (7 step process)

Possible cases for friction problems and questions to ask yourself.

**Unit 3 Test Description:**

|  |  |
| --- | --- |
| Day 1  10 x 2 pts Multiple choice | |
| 1 x 5 pts | 1st law problem |
| 1 x 5 pts | 3rd law problem |
| 1 x 7 pts | 1D 2nd law problem |
| 1 x 7 pts | 2nd law problem with kinematics |
| 1 x 10 pts | 2D 2nd law problem (possibly with angles) |
| 1 x 10 pts | Friction problem (horizontal motion, possibly with angles) |
| Day 2  1 x 12 pts | 2nd law problem with multiple angles |
| 1 x 12 pts | Multibody problem |
| 1 x 12 pts | Friction on incline problem |

You will be using our testing folders with 2-3 people per table. You will be allowed to use your calculator and a blank testing version of the IB data packet. BEWARE: YOU WILL NOT BE ALLOWED TO USE YOUR PHONE AS A CALCULATOR AND THERE ARE LIMITED CALCULATORS AVAILABLE TO BORROW. **BRING YOUR OWN CALCULATOR.** You will be asked to place your phone in your backpack at your feet or in a box on the front bench. There shall be nothing on the tables or chairs beside the test, your calculator, the data packet and a writing implement.

**IB Stated Objectives**

**2.2 Forces**

* **Objects as point particles**
* **Free-body diagrams**
* **Translational equilibrium**
* **Newton’s laws of motion**
* **Solid friction**

1. Representing forces as vectors
   1. Identify common forces, their directions and commonly used symbols including Applied force, Weight, Tension, Spring force, Normal force, Drag, Upthrust (buoyant force), Lift, and Friction
2. Sketching and interpreting free-body diagrams
   1. Defining the system of interest to be treated as a point particle
   2. Analyze any situation described in word or images to draw a FBD that includes all relevant forces
   3. Resolving all forces not aligned to the x and y axes into their components
3. Describing the consequences of Newton’s first law for translational equilibrium
4. Using Newton’s second law quantitatively and qualitatively
   1. Static equilibrium (Net force in each dimension = 0)
   2. Dynamic systems (Net force = ma in one or more dimensions)
5. Identifying force pairs in the context of Newton’s third law
   1. Recognize that third law pairs of forces exist on different Free Body Diagrams. (While equal and opposite forces often exist on a single FBD, they are not third law pairs!)
6. Solving problems involving forces and determining resultant force
   1. Mass hanging from two cords at angles.
   2. Mass pulled by a cord (horizontal, vertical or at an angle; accelerated or constant velocity; with or without friction present; one or more blocks stacked or side by side)
   3. Man riding in an elevator (Finding normal forces when elevator moves)
   4. Atwood’s machine and other systems of two blocks connected by a cord
   5. Mass sliding on an incline (parallel and perpendicular components rather than x and y)
   6. Mass on end of spring (horizontal and vertical)
7. Describing solid friction (static and dynamic) by coefficients of friction
   1. Recognize the variable magnitude of static friction force needed to maintain equilibrium
   2. Recognize the constant magnitude of dynamic friction

**IB Textbook Review Exercises (all answers in back of textbook)**

2.2 p76 #34-54 – Newton’s Laws problems

**Other Review Resources**

Class powerpoints (posted online) 2.2 Homework worksheets

Extra Problem Sets posted online

Personal Class notes