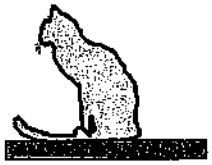
Challenge #1 FBD

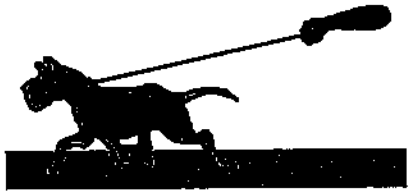
Force Diagrams

Worksheet

Show the forces that act on the object in each situation:



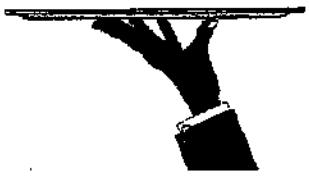
Cat on a mat



Dog pulling on a lead

Ball after a header

Car on a motorway



Tray on a hand

Tethered balloon

Aircraft

Swimmer

Child on pushchair

On a separate sheet of paper draw simplified sketches of the following situations.
Use dots (points) to represent the objects and arrows to represent the forces.

Mr Bean is being blown along by the wind!
Draw sketches to show

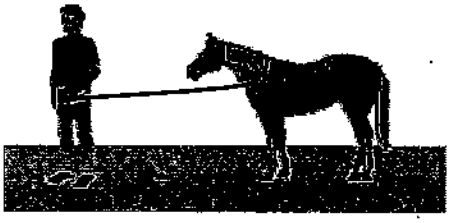
- the forces acting on the balloon
- the forces acting on Mr Bean

Draw sketches to show

- the forces acting on the weights
- the forces acting on the weightlifter.

Draw sketches to show

- the forces acting on the man
- the forces acting on his horse.



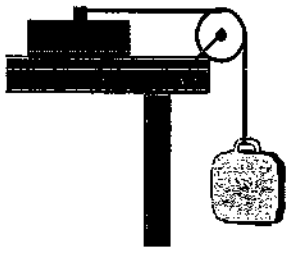
Draw a sketch to show the forces acting on a book lying on a sloping desk
Show the friction and normal reaction as separate forces.

A car tows a trailer along a horizontal road.
Draw sketches to show

- the forces acting on the trailer
- the forces acting on the car.

A tool box lying on a table is attached to one end of a light inextensible string. The string passes over a smooth pulley and the other end is attached to a bag that hangs vertically as shown in the diagram.
Draw sketches to show

- the forces acting on the bag
- the forces acting on the tool box.

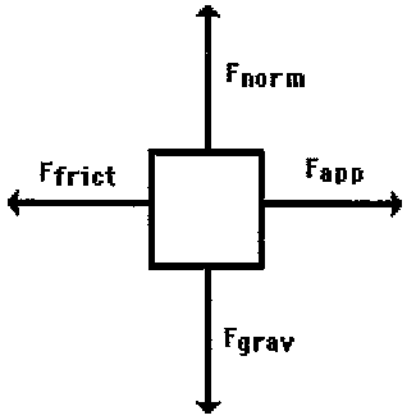


FBD Challenge #2

Name:_____

Drawing Free-Body Diagrams

Free-body diagrams are diagrams used to show the relative magnitude and direction of all forces acting upon an object in a given situation. A free-body diagram is a special example of the vector diagrams which were discussed in an earlier unit; these diagrams will be used throughout our study of physics. The size of the arrow in a free-body diagram is reflective of the magnitude of the force. The direction of the arrow reveals the direction which the force is acting. Each force arrow in the diagram is labeled to indicate the exact type of force. It is generally customary in a free-body diagram to represent the object by a box and to draw the force arrow from the center of the box outward in the direction that the force is acting. An example of a free-body diagram is shown at the right.



The free-body diagram above depicts four forces acting upon the object. Objects do not necessarily always have four forces acting upon them. There will be cases in which the number of forces depicted by a free-body diagram will be one, two, or three. There is no hard and fast rule about the number of forces which must be drawn in a free-body diagram. The only *rule* for drawing free-body diagrams is to depict all the forces which exist for that object in the given situation. Thus, to construct free-body diagrams, it is extremely important to know the various types of forces. If given a description of a physical situation, begin by using your understanding of the force types to identify which forces are present. Then determine the direction in which each force is acting. Finally, draw a box and add arrows for each existing force in the appropriate direction; label each force arrow according to its type. See the back side for 12 free-body problems.

Contact Forces

Frictional Force = F_{frict}

Tensional Force = F_{tens}

Normal Force = F_{norm}

Air Resistance Force = F_{air}

Applied Force = F_{app}

Spring Force= F_{spring}

Action-at-a-Distance Forces

Gravitational Force = F_{grav}

Name:_____

Practice Problems

Apply the method described above to construct free-body diagrams for the various situations described below.
Complete on a seperate sheet of paper & attach.

1. A book is at rest on a table top. Diagram the forces acting on the book.

2. A girl is suspended motionless from a bar which hangs from the ceiling by two ropes. Diagram the forces acting on the girl.

3. An egg is free-falling from a nest in a tree. Neglect air resistance. Diagram the forces acting on the egg as it is falling.

4. A flying squirrel is gliding (no *wing flaps*) from a tree to the ground at constant velocity. Consider air resistance. Diagram the forces acting on the squirrel.

5. A rightward force is applied to a book in order to move it across a desk with a rightward acceleration. Consider frictional forces. Neglect air resistance. Diagram the forces acting on the book.

6. A rightward force is applied to a book in order to move it across a desk at constant velocity. Consider frictional forces. Neglect air resistance. Diagram the forces acting on the book.

7. A college student rests a backpack upon his shoulder. The pack is suspended motionless by one strap from one shoulder. Diagram the vertical forces acting on the backpack.

8. A sydiver is descending with a constant velocity. Consider air resistance. Diagram the forces acting upon the skydiver.

9. A force is applied to the right to drag a sled across loosely-packed snow with a rightward acceleration. Diagram the forces acting upon the sled.

10. A football is moving upwards towards its peak after having been *booted* by the punter. Diagram the forces acting upon the football as it rises upward towards its peak.

11. A car is coasting to the right and slowing down. Diagram the forces acting upon the car.

12. A hockey puck is sliding freely across a pond of frictionless ice.

FBD Challenge #3

Name: _____

Free-Body Diagrams

Read from **Lesson 2** of the **Newton's Laws** chapter at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/newtlaws/u2l2b.html
http://www.physicsclassroom.com/Class/newtlaws/u2l2c.html

Construct free-body diagrams for the following physical situations. Label all forces (e.g., F_{grav}, F_{norm}, F_{app}, F_{frict}, F_{air}, F_{tens}, etc.).

a. A physics book rests upon a level table.

b. A skydiver is falling and has reached a terminal velocity.

c. A large crate is being pushed leftward at a constant velocity.

d. A sledder has reached the bottom of a hill and is coasting rightward while slowing down.

e. A ball is moving upwards towards its peak. Ignore air resistance.

f. An air track glider moves rightward at constant speed.

g. The brakes are applied to a rightward moving car and it skids to a stop.

h. A spider is slowly descending a thin silk thread at constant speed.

i. A projectile is moving upwards and rightwards towards the peak of its trajectory.

j. An elevator is rising at a constant velocity; it is not touching the elevator shaft.

k. An upward rising elevator is slowing down; it is not touching the elevator shaft.

l. A force is applied to accelerate a crate across a rough horizontal surface.