**FBDs & The Normal Force**

For each of the following draw an FBD and write an expression for the normal force on each object in terms of m, M, g, a, F and θ. All objects are in equilibrium, unless otherwise indicated. Unless otherwise indicated all objects are stationary.

1. 2.

F < mg

m

m

3.

μ >0

M

v

M

F

m

F

 4. 5.

v=0

μ > 0

a

 7.

m

F>mg

μ>0

M

F

θ

 8.

M

F

θ

6.

μ>0

m

9. 10.

 v (constant) v (constant)

m

(9-12 are objects on an elevators)

m

m

 11. 12.

 a a

**FBDs & The Frictional Forces**

* For each of the following draw the FBD
* For each of the following write an expression for the frictional force on each mass, m or M.
* For all pairs of surfaces µ>0.
* Unless otherwise indicated all objects are stationary, and have zero acceleration.
* Assume ALL APPLIED FORCES are shown.
* For each state whether it is *static friction* or *kinetic friction*.

**Solve in terms of m, M, g, F, a and θ : DO NOT USE Ff = μFN**

m

M

1. 2.

**v**

m

 **F**

 **a**=0m/s2  Find Ff on m from ground on m

m

M

**F**

**a**

**v**

M

**F**

3.

**v**

 4. 5.

M

 **a**

μ

M

F

θ

Find Ff on M.

**v**

 7.

**a**

 8.

M

**F**

θ

6.

**v**

M

Constant velocity **a**=0m/s2

 **v**=0m/s

9. 10.

**a**

M

M

**a**

m

11.

equilibrium