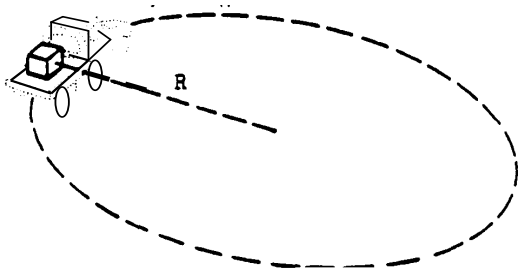
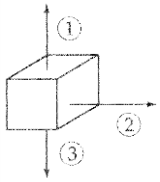
Name _____ Date _____ Period _____



5. A box of mass M, held in place by friction, rides on the flatbed of a truck which is traveling with constant speed v. The truck is on an unbanked circular roadway having radius of curvature R.

a. On the diagram provided above, indicate and clearly label all the force vectors acting on the box.



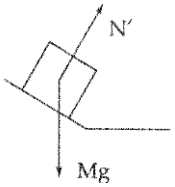
1 = normal force; 2 = friction; 3 = weight

b. Find what condition must be satisfied by the coefficient of static friction μ between the box and the truck bed. Express your answer in terms of v, R, and g.

Friction, $f \leq \mu N$ where $N = Mg$.
Friction provides the necessary centripetal force so we have $f = Mv^2/R$
$Mv^2/R \leq \mu Mg$, or $\mu \geq v^2/Rg$

If the roadway is properly banked, the box will still remain in place on the truck for the same speed v even when the truck bed is frictionless.

c. On the diagram above indicate and clearly label the two forces acting on the box under these conditions



d. Which, if either, of the two forces acting on the box is greater in magnitude?

from the diagram below, a component of the normal force N′ balances gravity so N′ must be greater than mg