

**State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Short Answers Should Be Short! – Feel Free to Ask Any Questions**

“Fact or Friction” (30,000 points) Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles

1.) (a) A car tire that leaves a thick black rubber mark on the road when you squeal away from the stop light is exhibiting _____ friction.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

(b) A tight fitting nail or screw is exhibiting _____ friction.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

(c) For the Space Shuttle in circular orbit, the velocity points _____.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

(d) The Total Net Work done on an object changes its _____ Energy.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

(e) _____ Energy can be thought of as energy stored because you did work to lift an object.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

(f) Old-timers sliding across the seat when they lost control in a turn thought there was a force that pointed _____.

- A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward

A B C D E F

In parts (g)-(i), select which of Newton’s 3 laws or the 2 Conservation laws that best describes the situation.

(g) An elevator going up and slowing down.

- A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
D = Momentum E = Energy F = None of these

A B C D E F

(h) The normal force of a book sitting on a table compared with the normal force of the table with the ground.

- A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
D = Momentum E = Energy F = None of these

A B C D E F

(i) A clown on roller skates finds himself moving backwards after throwing a pie forward.

- A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
D = Momentum E = Energy F = None of these

A B C D E F

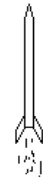
(j) You sitting there taking this Physics test.

- A = Newton’s 1st B = Newton’s 2nd C = Newton’s 3rd
D = Momentum E = Energy F = None of these

A B C D E F

Dateline: Rainbow Valley, Arizona, west of Phoenix... (35,000 points)

2.) Over the Memorial Day weekend, the National Sport Launch was held by a couple of thousand self-proclaimed nerds and geeks who like to fire off model rockets. (a) What is the weight of a 10.0 kg rocket?

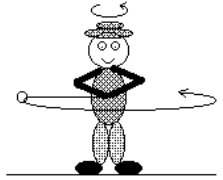


(b) Draw a Free Body Diagram of the rocket half a second *after* it has taken off from the ground.

(c) Suppose you have a 10.0 kg rocket and want it to have an initial acceleration of $a_y = +1.25 \text{ m/s}^2$. Find the *net* Force acting on the rocket.

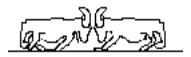
(d) What is the force that the rocket engine supplies in part (c)?

(e) A small boy whirls around a small ball (mass = 0.200 kg) on a 1.25 m string. If the force on the string exceeds 5.00 N, it will break. What is the maximum speed of the ball on the string?



“Ramming Speed!” (35,000 points)

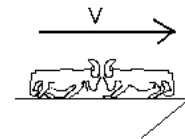
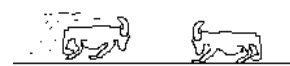
3.) High in the Teton Mountains of western Wyoming, it’s budding springtime and two huge male Big Horn Sheep are battling each other for the love of the Fair Ewe Guinevere. The ram on the left, Tony, is pushing the ram on the right, Rocco, with a force of +3550 N. (a) With what force does Rocco push Tony?



(b) The coefficients of friction between Rocco’s hooves and the rock are 0.780 and 0.630. If Rocco has a mass of 484 kg, does Tony move Rocco backwards if Tony pushes Rocco with a force of +3550 N?

(c) Tony isn’t sure beforehand if he’ll be able to shove Rocco, so he knocks heads with Rocco first, breaking whatever static friction barrier happens to be around. Now he can shove Rocco by applying a force of +3550 N and Rocco only has kinetic friction with the rock. Find the acceleration of Rocco.

(d) Tony (mass = 504 kg), comes running at +8.88 m/s towards Rocco, who is at rest. They collide totally inelastically, locking horns together. What speed, V , do the Big Horn Sheep have after the collision?



(e) Unfortunately, the collision between Tony and Rocco is right at the edge of a cliff, and with an initial speed of V , then fall 1380 m to the river valley below. Ignoring air resistance, use conservation of energy to find their speed when they hit the river. *If you didn’t get an answer to (d), use $V = 8.88 \text{ m/s}$.*