X2.h 107

Physics 107 (Kaldon-22243) **Name** _____

WMU - Spring 2001 **Book Title** _____

Exam 2 - 100,000 points

Rev. 05/24/01 Th.3 Rev.3a 06/03/02

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 Fiction" (30,000 points) ***Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles***

1.) (a) The coefficient of _____ friction is always smaller than the other kind of friction.
A = Static B = Kinetic C = Potential D = Radial
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(b) In Uniform Circular Motion, the centripetal acceleration points _____ .
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(c) In Uniform Circular Motion, the velocity points _____ .
A = Static B = Kinetic C = Potential D = Radial
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(d) _____ Energy is the energy of motion.
A = Static B = Kinetic C = Potential D = Radial
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(e) _____ Energy is arbitrarily set to zero as you choose.
A = Static B = Kinetic C = Potential D = Radial
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(f) The fictitious "centrifugal force" would have to point _____ and it can't, so it doesn't exist.
A = Static B = Kinetic C = Potential D = Radial
E =Tangent F = Radial Outward Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

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 at a constant speed.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(h) The normal force of a book sitting on a table and the normal force of a table with a book on it.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

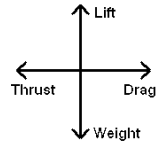
(i) The gravitational attraction between the Moon and the Earth.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

(j) A roller coaster going up and down its hills.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these Ⓐ Ⓑ Ⓒ Ⓓ Ⓔ Ⓕ

SR-71 Blackbird – The Fastest Plane In The World (35,000 points)

2.) The SR-71 was designed and built by the Lockheed Skunk Works. Approximately 32 were built, plus 18 earlier variants. SR-71s are powered by two Pratt and Whitney J-58 axial-flow turbojets with afterburners, each producing 32,500 pounds of thrust (145,000 N each). Three are still in operation with NASA. For a plane flying horizontally at a constant speed, we have a classic Free Body Diagram as shown. Halfway through its fuel load, the plane has a mass of 37,250 kg, flies at over 85,000 feet (26,000 m) and is cruising at a speed of over Mach 3.2 (3.2 times the speed of sound *or* 2200 mph = 3540 kph = 983 m/s). (a) Find the value of the lift force from the wings and body of the SR-71.

Hint: Use the F.B.D.!



(b) Find the value of the drag due to air resistance for this SR-71.

(c) At 85,000 feet (26,000 m) and a speed of 2200 mph (983 m/s) what is the total mechanical energy of a 37,250 kg SR-71? Which is the bigger piece – the kinetic energy or the potential energy?

(d) Flying in an SR-71 is a dangerous job. About a third of the planes suffered catastrophic failures in flight resulting in the two-man crew having to eject and parachute to earth. If we ignore air resistance and terminal velocity, if a 27.5 kg piece of the plane fell from rest from an altitude of 85,000 feet (26,000 m), how fast would that piece be going when it struck the ground at sea level ($y = 0$)?

(e) Given those two powerful engines, and a fully fueled takeoff of 140,000 pounds (m = 52,250 kg) – how far down the runway does an SR-71 travel from rest up to a speed of 250. mph (112 m/s)? *We're ignoring friction and air resistance here.*

My Other Car Is An SR-71

A Mission to Mars (35,000 points)

3.) (a) Man has dreamed of going to Mars (mass = 6.42×10^{23} kg ; radius = 3.37×10^{6} m) for a long time – and someday we probably will. It is a smaller planet than our Earth and its gravity is weaker. Here on Earth, a man of mass 100. kg has a weight of 980. N. What would this 100. kg man weigh on Mars?

$G = 6.67 \times 10^{-11}\ N{\cdot}m^2/kg^2$

(b) To travel to Mars, it would be best to construct a rotating space ship to provide artificial gravity. If the cylinder has a diameter of 20.0 meters and the centripetal acceleration at the rim is ½g , then find the time T it takes for the cylinder to make one complete revolution.

(c) Back here on Earth, one of our heroic Buzz Lightyear astronauts is driving along a Houston freeway at the posted speed limit of 65.0 mph (29.1 m/s). If the coefficients of friction between the car's tires and the concrete are 1.05 and 0.805, what is the shortest distance that this car ($m = 1950\ kg$) can be brought to rest?

(d) Our astronaut's car ($m_1 = 1950\ kg$, $v_1 = 29.1\ m/s$) accidentally runs into a pickup truck ($m_2 = 2480\ kg$). The wreck moves at $V = +11.3\ m/s$. What was the speed and direction of the pickup truck before the crash?

(e) This collision is a Totally Inelastic Collision. Show that K.E. is not conserved in this collision, that is, that the total K.E. before is not equal to the total K.E. after. *If you can't get an answer to (d), see Dr. Phil.*