X2.18a **1070**

PHYS-1070(18) (Kaldon-20592) Name ______ S O L U T I O N ______

WMU - Summer I 2006 Book Title ____________________

Exam 2 - 100,000 points

Rev. 06/04/06 Su.3

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

EXAM 2 [FORM - A]

PHYS-1070 (KALDON-18)

SUMMER I 2006

WMU

"The Only Thing I Have to Fear,
Is Fear Itself."

Franklin Delano Roosevelt
On the Occasion of His
Second Physics Exam
June the 5th, 1901

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

1.) (a) A block sits on an angle ramp, but does not move because of _______ friction.
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward
(**A**) (B) (C) (D) (E) (F)

(b) The mythical and impossible centrifugal force points _______.
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward
(A) (B) (C) (D) (E) (**F**)

(c) A rocket blasting off and going faster and higher is gaining in both _______ and …
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward
(A) (**B**) (C) (D) (E) (F)

(d) … _________ Energy.
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward
(A) (B) (**C**) (D) (E) (F)

(e) _________ friction is responsible for the warmth you feel when you rub your hands together briskly.
A = Static B = Kinetic C = Potential D = Radial Inward
E =Tangent F = Radial Outward
(A) (**B**) (C) (D) (E) (F)

(f) A squirrel in a tree holds a nut 20.0 m above the ground. The nut has stored ___________ Energy.
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) A car speeding down the road at 88 mph.
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)

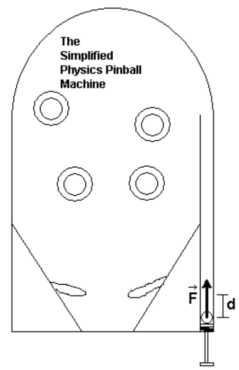
(h) The weight of a rock lying on the ground and the force of the ground pushing on a rock.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these
(**A**) (B) (C) (D) (E) (F)

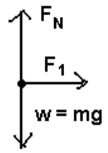
(i) The force of a bowling ball on a bowling pin – and the force of the bowling pin on the bowling ball.
A = Newton's 1st B = Newton's 2nd C = Newton's 3rd
D = Momentum E =Energy F = None of these
(A) (B) (**C**) (D) (E) (F)

(j) Finding the force acting on a satellite as it orbits the Earth uses _______________.
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**)

"He's a Pinball Wizard…!" **TOMMY, THE WHO (35,000 points)**

2.) *The Simplified Physics Pinball Machine* is simpler than a real pinball machine, to make our lives easier here in PHYS-1070. A real pinball machine is built at an incline – this machine lies flat on the table. In addition, there is no friction and we don't have to worry about the ball rolling. (a) The 0.0327 kg pinball has to go from rest to 3.00 m/s in a distance of 10.0 cm (0.100 m). Draw the Free Body Diagram of the pinball when the launcher applies a horizontal force on the ball.





(b) Find the constant force from the launcher that will make the pinball do this.

$$v^2 = v_0^2 + 2a(x - x_0)$$
$$v^2 = 2ax$$
$$a = \frac{v^2}{2x} = \frac{(3.00m/s)^2}{2(0.100m)}$$
$$= 45.00m/s^2$$
$$F = ma = (0.0327kg)(45.00m/s^2)$$
$$= 1.472N$$

OR

$$W = Fd \;\; ; \;\; W = \Delta KE = KE_f - KE_i$$
$$Fd = \tfrac{1}{2}mv^2$$
$$F = \frac{mv^2}{2d} = \frac{(0.0327kg)(3.00m/s)^2}{2(0.100m)}$$
$$= 1.472N$$

(c) Find the work done by the launcher on the pinball. *If you did not get an answer to (b), use F= 10.0 N.*

$$W = Fd$$
$$= (1.472N)(0.100m)$$
$$= 0.1472J$$

OR

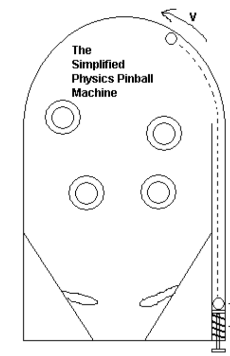
$$W = \Delta KE = KE_f - KE_i$$
$$= \tfrac{1}{2}mv^2$$
$$= \tfrac{1}{2}(0.0327kg)(3.00m/s)^2$$
$$= 0.1472J$$

(d) Find the Kinetic Energy of the pinball once it is up to speed.

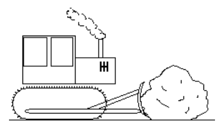
$$KE = \tfrac{1}{2}mv^2$$
$$= \tfrac{1}{2}(0.0327kg)(3.00m/s)^2$$
$$= 0.1472J$$

(e) Find the centripetal force acting on the pinball as it rounds the curve of radius *r = 18.0 cm*.

$$a_c = \frac{v^2}{r} = \frac{(3.00m/s)^2}{0.180m} = 50.00m/s^2$$



Bulldoze This! (35,000 points)



3.) A bulldozer of mass 6250 kg works a highway construction site. A boulder of mass 3850 kg is sitting on the road, with coefficients of friction between rock and pavement of 0.810 and 0.640 . The bulldozer pushes on the rock with a force of 29,500 N. (a) With what force does the rock push on the bulldozer?

Newton's 3rd Law: $\vec{F}_{1on2} = -\vec{F}_{2on1}$

So F = 29,500N (or F = -29,500N)

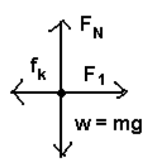
(b) Determine if the rock will move.

$$\begin{aligned} F_{f,s,\max} &= \mu_s F_N = \mu_s mg \\ &= (0.810)(3850kg)(9.81m/s^2) \\ &= 30{,}590N > 29{,}500N \end{aligned}$$

Applied Force < Maximum Static Friction… The Rock <u>Does NOT Move</u>.

(c) Impatient, the driver of the bulldozer doesn't want to wait to see if the rock moves. He just backs up a little bit, then rams the rock – shocking the system so it'll slide on the ground. Find the acceleration of the rock.

$$\begin{aligned} f_k &= \mu_k F_N = \mu_k mg \\ &= (0.640)(3850kg)(9.81m/s^2) \\ &= 24{,}170N \\ \sum F_x &= F_1 - f_k = ma_x \\ a_x &= \frac{F_1 - f_k}{m} = \frac{29{,}500N - 24{,}170N}{3850kg} \\ &= \frac{5330N}{3850kg} = 1.384m/s^2 \end{aligned}$$



(d) The bulldozer pushes the rock for a distance of 5.00 meters. Find the work that the bulldozer does on the rock.

$$W = Fd = (29{,}500N)(5.00m) = 147{,}500J$$

(e) Impressed with the success of his hitting the boulder, the driver stops, backs up further and comes racing at the rock with a speed of 5.00 m/s. The bulldozer blade crashes into the rock and the rock gets stuck on the blade. Find the speed *V* of the rock+bulldozer right after they hit.

$$\begin{aligned} p_{before} &= p_{after} \\ m_1 v_1 + m_2 v_2 &= (m_1 + m_2)V \\ m_1 v_1 &= (m_1 + m_2)V \\ V &= \frac{m_1 v_1}{(m_1 + m_2)} = \frac{(6250kg)(5.00m/s)}{(6250kg + 3850kg)} \\ &= 3.094m/s \end{aligned}$$