

X2.17a

PHYS-107 (17) (Kaldon-37944)
WMU - Fall 2004
Exam 2A - 100,000 points

107

Name _____ S O L U T I O N _____

Book Title _____

Rev. 10/24/04 Su.A4

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-107 (KALDON-17)

FALL 2004

WMU

Oh, my! It's getting late in October and – oh it's too scary, I can't look – and you've got another... Physics Test! Boo!
(with candy).

Trick-or-Treat!

"Fact or Friction" (50,000 points) Multiple-Guess-Pick-The-Best-Answer-Fill-In-The-Bubbles

- 1.) (a) The Work done by Conservative Forces can be written as a _____ Energy. *This is a Definition.*
A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward A B C D E F
- (b) The coefficient of _____ friction isn't always required for this type of friction.
Static friction varies up to its maximum value
A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward A B C D E F
- (c) The Centripetal Force is perpendicular to the _____ velocity vector.
The radial inward Centripetal Force must be perpendicular to the tangential velocity.
A = Static B = Kinetic C = Potential D = Radial Inward
E = Tangent F = Radial Outward A B C D E F
- (d) A man on ice skates throws a ball at a Standard Angle of 90°. The man's skates _____.
His knees might buckle with the recoil, but he's firmly on the surface of the Earth, which won't move much.
A = Move LEFT B = Move RIGHT C = Don't Move
D = Move UP E = Move DOWN F = None of these A B C D E F
- (e) A man on ice skates throws a ball at a Standard Angle of 45°. The man _____.
There is a component of the momentum to the right, so the man goes to the left.
A = Move LEFT B = Move RIGHT C = Don't Move
D = Move UP E = Move DOWN F = None of these A B C D E F
- (f) A man on ice skates throws a ball at a Standard Angle of 0°. The man _____. *Same as (e).*
A = Move LEFT B = Move RIGHT C = Don't Move
D = Move UP E = Move DOWN F = None of these 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 man leaning on a wall. *He's not moving and has two Normal Forces (floor and wall).*
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) Two bicyclists run into each other at an intersection, tangling up in each other's bicycle. *Inelastic collision.*
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) An object sits on a table and a 100. N force is applied to it. *We don't know what other forces, so...*
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) An object sits on a table and a net 100. N force is applied to it. *Ah, we have a NET force, so we do know:*
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

"When It Absolutely Positively Has To Get There Overnight..." (50,000 points)

2.) (a) A 45.0 kg FedEx box is pushed on a frictionless surface by a force $F_x = 125\text{ N}$. Find the vector acceleration \vec{a} of the box. Give the answer in Standard Form.

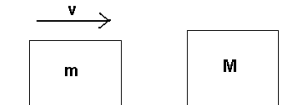


$$\begin{aligned} F_x &= ma_x \\ a_x &= \frac{F_x}{m} = \frac{125\text{ N}}{45.0\text{ kg}} = 2.778\text{ m/s}^2 \\ \vec{a} &= 2.778\text{ m/s}^2 @ 0^\circ \end{aligned}$$

(b) Another 45.0 kg box sits at the top of a ramp. The box is let go and slides from rest without friction or air resistance down to the floor, where it slides without friction at a speed $v = 5.35\text{ m/s}$. Use Conservation of Energy and find the original height h the box was above the floor.

$$\begin{aligned} mgh_1 + \frac{1}{2}mv_1^2 &= mgh_2 + \frac{1}{2}mv_2^2 \\ mgh_1 &= \frac{1}{2}mv_2^2 \\ gh_1 &= \frac{1}{2}v_2^2 \\ h_1 &= \frac{v_2^2}{2g} = \frac{(5.35\text{ m/s})^2}{2(9.81\text{ m/s}^2)} = 1.459\text{ m} \end{aligned}$$

(c) The box, moving at $v = 5.35\text{ m/s}$ collides with another box (mass $M = 68.0\text{ kg}$) and their packing tape makes the two boxes stick together. Find the speed V of the two boxes stuck together.



$$\begin{aligned} P_{\text{before}} &= P_{\text{after}} \\ m_1v_1 + m_2v_2 &= (m_1 + m_2)V \\ m_1v_1 &= (m_1 + m_2)V \\ V &= \frac{m_1v_1}{(m_1 + m_2)} = \frac{(45.0\text{ kg})(5.35\text{ m/s})}{(45.0\text{ kg} + 68.0\text{ kg})} = 2.131\text{ m/s} \end{aligned}$$

(d) Use the Work Energy Theorem to find the work necessary to bring both these stuck together boxes to a stop. If you didn't get an answer to (d), use $V = 1.00\text{ m/s}$.

$$\begin{aligned} m &= m_1 + m_2 = 45.0\text{ kg} + 68.0\text{ kg} = 113\text{ kg} \\ W &= \Delta K.E. = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 \\ &= 0 - \frac{1}{2}mv_0^2 = -\frac{1}{2}(113\text{ kg})(2.131\text{ m/s})^2 \\ &= -256.6\text{ J} \end{aligned}$$

(e) The boxes grind to a stop in a distance of 1.45 meters. Find the coefficient of friction that can do this. Hint: Treat the stuck together boxes as one object.

$$\begin{aligned} W &= Fd \\ F &= \frac{W}{d} = \frac{-256.6\text{ J}}{1.45\text{ m}} = -177.0\text{ N} \\ F_N &= mg \\ F_{f,k} &= \mu_k F_N = \mu_k mg = 177.0\text{ N} \\ \mu_k &= \frac{177.0\text{ N}}{(113\text{ kg})(9.81\text{ m/s}^2)} = 0.1597 \end{aligned}$$