Exam 2, PHY 191B   10/25/16, **100pts**

Name _____

The use of a calculator and *provided* cheat-sheet is allowed.
Put your cellphone, laptop, and Apple Watch in your backpack and place the backpack at the front of the hall.
**Anyone found in possession of these items, or any written information other than the
provided cheat-sheet, will be expelled from the exam.**

Part A (50 points) : 10 *multiple-choice numerical questions*. Each question is worth 5 points.
SHOW REASONING CLEARLY! <u>Correct answer w/o **clear** reasoning = ZERO credit!</u>

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1. A 3.2 kg wood block is pressed against a vertical wood wall by the
   40N force shown in the figure.
   If the block is initially at rest, will
   a) the block move downward?
   b) the block move upward?
   c) the block stay at rest?
   The coefficients of static and kinetic friction for
   wood on wood are 0.2 and 0.1 respectively.

   3.2 kg

   60⁰

   40 N
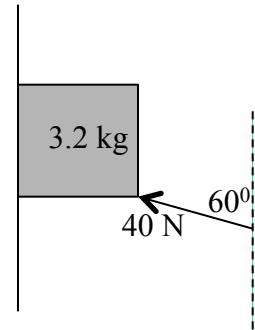
2. Consider a conical pendulum with a bob of mass 80 kg on
   a 10.0 m wire making an unknown angle with the vertical and
   moving in a horizontal circle, as shown below, with a
   radial acceleration toward the center of the circle of 8.2 m/s².
   What is the tension in the wire? (Pick the closest answer)
   a) 690 N
   b) 800 N
   c) 910 N
   d) 1020 N
   e) 1130 N

   θ

1
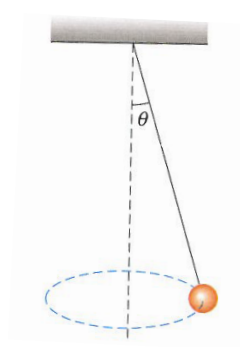
3. In the diagram on the right, a block of mass $m_2 = 2$kg is placed on a wedge of mass $m_1 = 3$kg, and a horizontal force $F = 53$N is applied to m_1 as shown. It is observed that m_2 does not slip either up or down along the wedge, as the wedge + block system moves forward. The contact force between the wedge and the block is (all surfaces are frictionless)
   a) 33N   b) 29N   c) 25N   d) 23N
   e) 20N
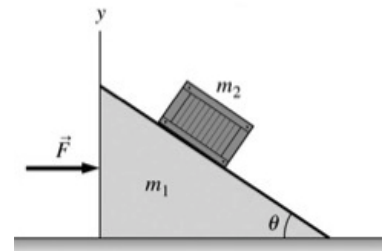
4. A 70 kg person stands on a 15 kg platform. He pulls on the rope that is attached to the platform via the frictionless system shown, with a force of 250N. If he pulls the platform (and therefore himself too) up at a steady acceleration of 2.5 m/s²,
   what is the contact force between him and the platform?
   Ignore friction, and pick the closest answer (assume $g = 10$ m/s²
   for this question).
   a) 575 N
   b) 625 N
   c) 675 N
   d) 725 N
   e) 775 N

15 kg   70 kg

2
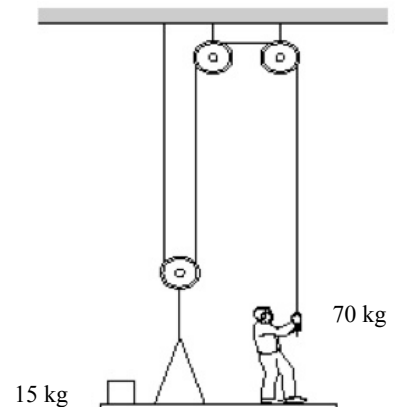
5. A car of unknown mass rounds a curve of unknown radius on a road banked at 30^0 to the horizontal, turning leftward as shown, with the maximum permissible speed before it begins to skid outward. The coefficient of static friction between the car and the road is 0.8, and the magnitude of the normal force between the car and the road is 24,672 N. The centripetal force acting on the car is

a) 18,927 N   b) 21,029 N
c) 23,133 N   d) 25,236 N
e) 29,429 N
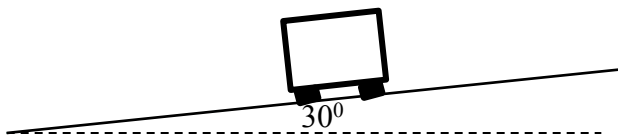
6. A person of mass 80 kg rides the "Human Centrifuge" as shown, with a uniform speed of 7 m/s. The coefficient of static friction is 0.6. The minimum normal force between the rider and the wall is

a) 1310 N   b) 1568 N   c) 1724 N
d) 1960 N   e) 2613 N
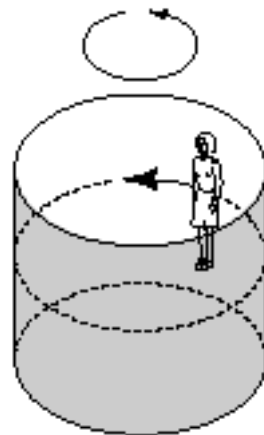
7. A ball of mass $m = 0.1$ kg drops from a height of $h = 0.5$ m
on to a vertical spring of force constant $k = 5$ N/m.
What is the maximum compression of the spring?
Caution! Don't ignore the potential energy lost by the ball even
while it is compressing the spring!
a) 0.7 m   b) 0.5 m
c) 0.3 m   d) 0.2 m
e) 0.1 m
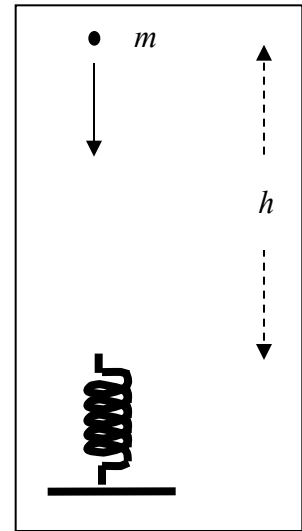
8. A particle of mass 1.5 kg moving along the x-axis is subjected to a contact force shown in the
figure. The particle goes from velocity 4 m/s at $x = 0$ to a velocity 6 m/s at $x = 2$m. Find the
value of F_{max}.

a) 5 N   b) 8 N
c) 15 N   d) 20 N
e) 36 N

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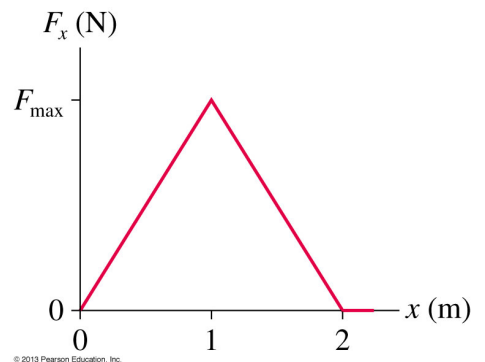
9. The two ropes seen in the figure are used to raise a 143 kg piano vertically by 7 m from the ground. What is the total work done by the non-conservative forces acting on the piano?
   a) 10 kJ
   b) 12 kJ
   c) 15 kJ
   d) 18 kJ
   e) 20 kJ

1100 N $\vec{T}_1$

60^0

$\vec{T}_2$ 700 N

40^0

$\vec{F}_G$
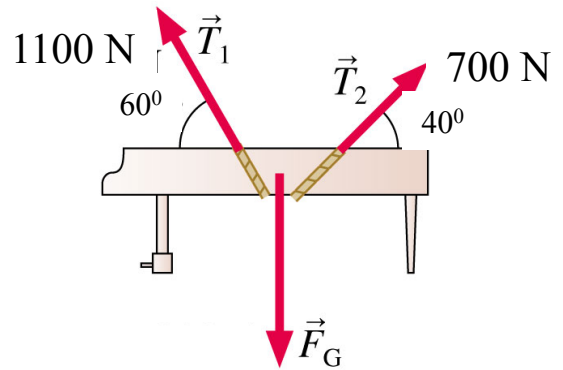
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10. A block of mass 2 kg slides toward a "loop-the-loop" arrangement and slides on the inside of the (frictionless) vertical circle of radius 2 m. The block has a velocity v_A as it whizzes past the bottom of the loop, and a velocity 8 m/s at the top of the circle..
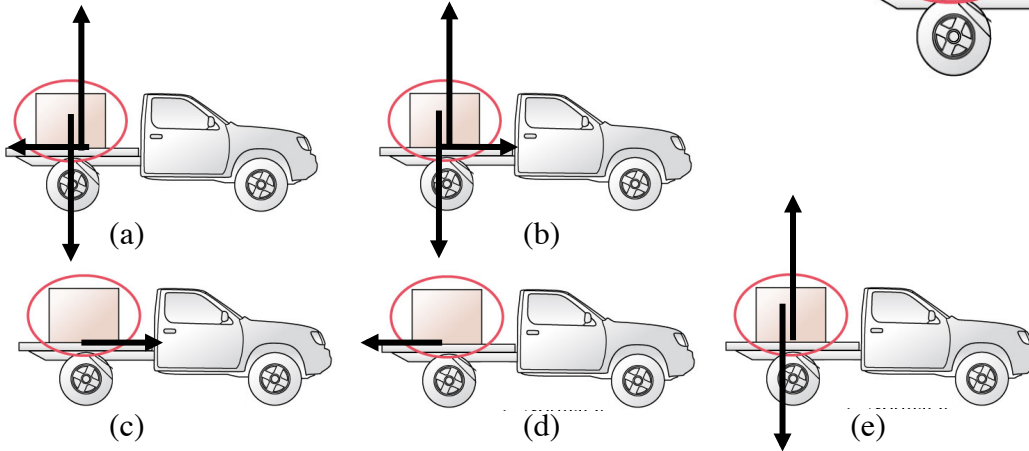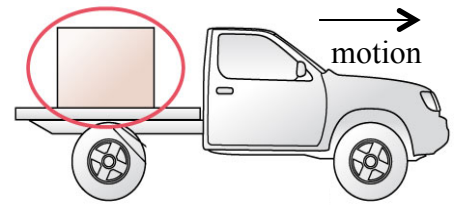   The normal force by the track on the block *at the bottom* is
    [Hint: First use C. O. M. E. to find v_A]
    a) 132 N
    b) 142 N
    c) 152 N
    d) 162 N
    e) 172 N
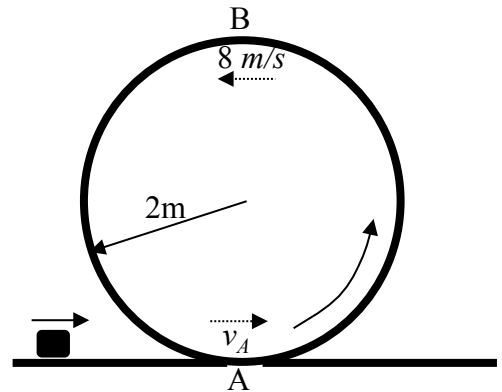
B
8 *m/s*

2m

v_A

A

11. Consider a crate riding along without slipping in a flatbed truck
which is **speeding up** in the direction shown. Which of the below
represents the correct free body diagram for the crate?

(a)   (b)

(c)   (d)   (e)

REASON:

12. The work done by a centripetal force of magnitude F as a particle moves once around a circle
of radius R is

a) Not enough info, can't tell   b) $F\pi R$ c) $2F\pi r$ d) 0

REASON:

13. Which statement below is true?
A stone is thrown with initial speed v_0 from the top of a cliff of height h, landing in the
ocean below. Neglecting air resistance,

  a) if it is thrown nearly straight upward, so that it rises to a great height before descending
     to the ocean, its speed when it strikes the ocean will be greater than if it is thrown horizontally.
  b) if it is thrown nearly straight downward, so that it descends as rapidly as possible, its speed
     when it strikes the ocean will be greater than if it is thrown horizontally.
  c) if it is thrown at an elevation angle of 45^0 its speed when it strikes the ocean will be greater than if it
     is thrown horizontally.
  d) the speed when it strikes the ocean is the same regardless of the initial elevation angle.
  REASON:

14. The mass $m_1 = 5.0$ kg and the mass $m_2 = 3.0$ kg are suspended
as shown by frictionless pulleys and strings of negligible mass. Note
that the pulley from which m_2 is suspended is movable.
Initially m_1 is held at rest. After m_1 is released what is the tension
in the string?   (12pts)
(Hint: Mind the acceleration constraint! For every 1 meter that m_1
descends, how much does m_2 ascend?)
a) 20 N   b) 25 N   c) 27 N   d) 29 N
e) 43 N
ANSWER:_____ (1pt)
SHOW WORK CLEARLY BELOW.
Note! Since the problem's not asking about speed or about height that any mass rises or falls (and
neither is this information provided) using C. O. M. E. is probably not a great idea. Alrighty then…
good old Newton's Laws it is…
TIPS: 1) Start by drawing a f. b. d. for each mass   (4 pts)
        2) Write down the F_{net} = ma equation for each mass   (4 pts)
   3) You should have 2 equations and 2 unknowns. Find the tension.   (4pts)

7
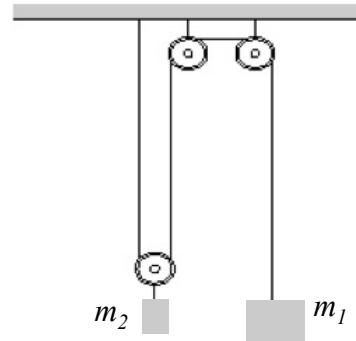
15. The spring in the figure below has a
    spring constant 1400 N/m. It is compressed
    15 cm, then launches a 200 g block over a
    horizontal frictionless surface. The block climbs
    a frictionless ramp, then sails a horizontal distance d
   through the air. Find the value of d

a) 7.5 m b) 9.8 m c) 12.1 m

ANSWER_____ (1pt)

SHOW WORK CLEARLY BELOW. (12 pts)

When JediMaster Samir is gone, slain by a Sith Lord, always remember his voice from the clouds "Who needs The Force…Use C. O. M. E. if you can. May the C. O. M. E. be with you!"
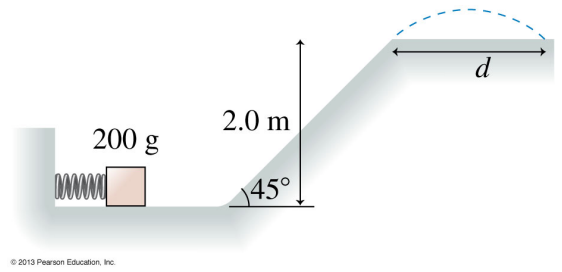
16. A 47 kg block and a 110 kg block are initially at rest, connected by a string as shown. The pulley is frictionless and of negligible mass. The coefficient of kinetic friction between the 47 kg block and incline is 0.2. What is the speed of the 110 kg block just before hitting the floor?

(12pts)
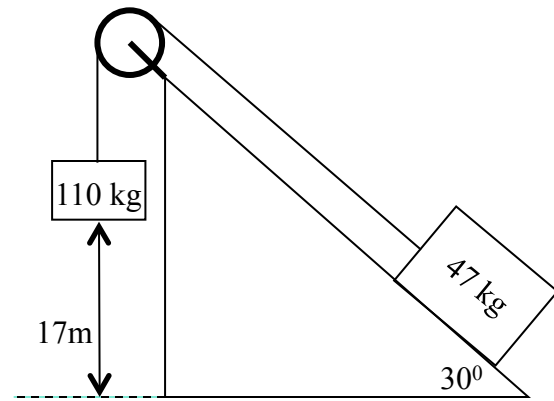
a) 7 m/s
b) 9 m/s
c) 11 m/s
d) 13 m/s
e) 15 m/s

110 kg

17m

47 kg

30°

ANSWER_____ (1pt)

SHOW WORK CLEARLY BELOW.   (11 pts)

"The C. O. M. E. …young Jedi… the C. O. M. E! And don't forget the friction!"