Prince Sultan University

Department of Mathematics and General Sciences

Physics I (PHY105)

Final Exam

Term 142

Date: Monday 1/6/2015

Name:

Student ID #:

Section: **Please circle your section number**

Sec. 139 (Sun/Tues/Thurs 8:00-9:00)	**Sec. 136** (Sun/Tues/Thurs 9:00-10:00)	**Sec. 138** (Mon/Wedn 8:00-9:30)

Instructions:

1. Examination time: **two hours**
2. Write your name and indicate your section before starting with the questions.
3. **Turn off your phone** and put any books and notes away.
4. Check that you have **6 pages** in total.
5. You may use a calculator but you may not borrow one.
6. Assume the acceleration of gravity $\boldsymbol{g = 9.8\ m/s^2}$.

Good luck!

	Mark
Part 1	
Part 2	
Total	

Part 1: (30 points total)

Read the questions ***carefully*** and circle the letter corresponding to the best answer (15 questions, 2 points each)

Q1. Which of the following is a unit of momentum:

a) N.s b) kg.m/s^2 c) N/s d) kg.m^2/s

Q2. Which of the following relations has the dimensions of acceleration?

a) v^2/t b) v/x^2 c) v^2/x d) none of these

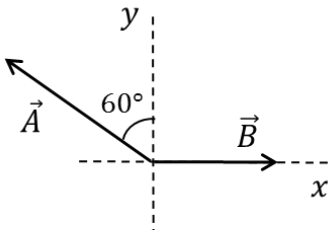
Q3. A car moving along a straight line at 3 m/s starts to accelerate with a uniform acceleration of 0.8 m/s^2 for 100 m. What is the final speed of the car?

a) 9 m/s b) 83 m/s c) 3.8 m/s d) 13 m/s

Q4. A ball is thrown vertically upwards at 19.6 m/s. What is its average *velocity* for its complete trip (up and back down to the starting position)?

a) 19.6 m/s b) 39.2 m/s c) 9.8 m/s d) zero

Q5. What is the resultant vector of the two vectors shown in the figure, given their magnitudes $A = 10$ m and $B = 5\sqrt{3}$ m?



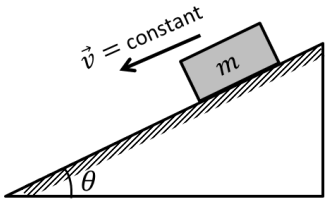
a) $10\,\hat{x}$ b) $5\,\hat{y}$

c) $5\sqrt{3}\,\hat{x} + 10\,\hat{y}$ d) $-5\hat{x} + \sqrt{3}\,\hat{y}$

Q6. When the total work done on an object is negative then

a) the kinetic energy of the object increases
b) the potential energy of the object increases
c) the object must be slowing down
d) None of these, total work can't be negative

Q7. A box of mass m is sliding down an inclined surface at a constant velocity, as shown. The magnitude of the friction force acting on the box in this case is equal to:



a) $mg\sin\theta$ b) $mg\cos\theta$

c) $g\tan\theta$ d) zero

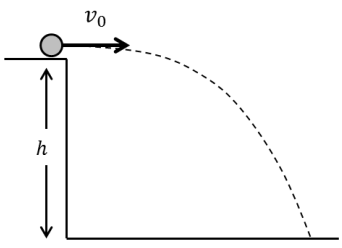
Q8. A running tiger jumps such that it leaves the ground at a speed of 16 m/s at an angle of $45°$ above the horizontal. What maximum height it reaches?

a) 13 m b) 0.8 m c) 6.5 m d) 1.2 m

Q9. A 100 g apple falls from a tree from a height of 2.8 m and reaches the ground at a speed of 5 m/s because of air resistance. How much work is done by air resistance on the apple?

a) -3 J b) -1.5 J c) -2.5 J d) -0.28 J

Q10. A stone is thrown horizontally from the top edge of a cliff with an initial speed of $v_0 = 15$ m/s, as shown. The stone takes 3 seconds to reach the bottom. What is the height of the cliff (h)? (air resistance is negligible)



a) 30 m b) 29.4 m

c) 44.1 m d) 0.9 m

Q11. A 0.2 kg ball moving at 6 m/s when it hits a wall, causing it to reverse direction and have a speed of 3 m/s. What is the magnitude of the change in the momentum of the ball?

a) 1.8 kg.m/s b) 0.2 kg.m/s c) 3 kg.m/s d) none

Q12. A cannon of mass 1500 kg fires a 4-kg shell with a velocity of 150 m/s at an angle of $60°$ above the horizontal. What is the recoil velocity of the cannon across the level ground

a) 3.5 m/s b) 20 m/s c) 0.15 m/s d) 0.2 m/s

Q13. Consider a bicycle wheel that turns about a fixed axis, neither speeding up nor slowing down. Compare the tangential and centripetal accelerations of a point on the wheel.

a) Both are zero
b) Only the centripetal acceleration is zero
c) Only the tangential acceleration is zero
d) Neither is zero

Q14. A car travelling at 108 km/h. Given the tires on the car have radius of 40 cm, what is their angular speed?

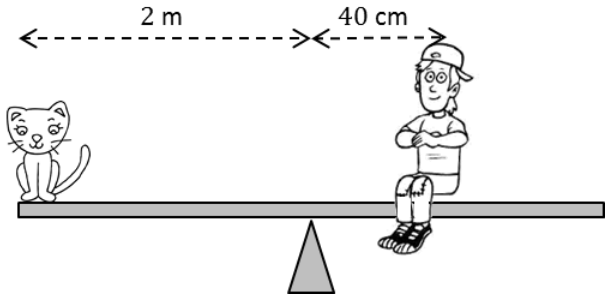
a) 75 rad/s b) 2.7 rad/s c) 60 rad/s d) 12 rad/s

Q15. An automobile tire starts to rotate from rest with a constant angular acceleration of $\alpha = 2\ \mathrm{rad/s^2}$. How many revolutions it makes in 4 seconds?

a) 8 rev. b) 2.5 rev. c) 100 rev. d) 4.2 rev.

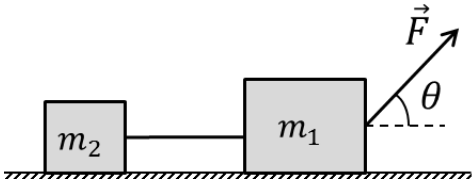
Part 2 (12 points total): Solve the following three problems. Show your ***detailed*** solution in the provided space

Q1. (3 points) A boy and a cat sit on a seesaw. The cat sits 2 m from the center of rotation to the left. When the boy sits at 40 cm from the center of rotation to the right the seesaw becomes balanced. Given the mass of the boy is 20 kg, what is the mass of the cat? (neglect the mass of the seesaw)



Q2. (5 points) Two boxes on a rough horizontal surface are connected by a light string as in the figure, where $m_1 = 20$ kg and $m_2 = 10$ kg. A force of $F = 100$ N is applied to m_1 at an angle of $\theta = 60°$ above the horizontal, and the system starts to move. The coefficient of kinetic friction between each box and the surface is $\mu_k = 0.1$. Draw a free-body diagram of each box and calculate:

a) The normal force acting on each box
b) The acceleration of the system
c) The tension in the string connecting the boxes
d) The total work done on m_2 as it slides a distance of 3 m.



Free-body diagram of m_2	Free-body diagram of m_1
m_2	m_1

Q3. (4 points) Consider a frictionless track as shown in the figure. A block of mass $m_1 = 5$ kg is released from rest from a height of $h = 5.1$ m at point A. It makes a head-on inelastic collision at point B with a block of mass $m_2 = 10$ kg initially at rest. The two block stick and slide together on the level surface until they encounter a spring at C having a spring constant of $k = 500$ N/m. They compress the spring and bounce back. Calculate:

a) The speed of m_1 just before colliding with m_2 at point B
b) The speed of the two blocks after the collision at point B
c) The maximum compression in the spring
d) The maximum height to which the two block rise on the track after leaving the spring