## 2013-14 Lab PHYSICS

## MIDYEAR TEST REVIEW

Complete the following problems. SHOW ALL WORK for full credit. This includes givens, formulas, units and circle final answers.

Motion in One Dimension:

1. Draw position-time and velocity-time graphs to show
a. An object at rest.
b. An object moving with a constant velocity.
c. An object moving with a constant acceleration.
2. A car starts from rest and accelerates with a constant positive acceleration. The car moves through a distance of 100 m in 10 seconds.
a. Find the acceleration of the car. (Ans. $2.0 \mathrm{~m} / \mathrm{s}^{2}$ )
b. What is the velocity of the car after 5 seconds? (Ans. $(10 \mathrm{~m} / \mathrm{s}$ )
3. A train experiences an acceleration of $-2.0 \mathrm{~m} / \mathrm{s}^{2}$. If the initial velocity of the train is $50 \mathrm{~m} / \mathrm{s}$, a. Find the time taken by the train to come to a stop. (Ans. 25 s )
b. Find the distance traveled by the train before it stops. (Ans. 625 m )
4. A ball is tossed straight up with a vertical velocity of $10 \mathrm{~m} / \mathrm{s}$.
a. What is the velocity of the ball at its highest point?
b. Find the maximum height reached by the ball. (Ans. 5.1 m )
c. Find the total time that the ball is in the air. (Ans. 1.0 s )

## Motion in 2-D

5. A plane flies due south with a velocity of $140 \mathrm{~m} / \mathrm{s}$. It experiences a wind velocity of $20 \mathrm{~m} / \mathrm{s}$ west. Draw a diagram and find the resultant velocity (magnitude and direction - include angle) of the plane. (Ans. $141 \mathrm{~m} / \mathrm{s}$ at $8.2^{\circ} \mathrm{W}$ of S or $81.8^{\circ} \mathrm{S}$ of W )
6. A river flows due east at $1.5 \mathrm{~m} / \mathrm{s}$. A boat crosses the river from the south shore to the north shore by maintaining a constant velocity of $10 \mathrm{~m} / \mathrm{s}$ due north relative to the water. Draw a vector diagram and find the resultant velocity of the boat (magnitude and direction-include angle). (Ans. $10.1 \mathrm{~m} / \mathrm{s}$ at $8.5^{\circ}$ East of North or $81.5^{\circ} \mathrm{N}$ of East)
7. A rock is thrown horizontally from a 100 m high cliff. It strikes level ground 90 m from the base of the cliff. At what speed was it thrown? $(19.9 \mathrm{~m} / \mathrm{s})$
8. A scared kangaroo once cleared a fence by jumping with a speed of $8.42 \mathrm{~m} / \mathrm{s}$ at an angle of $55.2^{\circ}$ with respect to the ground.
a. If the jump lasted 1.4 s , how high was the fence? ( 2.4 m )
b. What was the kangaroo's horizontal displacement? ( 6.7 m )

## Newton's Laws and Forces

9. Andrew pulls a 0.75 kg toy car with a horizontal applied force of 4.3 N . The car is moving with a constant velocity.
a. Draw a free-body diagram including $F_{A}, F_{f}, F_{g}$, and $F_{N}$.
b. Calculate the force of friction. (Ans. 4.3 N )
c. Calculate the coefficient of friction between the car tires and the floor. Is this the coefficient of static or kinetic friction? (Ans. 0.58)
d. If Andrew pulls the car for 2.3 m , how much work does he do on the car?(Ans. 9.9J)
10. Amber pushes a 1.35 kg book across the desk accelerating it at a constant rate. The coefficient of friction between the book and the desk is 0.088 . If she is applying a constant horizontal force of 6.40 N ,
a. Draw a free-body diagram and calculate the force of friction. (Ans. 1.17 N)
b. Calculate the horizontal net force. (Hint: Write an equation for the net horizontal force on the book using the force of friction and the horizontal applied force.) (Ans. 5.23 N)
c. Calculate the horizontal acceleration of the book. (Ans. $3.9 \mathrm{~m} / \mathrm{s}^{2}$ )

Circular Motion and Universal Gravitation
11. A 5 kg dog is attached to a leash that is 6 m long. He runs in circles chasing a squirrel while his owner applies a force of 15 N .
a. What is the speed of the dog? (Ans: $4.24 \mathrm{~m} / \mathrm{s}$ )
b. What is the dog's period? (Ans: 8.9 s )
c. What is the frequency of the dog? (Ans: 0.11 Hz or $0.11 \mathrm{rev} / \mathrm{s}$ )
12. A 20 kg car travels at $18 \mathrm{~m} / \mathrm{s}$ around a curve with radius 100 m . What minimum coefficient of friction between the tires and road will allow the car to round the curve safely? (Ans: 0.33 )
13. The gravitational force between Dan and Carl is $4 \times 10^{-7} \mathrm{~N}$. If Dan has a mass of 45 kg and Carl has a mass of 60 kg then how far apart are Dan and Carl? (Ans: 0.67m)
14. Planet $X$ has a mass of $3 \times 10^{26} \mathrm{~kg}$ and radius of $5.5 \times 10^{7} \mathrm{~m}$.
a. What is the acceleration due to gravity on planet $X$ ? (Ans: $6.61 \mathrm{~m} / \mathrm{s}^{2}$ )
b. What is the orbital velocity of a moon $7.5 \times 10^{8} \mathrm{~m}$ away from planet $X$ ? (Ans: $5165 \mathrm{~m} / \mathrm{s}$ )
c. What is the orbital period of the moon? (Ans: 912370 s)

