Final Exam

SABIC Physics, Winter 2016

Name:

Problem 1.(12 points.) Short answer–no more than one sentence each.

(a) If $\vec{C} = \vec{A} + \vec{B}$ and $|C| = |A| + |B|$, then what must be true about $\vec{A}$ and $\vec{B}$?

(b) A dripping shower faucet releases drops at a rate of 10 per second (or one drop every 0.1s). Find the seperation (difference in height) between two consecutive drops when (i) the topmost drop just leaves the faucet, and (ii) when the bottommost drop is 1m below the faucet.

(c) James Bond's Aston Martin strikes a henchman's BMW head on, and the henchman, not wearing his seatbelt, is thrown out of the front of his car. Use Newton's laws of motion to explain why this happens.

(d) A force exerts total work W to accelerate an object from rest to 10m/s. In terms of W, how much work must be done to accelerate the object from that 10m/s to 20m/s?

(e) Two objects A and B are launched into the air using identical springs compressed by the same distance. The mass of object A is twice the mass of object B. At its maximum height, object B has a potential energy of 100J. What is the gravitational potential energy of object A at its own maximum height?

Problem 2.(14 points.) (Motion in 2 dimensions): A shell is fired with initial velocity 40m/s at 60° above the horizontal and feels no air resistance.

(a) Find the horizontal and vertical components of the initial velocity

(b) Calculate the time it takes for the shell to reach its highest point.

(c) Find the maximum height the shell reaches above the ground.

(d) How far from the firing point does the shell land?

(e) At its highest point, find the horizontal and vertical components of its acceleration and velocity.

Problem 3.(14 points.) (Work and kinetic energy, Newton's Laws): A 5.00kg package slides 2.80m down a long ramp inclined 24.0° below the horizontal. The coefficient of kinetic friction between the package and the ramp is $\mu_k = 0.310$.

(a) Draw a force diagram on the package, and label all forces.

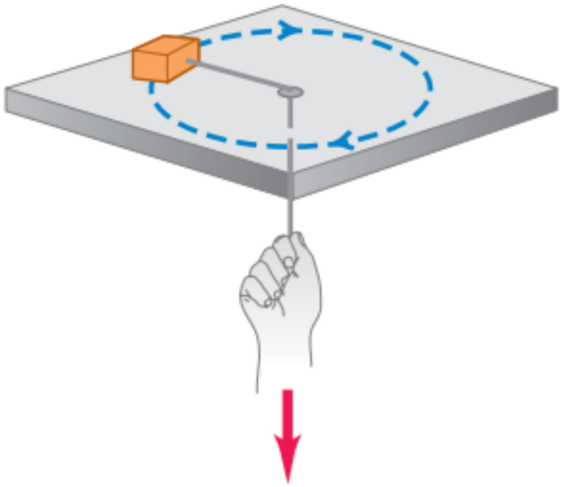
(b) Using Newton's Laws, calculate the acceleration on the package.

(c) Calculate the work done by friction on the package.

(d) Calculate the work done by gravity on the package.

(e) What is the final velocity of the package after it slides the 2.80m if the initial velocity was 2.20m/s?

Problem 4.() (Energy and motion in a circle) A small block with a mass of 0.06kg is attached to a cord passing through a hole in a frictionless, horizontal surface (see figure), which you hold with your hand. The block is originally revolving at a distance of 0.4m from the holes with a speed of 0.70m/s.



(a) Calculate the tension on the string.

(b) How much work is done by this tension force to keep the block revolving in a circle?

(c) You then pull the string, shortening the radius of the circle in which the block revolves to 0.1m, and increasing its speed to 2.8m/s. Calculate the new tension of the cord.

(d) How much work did you do to shorten the radius of the circle?

(e) Calculate the average tension on the string during the time you shortened the circle.