Midterm Exam No. 01 (2018 Spring)

PHYS 205A-001: University Physics

Date: 2018 Feb 12

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(Name)   (Signature)

Instructions

1. Seating direction: Please be seated on seats with seat-numbers divisible by 3.

2. Total time = 50 minutes.

3. There are 7 questions in this exam.

4. Equation sheet is provided separately.

5. To be considered for partial credit you need to show your work in detail and organize it clearly.

6. A simple calculator (with trigonometric functions) is allowed.

7. Use of mobile phones is strictly prohibited. It should stay out of reach during the exam.

1. (**10 points.**) You come across the following expression

$$K = \pi(r_1 + r_2)\sqrt{h^2 + (r_2 - r_1)^2},\qquad(1)$$

where the variables r_1 and r_2 represent distances. You do not know the definitions of the variables h and K a priori. Using dimensional analysis deduce if h could represent a perimeter, a area, or a volume. That is, what is the dimension of h?

2. (**10 points.**) An object moves along the x axis according to the equation

$$x = 2.75\,t^2 - 2.00\,t + 3.00, \tag{2}$$

where x is in meters and t is in seconds. Determine the instantaneous acceleration at $t = 2.87\,\mathrm{s}$.

3. (**10 points.**) A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes 2.90 s for the ball to reach its maximum height. Find the ball's initial velocity.

4. (**10 points.**) A fish is dropped by a pelican that is rising steadily at a speed $v_i = 4.0\,\mathrm{m/s}$. Determine the time taken for the fish to reach the water $30.0\,\mathrm{m}$ below.

5. (**10 points.**) If three vectors satisfy the relations

$$3\vec{\mathbf{A}} + 4\vec{\mathbf{B}} = \vec{\mathbf{C}}, \tag{3}$$
$$2\vec{\mathbf{A}} + 3\vec{\mathbf{B}} = 2\vec{\mathbf{C}}, \tag{4}$$

where

$$\vec{\mathbf{C}} = 3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}}, \tag{5}$$

then what are $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ in component form?

6. (**10 points.**) A placekicker must kick a football from a point 36.0 m (about 40 yards) from the goal. Half the crowd hopes the ball will clear the crossbar, which is 3.05 m high. When kicked, the ball leaves the ground with a speed of 20.0 m/s at an angle of 40.0° to the horizontal. By how much does the ball clear or fall short of clearing the crossbar? (Enter a negative answer if it falls short.)

7. (**10 points.**) A ball is dropped from rest from a building's roof and passes a window, taking $0.125\,\mathrm{s}$ to fall from the top to the bottom of the window, a distance of $1.50\,\mathrm{m}$. Determine the height between the window top and the building's roof.