College of Arts and Sciences
Department of Mathematics, Statistics, and Physics
Physics Program
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Name……
Student ID……List #……
Section:……

Physics for Engineers I (PHYS 191)
and
General Physics I (PHYS 101)
Spring 2015
Exam 1
March 24, 2015

Please read the following instructions carefully before you start answering:

1. Make sure that you have **7** pages including two parts, A and B. Part A consists of 10 multiple choice questions, while Part B consists of 3 problems.
2. Answer all the questions and show all the steps of your work in part B in a clear tidy way.
3. Calculators are permitted but no electronic dictionaries.
4. Include units in all calculations and answers.
5. All your work must be done on your exam paper; no loose papers are allowed. If additional space is required use the last page and indicate that this has been done.
6. This is a timed exam (90 min). Do not spend too much time in any particular question.

Useful Information:

$\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$, $\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t}$, $\vec{v} = \lim_{\Delta t\to 0}\frac{\Delta\vec{r}}{\Delta t} = \frac{d\vec{r}}{dt}$, $\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t}$, $\vec{a} = \lim_{\Delta t\to 0}\frac{\Delta\vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$

$v_x = v_{0x} + a_x t$, $x = x_0 + v_{0x}t + \frac{1}{2}a_x t^2$, $v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$, $x - x_0 = \left(\frac{v_{0x}+v_x}{2}\right)t$

$v_x = v_{0x} + \int_0^t a_x\, dt$, $x = x_0 + \int_0^t v_x\, dt$, $a_{rad} = \frac{v^2}{R}$; g = 9.80 m/s^2

Good Luck

Part A: *Please choose the correct answer for each question*

Question 1: (1 pt) What is the result of 1.58 ÷ 3.793 written with the correct number of significant figures?

A) 4.1656×10^{-1}
B) 4.166×10^{-1}
C) 4.17×10^{-1}
D) 4.2×10^{-1}
E) 4×10^{-1}

Question 2: (1 pt) The speed of a wave on a string depends on the tension, T, in the string and the mass per unit length, μ, of the string. Tension has SI units of $kg.m.s^{-2}$ and the mass per unit length has SI units of $kg.m^{-1}$. What combination of T and μ must the speed of the wave be proportional to?

A) $\frac{T}{\mu}$
B) $\frac{\mu}{T}$
C) $\sqrt{\mu T}$
D) $\sqrt{\frac{T}{\mu}}$
E) $\sqrt{\frac{\mu}{T}}$

Question 3: (1 pt) Let $\vec{R} = \vec{S} \times \vec{T}$ and $\theta \neq 90°$, where θ is the angle between $\vec{S}$ and $\vec{T}$ when they are drawn with their tails at the same point. Which of the following is NOT true?

A) $\left|\vec{R}\right| = \left|\vec{S}\right|\left|\vec{T}\right| \sin\theta$
B) $-\vec{R} = \vec{T} \times \vec{S}$
C) $\vec{R} \cdot \vec{S} = 0$
D) $\vec{R} \cdot \vec{T} = 0$
E) $\vec{S} \cdot \vec{T} = 0$

Question 4: (1 pt) Determine the angle between the directions of vector $\vec{A} = 3.00\,\hat{\imath} + 1.00\,\hat{\jmath}$ and vector $\vec{B} = -3.00\,\hat{\imath} + 3.00\,\hat{\jmath}$.

A) 26.6°
B) 30.0°
C) 45.2°
D) 88.1°
E) 117°

Question 5: (1 pt) When can we be certain that the average velocity of an object is always equal to its instantaneous velocity?

A) always
B) never
C) only when the velocity is constant
D) only when the acceleration is constant
E) only when the acceleration is changing at a constant rate

Question 6: (1 pt) A ball is thrown directly upward and experiences no air resistance. Which one of the following statements about its motion is correct?

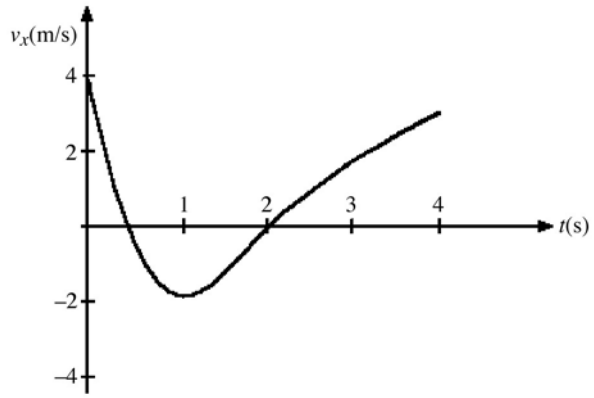
A) The acceleration of the ball is upward while it is traveling up and downward while it is traveling down.
B) The acceleration of the ball is downward while it is traveling up and upward while it is traveling down.
C) The acceleration is downward during the entire time the ball is in the air.
D) The acceleration of the ball is downward while it is traveling up and downward while it is traveling down but is zero at the highest point when the ball stops.
E) None of the above.

Question 7: (1 pt) An object has a position given by $\vec{r} = [2.0\text{ m} + (3.00\text{ m/s})t]\hat{\boldsymbol{\imath}} + [3.0\text{ m} - (2.00\text{ m/s}^2)t^2]\hat{\boldsymbol{\jmath}}$, where all quantities are in SI units. What is the magnitude of the acceleration of the object at time $t = 2.00$ s?

A) 0.00 m/s^2
B) 0.522 m/s^2
C) 1.00 m/s^2
D) 2.00 m/s^2
E) 4.00 m/s^2

Question 8: (1 pt) The figure below shows the velocity of a particle as it travels along the x-axis. What is the direction of the acceleration at $t = 0.5$ s?

A) in the $+x$ direction
B) in the $-x$ direction
C) the acceleration is zero
D) None of the above



Question 9: **(1 pt)** Two particles, *A* and *B*, are in uniform circular motion about a common center. The acceleration of particle *A* is 8.5 times that of particle B. The period of particle B is 2.0 times the period of particle A. The ratio of the radius of the motion of particle A to that of particle B is closest to

A) $r_A/r_B = 2.1$.
B) $r_A/r_B = 4.3$.
C) $r_A/r_B = 18$.
D) $r_A/r_B = 0.24$.
E) $r_A/r_B = 17$.

Question 10: **(1 pt)** A ball is tied to the end of a cable of negligible mass. The ball is spun in a circle with a radius of 2.00 m making 7.00 revolutions every 10.0 seconds. What is the magnitude of the acceleration of the ball?

A) 14.8 m/s^2
B) 29.3 m/s^2
C) 38.7 m/s^2
D) 67.9 m/s^2
E) 74.2 m/s^2

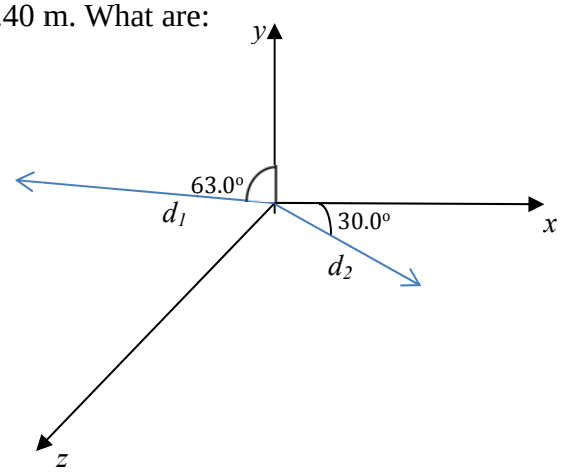
Part B: *Please solve the following problems showing all the steps of your solutions.*

Problem 1: (3 pts) Displacement $\vec{d}_1$ is in the *yz* plane 63.0° from the positive direction of the *y*-axis, has a positive *z* component, and has a magnitude of 4.80 m. Displacement $\vec{d}_2$ is in the *xz* plane 30.0° from the positive direction of the *x*-axis, has a positive *z* component, and has magnitude 1.40 m. What are:

(a) The scalar product $\vec{d}_1 . \vec{d}_2$?

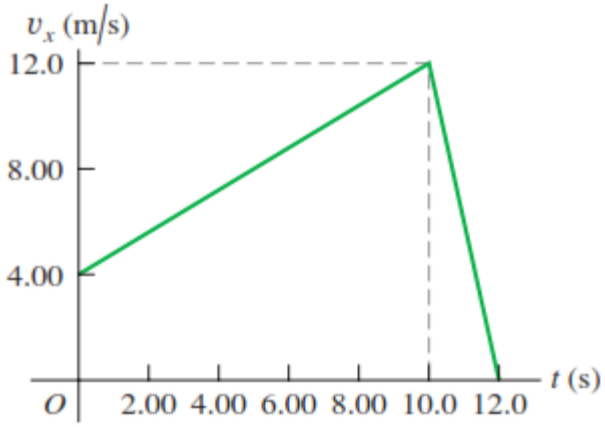
(b) The vector product $\vec{d}_1 \times \vec{d}_2$?

(c) the angle between $\vec{d}_1$ and $\vec{d}_2$.



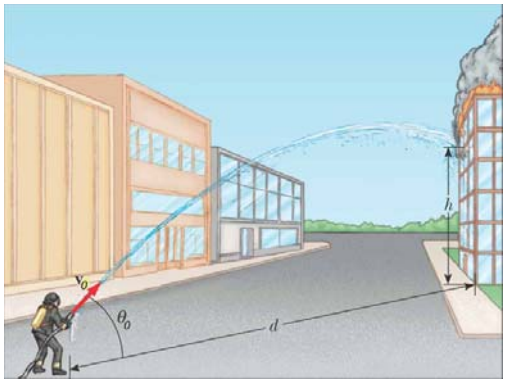
Problem 2: **(3 pts)** A gazelle is running in a straight line (the x-axis). The graph in the figure below shows this animal's velocity as a function of time during the first 12.0 s.

a) Find the total distance moved by the gazelle during this 12.0 s.
b) What is the gazelle's average acceleration during this 12.0 s?
c) Sketch an a_x-t graph showing the gazelle's instantaneous acceleration as function of time.



Problem 3: (4 pts) A fireman is shooting a stream of water at a burning building using a high-pressure hose that shoots out the water with a speed of 25.0 m/s as it leaves the end of the hose. Once it leaves the hose, the water moves in projectile motion with negligible air resistance. The fireman adjusts the angle of elevation θ_0 of the hose so the water takes 3.00 s to reach the building which is 45.0 m away. Take origin of your reference frame at the launching point.

a) Find θ_0 , the angle of elevation at time t =0. (2pts)
b) Find the speed and acceleration of the water at the highest point in its trajectory. (1pt)
c) At what height above the launching point does the water strike the building? (1pt)



End of Exam