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Physics Program
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Name:.....
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Physics for Engineers I (PHYS 191)
and
General Physics I (PHYS 101)
Fall 2015
Exam 1
November 3, 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 12 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 (120 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) Under what condition is $|\vec{A} - \vec{B}| = A + B$?

A) The magnitude of vector $\vec{B}$ is zero.
B) Vectors $\vec{A}$ and $\vec{B}$ are in opposite directions.
C) Vectors $\vec{A}$ and $\vec{B}$ are in the same direction.
D) Vectors $\vec{A}$ and $\vec{B}$ are in perpendicular directions.
E) The statement is never true.

Question 2: (1 pt) The angle between vector $\vec{A} = 2.00\,\hat{\boldsymbol{i}} + 3.00\,\hat{\boldsymbol{j}}$ and vector $\vec{B}$ is 45.0°. The scalar product of vectors $\vec{A}$ and $\vec{B}$ is 3.00. If the *x* component of vector $\vec{B}$ is positive, what is vector $\vec{B}$.

A) $4.76\hat{\boldsymbol{i}} + 0.952\hat{\boldsymbol{j}}$
B) $3.42\hat{\boldsymbol{i}} + 0.684\hat{\boldsymbol{j}}$
C) $2.96\hat{\boldsymbol{i}} - 0.973\hat{\boldsymbol{j}}$
D) $0.871\hat{\boldsymbol{i}} + 0.419\hat{\boldsymbol{j}}$
E) $1.15\hat{\boldsymbol{i}} + 0.231\hat{\boldsymbol{j}}$

Question 3: (1 pt) What is the result of $1.58 \div 3.793$ 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 4: (1 pt) The period of a pendulum is the time it takes the pendulum to swing back and forth once. If the only dimensional quantities that the period depends on are the acceleration of gravity, *g*, and the length of the pendulum, ℓ, what combination of *g* and ℓ must the period be proportional to? (Acceleration has SI units of $m.s^{-2}$).

A) g/ℓ
B) $g\ell^2$
C) $g\ell$
D) $\sqrt{g\ell}$
E) $\sqrt{\ell / g}$

Question 5: (1 pt) A ball rolls across a floor with an acceleration of 0.100 m/s^2 in a direction opposite to its velocity. The ball has a velocity of 4.00 m/s after rolling a distance 6.00 m across the floor. What was the initial speed of the ball?

A) 4.15 m/s
B) 5.85 m/s
C) 4.60 m/s
D) 5.21 m/s
E) 3.85 m/s

Question 6: (1 pt) The acceleration of an object as a function of time is given by $a(t) = (3.00\ \text{m/s}^3)t$, where t is in seconds. If the object is at rest at time $t = 0.00$ s, what is the velocity of the object at time $t = 6.00$ s?

A) 18.0 m/s
B) 54.0 m/s
C) 0.00 m/s
D) 15.0 m/s
E) 108 m/s

Question 7: (1 pt) A car accelerates from 10.0 m/s to 30.0 m/s at a rate of 3.00 m/s^2. How far does the car travel while accelerating?

A) 80.0 m
B) 133 m
C) 226 m
D) 399 m
E) 0 m

Question 8: (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 9: (1 pt) For general projectile motion, when the projectile is at the highest point of its trajectory

A) its acceleration is zero.
B) its velocity is perpendicular to the acceleration.
C) its velocity and acceleration are both zero.
D) the horizontal component of its velocity is zero.
E) the horizontal and vertical components of its velocity are zero.

Question 10: (1 pt) An electrical motor spins at a constant 2857.0 rev/min. If the armature radius is 2.685 cm, what is the acceleration of the outer edge of the armature?

A) 2403 m/s^2
B) 844.4 m/s^2
C) 241,100 m/s^2
D) 84.40 m/s^2
E) 0 m/s^2

Question 11: (1 pt) If an object travels at a constant speed in a circular path, the acceleration of the object is

A) larger in magnitude the smaller the radius of the circle.
B) in the same direction as the velocity of the object.
C) smaller in magnitude the smaller the radius of the circle.
D) in the opposite direction of the velocity of the object.
E) zero.

Question 12: (1 pt) An object has a position given by $\vec{r}$ = [2.0 m + (3.00 m/s)t]$\hat{\imath}$ + [3.0 m - (2.00 m/s^2)t^2]$\hat{\jmath}$, where all quantities are in SI units. What is the magnitude of the acceleration of the object at time t = 2.00 s?

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

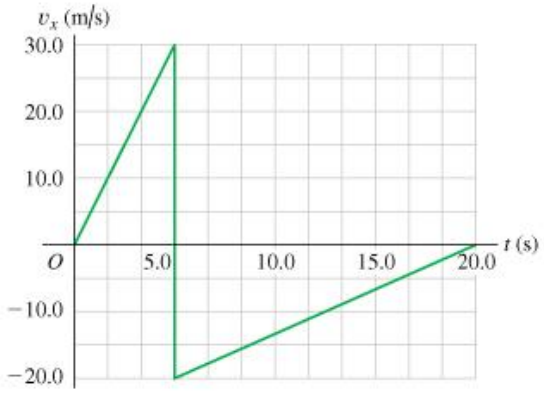
Part B: *Please solve the following problems showing all the steps of your solutions.*

Problem 1: (3 pts) You are to program a robotic arm on an assembly line to move in the *xy*-plane. Its first displacement is $\vec{A}$; its second displacement is $\vec{B}$ of magnitude 6.40 cm and direction 63.0° measured in the sense from the +*x*-axis toward the −*y*-axis. The resultant $\vec{C} = \vec{A} + \vec{B}$ of the two displacements should also have a magnitude of 6.40 cm, but a direction 22.0° measured in the sense from the +*x*-axis toward the +*y*-axis.

a) Draw the vector-addition diagram for these vectors, roughly to scale.
b) Find the components A_x and A_y of $\vec{A}$.
c) Find the magnitude and direction of $\vec{A}$.

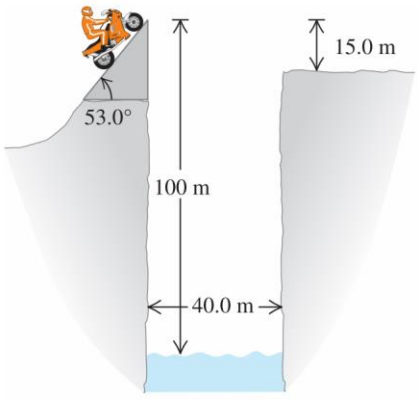
Problem 2: **(3 pts)** A rigid ball traveling in a straight line (the *x*-axis) hits a solid wall and suddenly rebounds during a brief instant. The graph in in the figure below shows this ball's velocity as a function of time. During the first 20.0 s of its motion, find:

a) The total distance the ball moves
b) Its displacement.
c) Sketch a graph of for this ball's motion (*x*-t graph).



Problem 3: (3 pts) A person attempts to jump across a river on a motorcycle. The takeoff ramp was inclined at 53.0°, the river was 40.0 m wide, and the far bank was 15.0 m lower than the top of the ramp. The river itself was 100 m below the ramp. You can ignore air resistance.

a) What should his speed have been at the top of the ramp to have just made it to the edge of the far bank?
b) If his speed was only half the value found in part (a), where did he land?



End of Exam