Name, Surname:	Signature:
Exam Room: SOS B21	Student ID Number:

PHYS 102 General Physics I – Midterm 1

9 March, 2018 Thursday 19:00 -20:50

Please read!

- Count to make sure that there are 7 pages in the question booklet.
- Check your name and surname on front page, and student ID number on each page, and sign each page.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct!).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are not allowed to use calculators during this exam.

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Short Questions

1	2	3	4	5	6	7	8	9	10

Problems

1	2	3	4

TOTAL

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1- SHORT QUESTIONS (3 points each)

1. Given $\vec{a} = \vec{\imath} + 2\vec{j} - \vec{k}$, $\vec{b} = \vec{j} + \vec{k}$, $\vec{c} = \vec{\imath} - j$, what is $\vec{c} \cdot (\vec{a} \times \vec{b})$ =?

a) 2 b) 4 c) 6 d) 8 e) None

2. Consider the same vectors as above. What is the angle between $\vec{b}$ and $\vec{c}$?

a) π/3 b) π/6 c) −π/3 d) −π/6 e) None.

3. What does the vector $\vec{\imath} \times (\vec{\imath} \times \vec{j})$ equal to?

a) $\vec{0}$ b) $\vec{k}$ c) $\vec{j}$ d) $-\vec{j}$ e) None

4. The position of a material point that is moving along the positive x-axis is given as a function of time t by $x(t) = 3t^2 - 2t - t^3$ (in meters). What is the average velocity of this object during the time interval from t = 1 to t = 3? (in m/sec)

a) -4 b) 4 c)-3 d) -2 e) None

5. A train starts from rest to move on a straight horizontal track with constant acceleration. It reaches the speed 20 m/s after 1500 meters. How long does it take the train to reach this speed?

a) 1 minute b) 2 minutes c) $2\frac{1}{2}$ minutes d) 3 minutes e) None

6. A mass is hanged by a string to the ceiling of an elevator. Which of the following corresponds to minimum tension on the string?

a) Elevator is at rest.

b) Elevator is going up at constant speed.

c) Elevator is accelerating upwards.

d) The elevator is going down at constant speed.

e) Elevator is coming to a stop as it moves upwards.

Solution continues on the back side of the page **Yes** □ **No** □

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7. The arm of a ventilator fan is 25cm long. If the fan is rotating uniformly at 120 cycles per minute, then what would be the magnitude and the direction of the radial acceleration (in m/s^2) of the tip of the ventilator fan?

a)2 π^2 towards the center.

b) 4 π^2 towards the center

c) $4\pi^2$ away from the center

d) $2\pi^2$ away from the center

e) None of the above.

8. A car traveling at a constant speed of 20 m/s enters a curve with a radius of curvature equals to 100 m. What should be the minimum value of the coefficient of static friction between the road and the tires so that the car remains on the road?

a) 3/10 b) 1/10 c) 1/5 d) 2/5 e) 3/5

9. A horizontal force of at least 200 N must be applied to a body of weight 500 N to set it in motion on a horizontal surface. Once in motion a horizontal force of 100 N is sufficient to keep it going at constant speed. What are the static and kinetic coefficients of friction between the body and the surface?

a) (2,1) b) (1/5,2/5) c) (1/5,3/5) d) (2/5,1/5) e) (3/5,1/5)

10. Two cubical blocks of masses m_1 and m_2 on a smooth horizontal surface are side by side touching each other. If the block m_1 is pushed by a force F, then what would be the magnitude of the normal force between these bodies for $m_2 = 2m_1$?

a) 2/3 F b) 3/2 F c) 1/3 F d) 3F e) 2F

 Solution continues on the back side of the page **Yes** □ **No** □

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PROBLEMS (20 points each) Write all the relevant equations and show details of your calculations.

Problem 1 A brick falls off from the roof at the top of a building and passes across the window of the flat below. Ignore air resistance. It takes the brick 0.380 s to pass from the top to the bottom of the window, that is 1.90 m high. How far is the top of the window to the roof top from which the brick fell?

Solution continues on the back side of the page **Yes** □ **No** □

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Problem 2 Firemen use a high-pressure hose to shoot a stream of water at a burning house. The water has a speed of 25.0 m/s as it leaves the end of the hose and then exhibits projectile motion. The firemen adjust the angle of elevation θ of the hose until the water takes 3.00 s to reach a house 45.0 m away. Ignore air resistance; assume the end of the hose is at the ground level.

i) Determine θ =?

ii) What will be the speed and acceleration of the water at the highest point of its trajectory?

iii) How high above the ground does the water strike the house, and how fast is it moving just before it hits the house?

Solution continues on the back side of the page **Yes** □ **No** □

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Problem 3 The engines of an old oil tanker sailing down the Bosphorus has suddenly stopped. The surface current is taking the tanker straight towards the shore directly ahead at a constant speed of 3.5 m/s. When the tanker is 900 m away from the shore engines start to work but the rudder is stuck. The only choice is to accelerate backwards from the shore. The total mass of the tanker and its cargo is 12000 tons and the engines produce a net horizontal force of $8.0 \times 10^4 N$ on the tanker.

i) Will the tanker hit the shore?

ii) If it does, will the oil be safe? Suppose the hull can withstand an impact at a speed of 0.6m/s or less. Ignore the retarding force of water on the tanker's hull.

 Solution continues on the back side of the page **Yes** □ **No** □

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Problem 4 Suppose that a block of mass m_1 = 22.0kg moves on an inclined plane that makes an angle $\theta \cong 370$ with the horizontal. The coefficient of kinetic friction between the body and the inclined plane is given as μ_K = 0.40. This block is tied to a rope that passes over a pulley and a second mass m_2 is hung vertically at the other end of the rope. What must be m_2 so that the hanging block drops a distance of 12m during the first 3.0 s after the system is released from rest?

 Solution continues on the back side of the page **Yes** □ **No** □