Time of completion _____ Cadet _____ Section_____
18 November 2003 Version 2

DEPARTMENT OF PHYSICS
PH203, Physics I
Written Partial Review II

1. Instructions:

   a. Bring only a hand-held calculator, a straight-edge, and pencil(s) into the examination room.

   b. Check your exam for four problems and one bonus problem on eight pages. Write your name and section at the top of each page. Check for the Physics Reference Card provided with the exam.

   c. For calculation problems, **show all work**; partial credit will be given for correct work shown.

   d. Take up to 55 minutes to complete the examination. If you leave early, record your time of completion above.

   e. BONUS problems are optional.

2. An instructor is in the hall.

3. Grading summary (**for instructor use only**):

PROBLEM	WEIGHT	SCORE
1	75	
2	100	
3	100	
4	75	
SUBTOTAL	350	
BONUS	20	
TOTAL	350	

_____%

Wt. No. Cadet_____

75 1. During an assignment at the Army Research Laboratory, you are required to determine the wavelength of a new laser. You send the beam of the laser through a 0.285 mm wide slit in a single-slit diffraction experiment. The diffracted laser beam is allowed to strike a screen 6.12 m from the slit. You measure the distance from the center of the pattern to the third order minimum to be 3.63 cm.

(60) a. Calculate the wavelength of the laser.

$\lambda = \underline{\underline{5.63x10^{-7}\ \text{m}}}_{\text{ANS}}$

(15) b. Assume you replace the above laser with one that has a longer wavelength. In order to maintain the same distance of 3.63 cm from the central maximum to the third order minimum of the diffraction pattern, determine whether you should increase, decrease, or keep the same, the separation distance between the slit and the screen. Justify your response.

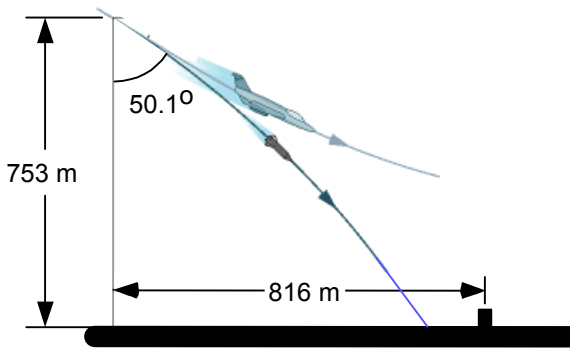
from part a.,

$$D = \frac{ya}{m\lambda}$$

therefore, if you increase λ then D must $\underline{\underline{\text{decrease}}}_{\text{ANS}}$

Wt. No. Cadet_____

100 2. A bomber diving at an angle of 50.1^{o} from the vertical releases a bomb at a vertical distance of 753 m above the target and at a horizontal distance of 816 m from the target as shown. The bomb reaches the ground in 5.11 s. Neglect air resistance.



(60) a. Calculate the bomb's velocity just after it is released. Report your result using the unit vector notation.

$$\vec{v}_o = \underline{\underline{(146\hat{i} - 122\hat{j})\ \text{m/s}}}_{\text{ANS}}$$

2. (cont'd)

(40) b. Calculate whether the target lies within the burst radius of the bomb. The burst radius of the bomb is 49.3 m.

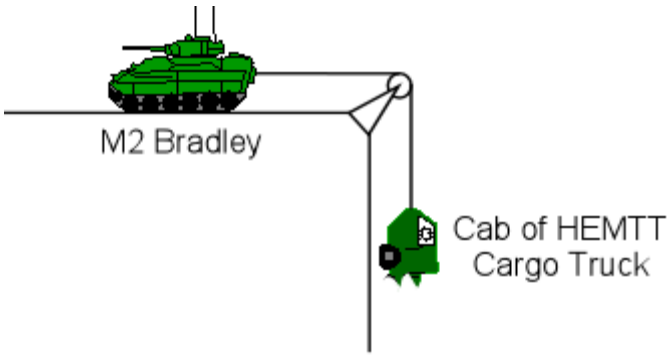
$R = 749 \text{ m}$

$749 \text{ m} + 49.3 \text{ m} < 816 \text{ m}$
ANS

the target does not lie within the burst radius of the bomb.

Wt. No. Cadet_____

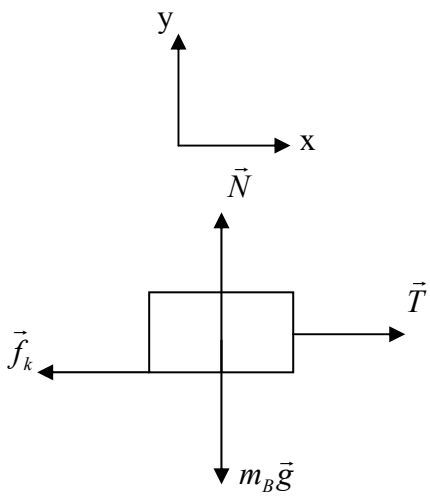
100 3. The cab of the Heavy Expanded Mobility Tactical Truck (HEMTT) Cargo Truck, with a mass of 12,500 kg, is being lifted from a canyon floor by an M2 Bradley after a recent accident. The M2 Bradley's transmission locks up and the M2 Bradley starts to slide backward on its locked treads. The tension in the cable connecting the HEMTT to the M2 Bradley is 115,000 N. The coefficient of kinetic friction between the M2 Bradley and the ground is 0.316. Assume the pulley is massless and frictionless. Neglect the mass of the cable and neglect air resistance.



(20) a. The force of kinetic friction (circle each correct answer)

(1.) does not vary with the speed of the M2 Bradley.
(2.) is equal to the weight of the M2 Bradley times the coefficient of kinetic friction.
3. is greater than the maximum force of static friction.
4. is in the direction of the motion of the M2 Bradley.

(20) b. Draw a free-body diagram of the M2 Bradley.



3. (cont'd)

(60) c. Calculate the mass of the M2 Bradley.

$$m_B = \underline{\underline{31{,}100\ \text{kg}}}_{\text{ANS}}$$

Wt. No. Cadet_____

75 4. Milstar is a joint service satellite communications system that provides secure, jam resistant, worldwide communications to meet essential wartime requirements for high priority military users. Each satellite has a mass of 4,540 kg and orbits the Earth at an altitude of 35,900 km. Assume the Earth has a mass of 5.98×10^{24} kg and mean radius of 6,370 km.

(45) a. Calculate the magnitude of the gravitational acceleration experienced by a Milstar satellite.

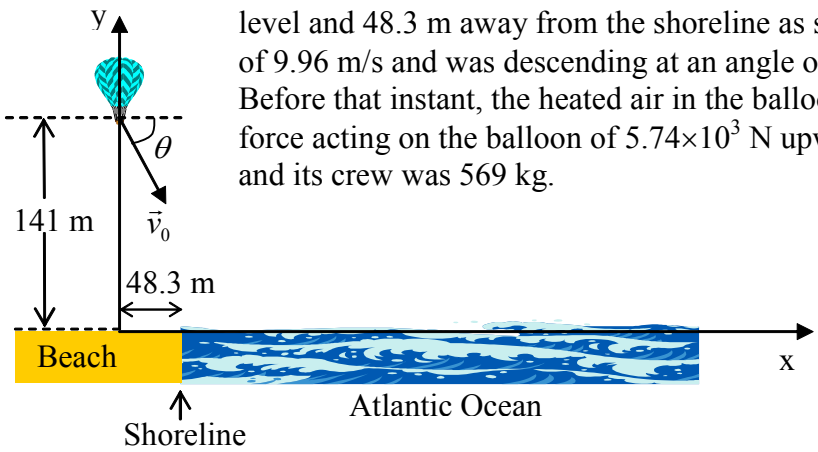
$a_x = \underline{\underline{0.223\ \text{m/s}^2}}_{\text{ANS}}$

(30) b. Assume the answer to part a. is 0.344 m/s^2. Calculate the speed with which a Milstar satellite is orbiting the Earth.

$v = \underline{\underline{3{,}810\ \text{m/s}}}_{\text{ANS}}$

Wt. No. Cadet_____

20 BONUS A civil war reconnaissance balloon was attempting to land on a beach. When the balloon's crew realized it would land in the ocean instead, they started to heat the air in the balloon. At the instant the balloon was 141 m above sea level and 48.3 m away from the shoreline as shown, the balloon had a speed of 9.96 m/s and was descending at an angle of $\theta = 60.9^{o}$ below the horizontal. Before that instant, the heated air in the balloon had resulted in a constant force acting on the balloon of 5.74×10^{3} N upward. The mass of the balloon and its crew was 569 kg.



(10) a. Calculate the altitude of the balloon when it passed above the shoreline.

$h = \underline{68.5\text{ m}}_{\text{ANS}}$

BONUS (cont'd)

(10) b. Calculate the height above the water when the balloon starts to ascend.

$h = \underline{9.45\ \text{m}}_{\text{ANS}}$