Time of completion _____ Cadet _____ Section_____
13 November 2004 Version 1

DEPARTMENT OF PHYSICS
PH203, Physics I
Written Partial Review II

1. Instructions:

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

   b. Check your exam for five problems and three bonus problems 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 may 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	65	
2	85	
3	95	
4	75	
5	30	
SUBTOTAL	350	
BONUS	20	
TOTAL	350	

_____%

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65 1. Light with a wavelength of 684 nm is used to create a double-slit interference pattern on a screen that is 3.45 m away from the slits. The slit separation is 0.781 mm. Determine whether a bright spot or a dark spot is observed 2.72 cm from the center of the pattern. Justify your answer.

Ans: A bright spot is at this location since the equation modeling bright spots gives an integer value for m.

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85 2. Your mortar platoon is tasked to train a group of Afghan soldiers in the use of the 81-mm mortar. To prevent fratricide of friendly aircraft, you have a fire control measure that restricts fires 3.25 km above your firing position. You fire a round using a charge that produces an initial speed of 334 m/s while the mortar is set at an angle of 48.1° above the horizontal. Neglect air resistance.

(50) a. Will this round remain within the required height? Justify your answer.

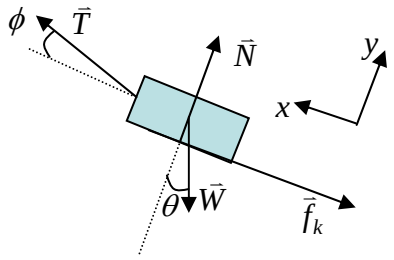
Ans: Yes, the round remains within the required height because the maximum height is 3150 m.

(35) b. Calculate the time it takes the round to achieve its maximum height.

Ans: $t = 25.4\text{s}$

95 3. You are loading an ammunition pallet onto a CH-47 Chinook aircraft for resupply to your company. You tie a rope to the pallet and pull it up the loading ramp of the aircraft with the help of the crew. The ramp of the aircraft is 27.4° above the horizontal. The coefficient of kinetic friction between the pallet and the ramp is 0.591. The ammunition pallet has a mass of 362 kg. You pull on the rope at an angle of 7.04° above the surface of the ramp.

(30) a. Construct a free body diagram of the pallet on the ramp.



(65) b. Calculate the magnitude of the tension in the rope that is necessary to accelerate the pallet up the ramp at 0.255 m/s^2 once the pallet begins moving.

Ans: T = 3370N

75 4. Derive the law of periods for the special case of circular orbits. Use Newton's second law, the definitions of radial acceleration and average speed, and Newton's law of gravitation in your derivation.

$$\sum F_{ext,r} = ma_r$$

$F_{12} = m_1 a_r$ (5)

Sub (2) & (3) into (5)

$$\frac{Gm_1m_2}{r_{12}^2} = m_1\frac{v^2}{r_{12}} \quad (6)$$

using (4) for a circular orbit

$dx = 2\pi r_{12}$

and the time for one orbit is

$dt = T$, the period so,

$$v = \frac{2\pi r_{12}}{T} \quad (7)$$

Sub (7) into (6)

$$\frac{Gm_1m_2}{r_{12}^2} = m_1\frac{4\pi^2 r_{12}^2}{T^2 r_{12}}$$

$$T^2 = \frac{4\pi^2 r_{12}^3}{Gm_2}$$

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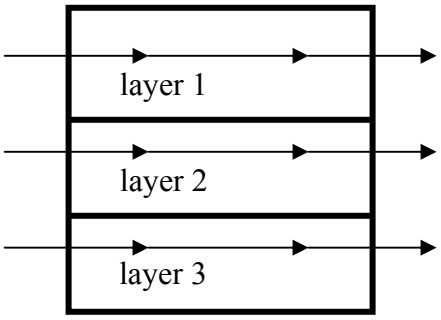
30 5. Circle the best answer in the following multiple choice questions.

(10) a. The light waves represented by the three rays shown in the diagram below all have the same frequency. 4.7 wavelengths fit into layer 1, 3.2 wavelengths fit into layer 2, and 5.3 wavelengths fit into layer 3. Rank the layers according to their indices of refraction, least to greatest.



A. 1, 2, 3
B. 2, 1, 3
C. 3, 1, 2
D. 3, 2, 1
E. 1, 3, 2

(10) b. Monochromatic light, at normal incidence, strikes a thin film in air. If λ_n denotes the wavelength in the film, what is the thinnest film in which the reflected light will be a maximum?

A. Much less than λ_n
B. $\lambda_n/4$
C. $\lambda_n/2$
D. $(3\lambda_n)/4$
E. λ_n

(10) c. In a Young's double-slit experiment, the center of a bright fringe occurs wherever waves from the slits differ in the distance they travel by a multiple of:

A. a fourth of the wavelength
B. a half of the wavelength
C. a wavelength
D. three fourths of the wavelength
E. none of the above

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10 BONUS 1 Calculate the displacement, x, of a block sliding down a frictionless, inclined ramp using the following equation. Report the displacement as a confidence interval.

$$x = \frac{1}{2} g \sin(\theta) t^2$$

Use the following values:

Angle of inclination	(0.195±0.002) rad
Elapsed time	(2.71±0.01) s
Acceleration due to gravity	(9.80±0.03) m/s^2

Ans: $(x \pm \delta x) = (6.97 \pm 0.09)\text{m}$

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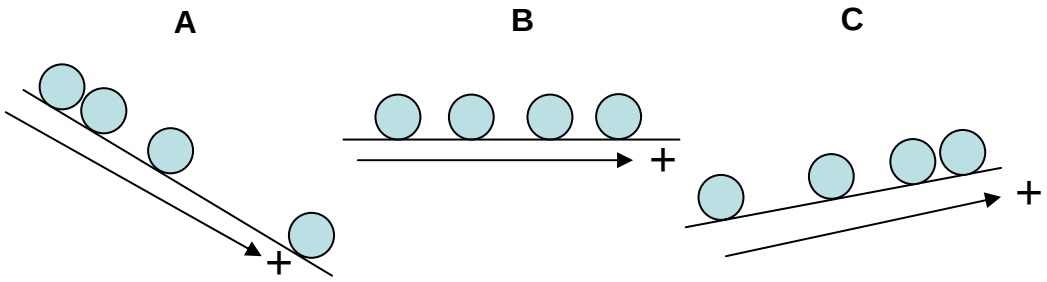
5 BONUS 2 The following drawings indicate the time-sequenced motion of a ball that is acted on by one or more forces. The ball is moving from left to right in each case. Each circle represents the position of the ball at the end of equal intervals of time (stroboscopic picture). Assume all accelerations are constant. A dashed line with an arrowhead on the end indicates the positive direction of the coordinate system for that drawing. Note: Zero is greater than negative acceleration, and ties are possible.

Rank each case from the highest to the lowest acceleration, based on the drawings.



Highest 1___A____ 2___B____ 3___C____Lowest

Or, all have the same acceleration. _____

5 BONUS 3 Two stars that are close together are photographed through a telescope, and their image is focused on black and white film. The film is equally sensitive to all colors. Which situation will result in the most clearly separated images of the stars?

A. Small diameter lens, red light from the stars
B. Small diameter lens, blue light from the stars
C. Large diameter lens, red light from the stars
D. Large diameter lens, blue light from the stars
E. Large diameter lens, red light from one star and blue light from the other star