PH 203 Phase-Line Writ 2, Fall 2004 **Name**_____
Lesson 24 / 100 Marks / 30 minutes **Section**_____**, A Hour**

AUTHORIZED REFERENCES: Calculator, PH203 Physics Reference Card

Wt.	**No.**	
50	1.	You are flying your UH-60 helicopter at a constant altitude of 497 m and speed of 198 km/hr over the Persian Gulf. You spot a person in the water, and instinctively you fly towards the person, while maintaining the same altitude and speed. You instruct your crew chief to drop one of your survival rafts to the person in the water. Worried that the raft might hit the person, you perform a quick calculation to ensure that the raft lands 5.00 m short of the person's location. Assuming that air resistance is negligible, calculate the horizontal distance from the helicopter to the person when your crew chief must drop the raft.

$D = 559$ m ANS

Wt. **No.** **Name:**_____

50 2. After your rescue of the drowning person, your #1 and #2 engines fail, and you have to perform an emergency landing into the water. While your helicopter sinks, an oil film (n = 1.41) forms on the surface of the water (n = 1.33). A pilot in a combat search and rescue (CSAR) helicopter, hovering 146 m directly above the oil slick, notices the absence of blue light (λ = 465 nm) from the light reflected from the oil.

(30) a. Calculate the minimum thickness of the oil film.

L_{min} = 165 nm ANS

(20) b. Assume that the thickness of the oil is 251 nm. Calculate the wavelength(s) of reflected light within the visible spectrum (400 nm – 700 nm) that would produce a maxima when reflected off of the oil.

λ = 472 nm ANS

BONUS (5 MARKS): Describe the geometric approximation used in deriving the model equation for Young's double-slit interference experiment.

The distance from the slits to the screen is much greater than the distance between the slits (D >> d) therefore, the rays are approximately parallel.

PH 203 Phase-Line Writ 2, Fall 05 **Name**_____
Lesson 24 / 100 Marks / 30 minutes **Section**_____**, C Hour**

AUTHORIZED REFERENCES: Calculator, PH203 Physics Reference Card

Wt.	**No.**	
50	1.	Prior to sending your platoon into the attack in Afghanistan, an F-117 is called to prep the target with a 200-pound bomb. The F-117 is in a dive with a velocity of 125 m/s at an angle of 16.2 ^{o} below the horizontal. When the F-117 is at an altitude of 2.45 km above the target, the pilot releases the bomb. Calculate the final velocity of the bomb just before it impacts the ground. Report the velocity in magnitude and angle notation. Assume air resistance is negligible.

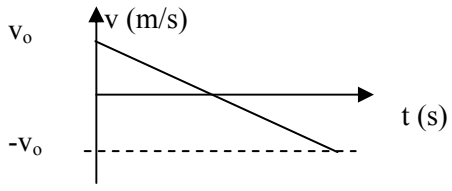
$\vec{v}_o = 252 \text{ m/s } 61.6^{o} \text{ below the x - axis}$ ANS

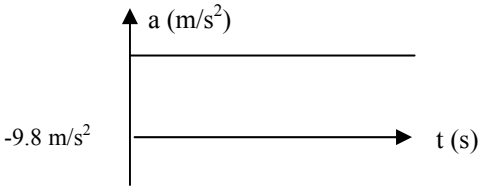
Wt. **No.** **Name:**_____

50 2. You are an ordinance officer in Iraq; your team discovers a remote detonator for an improvised explosive device (IED) that uses radio signals transmitted at 7.75 THz (1THz = 1 x 10^{12} Hz). Upon closer inspection, you notice that there is a shield with a single slit on the end of the transmitter. You suppose that the device is used to detonate IEDs that are in close proximity to each other. In order to test your theory, you orient the transmitter with the slit directed towards the center of a wall 25.2 m away and measure the intensity of the radio frequency along the wall. As you move the receiver from the center of the wall outward, the signal is greatest at the center, and the signal disappears 173 cm from either side of the center. Calculate the width of the single slit on the transmitter.

$a = 5.63 \times 10^{-4}$ m ANS

BONUS (5 MARKS): Sketch a graph of velocity versus time and acceleration versus time for an object thrown vertically up in the air and returning to earth.





PH 203 Phase-Line Writ 2, Fall 2004 **Name**_____
Lesson 24 / 100 Marks / 30 minutes **Section**_____**, G Hour**

AUTHORIZED REFERENCES: Calculator, PH203 Physics Reference Card

Wt.	**No.**	
50	1.	Your reconnaissance team is patrolling in the Afghanistan mountains when a large bunker buster bomb explodes on top of a hill 1.45 km high. You are on patrol at the base of the hill at a horizontal distance of 3.31 km from where the bomb explodes. A piece of shrapnel from the device strikes you on the foot. Its initial direction of travel was 35.2° above the horizontal when it left the hill. Calculate the initial velocity of the shrapnel when the bomb exploded. Assume no air resistance.

$\vec{v}_o = 146\ \text{m/s}\ \ 35.2^o \text{ above the x - axis}$ ANS

Wt. **No.** **Name:**_____

50 2. Your recon platoon is behind enemy lines waiting for extraction. You use your night vision goggles (NVGs) to search for any approaching vehicles. In the darkness, you see what appears to be a single infrared headlight approaching your position. Concerned that you may have been spotted, you remember the distance between infrared headlights on the enemy patrol vehicles are exactly 1.86 m apart, and the wavelength of the infrared headlight is 815 nm. The diameter of your NVG's circular aperture is 4.15 mm. Calculate how close an enemy vehicle can get to your position before you can just resolve the headlights.

$D = 7{,}760$ m ANS

BONUS (5 MARKS): List five different types of interference and diffraction problems and state which type of interference result you can use the equation for: minima, maxima, or both.

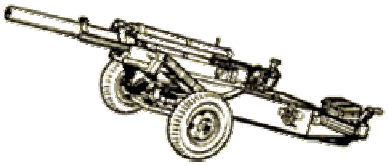
Double slit	Both
Thin film	Both
Diffraction grating	Maxima
Single slit	Minima
Circular apperature	Minima

PH 203 Phase-Line Writ 2, Fall 2004 **Name**_____
Lesson 24 / 100 Marks / 30 minutes **Section**_____**, I Hour**

AUTHORIZED REFERENCES: Calculator, PH203 Physics Reference Card

Wt. **No.**

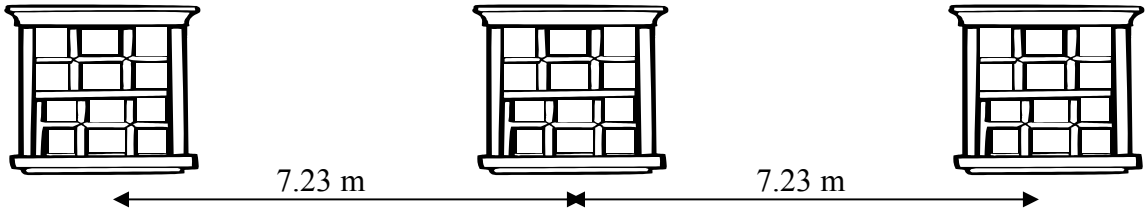
50 1. During combat, one of your howitzer tubes is stuck at an elevation angle of 27.1^{o} above the horizontal. You can adjust the speed of the round that it fires by changing the amount of propellant used. You engage a target at a height 195 m higher than your howitzer's position and a horizontal distance 8.27 km away. You adjust the propellant to give the round an initial speed of 324 m/s. Calculate the final velocity, in unit vector notation, of the round just before it strikes the target. Assume air resistance is negligible.



$\vec{v} = 288\,\hat{\mathrm{i}} - 133\,\hat{\mathrm{j}}$ m/s ANS

Wt. **No.** **Name:**_____

50 2. You are an infantry platoon leader preparing to assault a building that has three windows as shown below. The windows are evenly spaced 7.23 meters from center to center. Your platoon is using a new weapon that fires laser-designated munitions. The laser-designator has a wavelength of 886 nm. You also have a double-slit plate with a slit spacing of 0.131 mm. Your goal is to fire the laser beam through the plate in order to laser-designate all the windows simultaneously. Assume that the center of each bright spot is centered on each window and that the windows coincide with adjacent bright spots. Calculate the distance between the center window and the double-slit grating that will allow you to accomplish your goal.



$D = 1070$ m ANS

BONUS (5 MARKS): How would the diffraction pattern from a diffraction grating change on a screen if the incident light changes from a red to a blue light source and all other parameters remained the same? Justify your response.

The pattern would be less spread out on the screen because blue light has a shorter wavelength. The equation for diffraction is $d \sin\theta = m\lambda$; θ would decrease with a smaller wavelength.