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## Sample Test 1

### Disclaimer:

A test similar to the following has been given PHYS1112 students in the past. This does not imply that the upcoming test cannot be more (or less) difficult.

### Problem 1: Doppler Effect

A spiral galaxy is moving directly towards the Earth with a speed  $v = 3.00 \times 10^5$  m/s. The galaxy is also rotating about its center, so that points in its spiral arms are moving with a speed of  $v = 6.500 \times 10^5$  m/s relative to the galaxy center. If light with a wavelength of 365.0 nm is emitted in both arms of the galaxy, what wavelength is detected by observing the arm that is moving (a) toward and (b) away from Earth?

### Problem 2: Reflection

The reflecting surfaces of two mirrors form a vertex with an angle of  $60^\circ$ . If a ray of light strikes mirror 1 with an angle of incidence of  $\theta$  ( $\theta < 60^\circ$ ), find the angle of reflection of the ray when it leaves mirror 2.

### Problem 3: Spherical Mirror

A concave mirror produces a virtual image that is two times as tall as the object.

- (a) If the object is 50 cm in front of the mirror, what is the image distance?
- (b) What is the focal length of this mirror?

### Problem 4: Refraction

A submerged scuba diver looks up toward the calm surface of a freshwater lake and notes that the sun appears to be  $20^\circ$  from the vertical.

- a) At what angle would he see the sun were he diving in a sugar solution?

( $n_{\text{water}} = 1.33$ ,  $n_{\text{sugar sol.}} = 1.49$ )

- b) The diver directs a laser beam towards the surface. At what angle with respect to the vertical will the laser beam undergo complete reflection?

**Problem 5 : Optical Instruments**

A concave lens with  $f = -12.0$  cm and a convex lens with  $f = +7.0$  cm are separated by 6.0 cm. An object is placed 24 cm in front of the concave lens. Find

(a) the location and

(b) the magnification of the final image produced by this lens combination.

The object is then placed on the other side of the lens assembly, 14 cm in front of the convex lens.

Find

(c) the location and

(d) the magnification of the final image produced by this lens combination.