

# Physics 112, spring 2015 Exam 3 42 points

Dr. Jared Workman

## RULES

You may use an equation sheet with whatever you want on both sides, you may not use a tablet or a smartphone or a laptop as a calculator. Do not forget to include direction in all answers. Please return the test to me. Write all your answers on a separate piece of paper. Paper and staplers will be provided. You may bring one sheet of equations and one sheet with sign conventions

## Problems

1:) A professor returns home after a long day at work and sits down outside, exactly 10 meters (perpendicularly) away from an open window with a width of 1 meter. One of his obnoxious birds, in the room with the open mirror, begins screeching uncontrollably at a frequency of 2000 HZ and the sound travels towards the professor at 350 m/s. How far should the professor move to the right or left to get to the first quiet spot? (10 pts)

2:) An object is placed 10 meters to the right of a concave mirror with a focal length of 4 meters. Where is the image formed? Is it real or virtual? What is the magnification? Draw a ray diagram to support your conclusions. To what object distance would the object need to be placed for the image to form at the focal point? What type of objects are at this distance? (11 pts)

3:) A beam of light, 600nm in wavelength, is shone at an angle of 44 degrees with respect to the normal "inside a slab of crystal quartz. Over the quartz a layer of water with index of refraction  $n=1.33$  is placed and the beam is totally internally reflected back into the quartz. What is the index of refraction of the quartz? What is the speed of light in the crystal quartz? (6 pts)

4:) A beam of light is shone towards the moon where it hits a reflecting panel and returns in 2.51 seconds. How far is the moon from the earth? (4 pts)

5:) A gamma ray photon has a wavelength of  $10^{-15}m$ . A radio photon has a wavelength of 1m. Calculate the frequency and energy of each photon. Plank's constant is  $6.62 \times 10^{-34}Js$ . (5 pts)

6: CONCEPTUAL

A: How does a prism work?

B: Why does interference occur for light?

C: Why does an object placed underwater not exist where it appears to exist?



$$3.) \quad n_1 \sin \theta_1 = n_2 \sin \theta_2 \quad (1)$$

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$\nearrow 90^\circ (1)$

$$\frac{n_1}{n_2} \sin \theta_1 = 1$$

$$n_1 = \frac{n_2}{\sin \theta_1} = 1.91 \quad (1)$$

$$v = \frac{c}{n} = 1.57 \cdot 10^8 \frac{\text{m}}{\text{s}} \quad (1)$$

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4.)  $v = \frac{d}{t}$   $vt = d$  but this is 2 waves 2

$$\text{So } \frac{vt}{2} = d = 3.765 \cdot 10^8 \text{ m} \quad (4)$$

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5.)  $\lambda f = c$   $f = \frac{c}{\lambda}$   $f = \frac{3 \cdot 10^8}{[10^{-11}, 1]} = 3 \cdot 10^{23} \text{ Hz}, 3 \cdot 10^9 \text{ Hz}$  (1) (1)

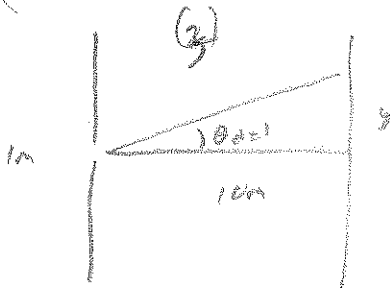
$$E = hf = 1.989 \cdot 10^{-10} \text{ J}, 1.989 \cdot 10^{-21} \text{ J} \quad (5)$$

6.) A) dispersion (2)

B) Phases along/anti along (2)

C) reflection (2)

1:1) (42)



$$v = F\lambda$$

$$\frac{350}{2000} = \lambda \quad (1)$$

$$\lambda = 0.175 \text{ m} \quad (2)$$

(10)

$$\sin \theta = \frac{\lambda}{a} \quad (1)$$

$$\sin \theta = 0.175 \quad (1)$$

$$\theta = 10.08^\circ \quad (1)$$

$$\frac{y}{10} = \tan \theta \quad y = 10 \tan \theta \quad (2) \quad y = 1.78 \text{ m} \quad (1)$$

2:1)

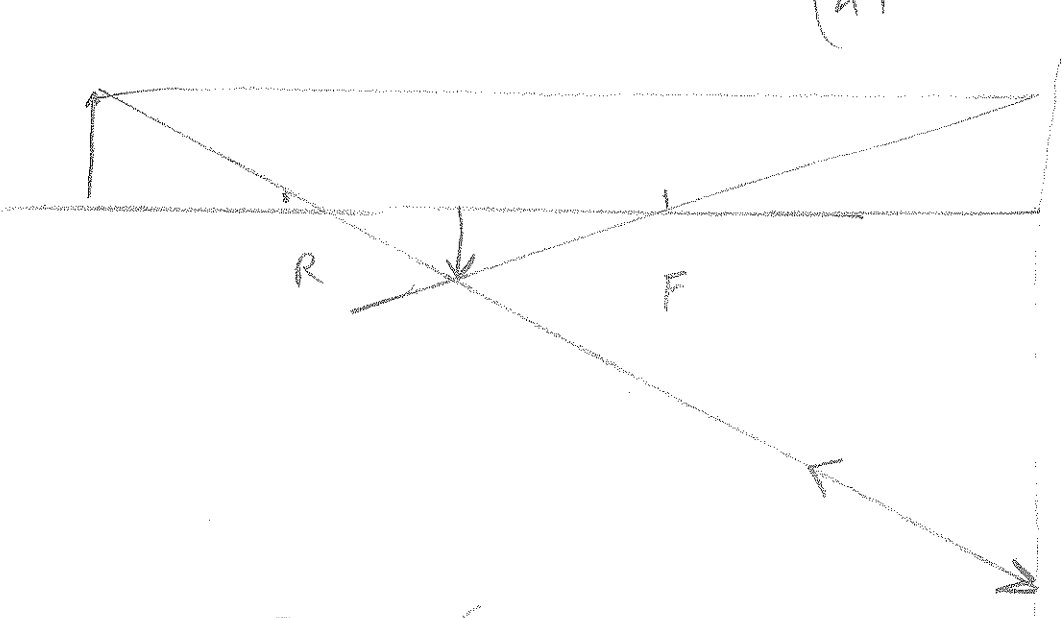
$$\frac{1}{P} + \frac{1}{Q} = \frac{1}{F} \quad (1)$$

$$\frac{1}{Q} = \frac{1}{F} - \frac{1}{P}$$

$$\frac{P-F}{FP} = \frac{1}{Q}$$

$$Q = \frac{FP}{P-F} = \frac{40 \times 2}{6} = 13.33 \text{ m} \quad (1)$$

(4)



real (1)

$$M = \frac{-Q}{P} = \frac{-13.33}{40} = -\frac{2}{3} \quad (1)$$

Inverted (1)

(11)

Infinity Stars

(1)

(1)