Science Olympiad, Optics, Division B, January 15th 2011

Name (Partner#1):

Name (Partner#2):

School:

Key

Points:

Geometric Optics:

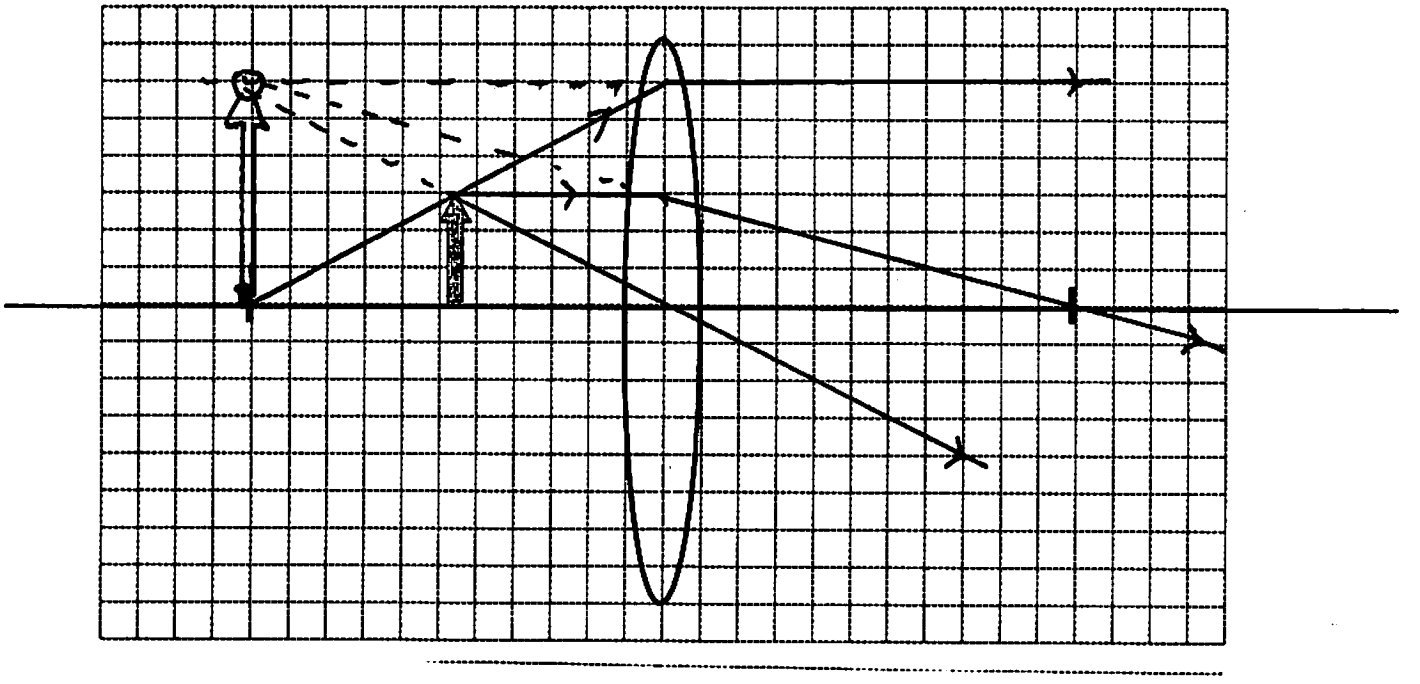
Physical Optics:

LaserShoot Setup t:

LaserShoot Accuracy:

Total Score:

Diagram to be used for Questions 1-10



1. What type of optic is represented in the center of the diagram above
   a. Is it a mirror or a lens (1pt)? lens
   b. Is it concave or convex (1pt)? convex
2. What do the red perpendicular short lines represent (1pt)? focal points or focal distance
3. Label the principle axis on the diagram (1pt)
4. Draw the image that would be produced from this Object (green arrow) and Optic.
   a. (3pts for the correct Image + 3pts for drawing light rays entering and exiting the Optic)
   b. (2 pts) Characterize the resulting image with at least three of the following terms that describe its relationship to the Object (terms: real, virtual, inverted, upright, shrunk, magnified)

5. Still considering the diagram on page 1, the optic's focal distance is 22cm and the Object's distance is 11cm:
   a. (5 pts) Calculate the Image's distance. Show your work including the formula.
   b. (5 pts) Calculate the Image's magnitude. Show your work including the formula.

a. $\frac{1}{f} = \frac{1}{i} + \frac{1}{o} \rightarrow \frac{1}{22} = \frac{1}{i} + \frac{1}{11}$ $\quad i = -22\,cm$

b. $m = \frac{-i}{o} \rightarrow m = \frac{-(-22)}{11}$ $\quad m = 2\,cm$

6. Draw a concave lens (1pt). Is its focal distance >0 or <0 (1 pt)?

7. Draw a concave mirror (1pt). Is its focal distance >0 or <0 (1pt)?

8. Draw a convex lens (1pt). Is its focal distance >0 or <0 (1 pt)?

9. Draw a convex mirror (1pt). Is its focal distance >0 or <0 (1pt)?

II. Physical Optics (30 point total)

1. Identify the missing labels on the diagram to the right (4pts):

   1a. Microwave

   1b. Visible

   1c. Ultraviolet

   1d. X-rays

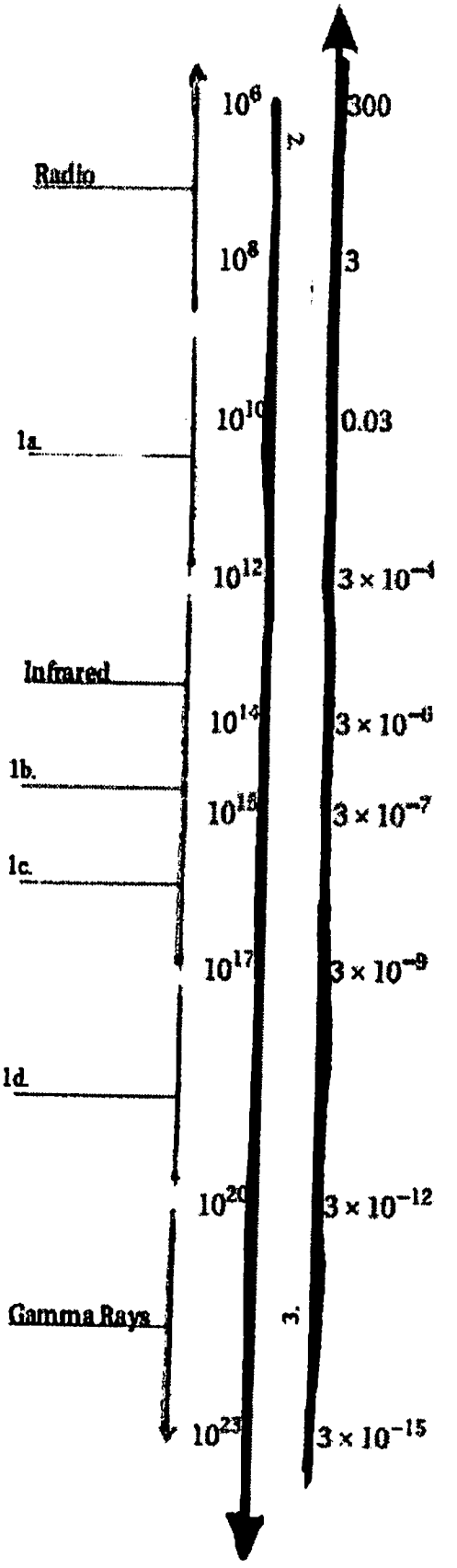
2. What does the ~~bark~~ dark blue line represent, and what are its typical units of measure (2pts)?

   Frequency, Hertz (Hz)

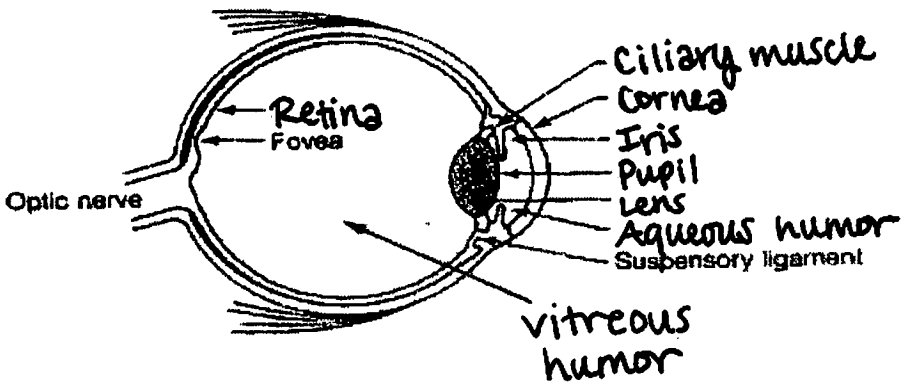
3. What does the red line represent and what are its typical units of measure (2pts)?

   wavelength, nm

4. This diagram is a electromagnetic spectra (1pt).



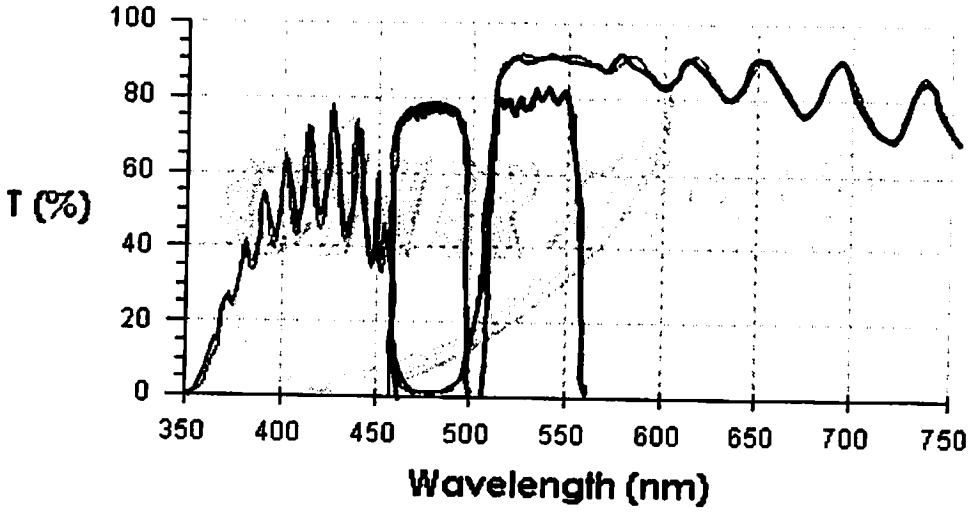
5. Label the missing part of this diagram (8pts):



6. Is the lens in the eye a convex or concave lens (1pt)?

convex

7. Identify items on the following spectra graph:



a. The label "T (%)" on the Y-Axis is an abbreviation for what (1pt)? transmittance %

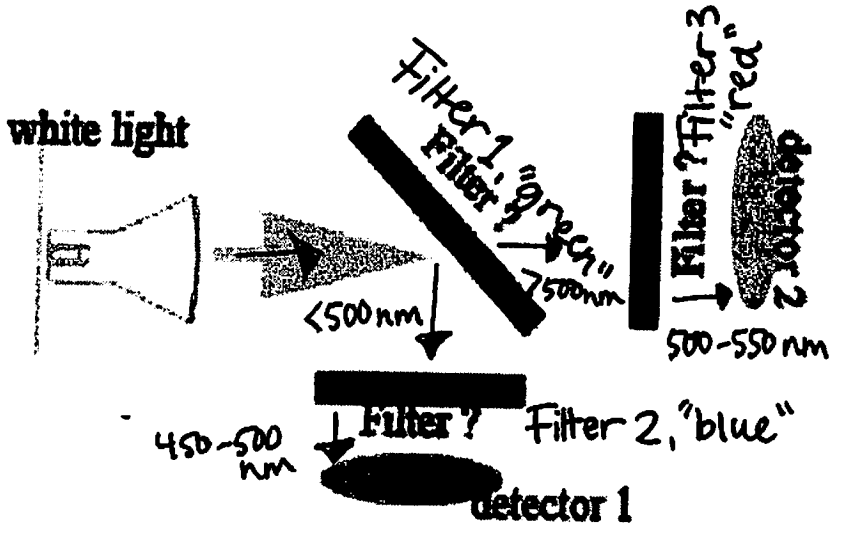
b. The blue trace on the graph represents an optical filter that is doing what (1pt)?
allows 80% of light from 450 to 500 nm through

c. The red trace on the graph represents an optical filter that is doing what? (1pt)
allows 80% of light from 500 to 550 nm through

d. The green trace on the graph represents an optical filter that is doing what (1pt)? either of the two: 1) blocks/reflects light from 450-500 nm
2) allowing 90% of >500nm through

e. Using the three optical filters represented in the graph above, design an arrangement of these filters to collect blue/green light into Detector 1 and green light into Detector 2. Briefly describe how the light moves through the device. Use the partially labeled figure below (8pt):

(green trace="Filter1", blue trace="Filter2", and red trace="Filter3)



1) white light hits Filter 1, allows >500nm through and reflects <500nm
2) Filter 2 allows only 450-500 nm through
3) Filter 3 allows only 500-550nm through