# Science Olympiad Regional Tournament

March 2011

# Optics Exam

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# Instructions:

1. **READ ALL THESE INSTRUCTIONS CAREFULLY BEFORE STARTING!**
2. Do not open this test until instructed to.
3. Be sure to write legibly.
4. Fill out your school name and number on EVERY PAGE. Abbreviations are acceptable.
5. Only the answers in the answer boxes will be scored. If you decide to change an answer after entering it you may thoroughly cross it out and create a new box next to the printed one to enter the answer.
6. Where relevant, answers must include APPROPRIATE SI UNITS and significant figures.
7. The testing period is over at 45 minutes past the start time. We will give time warnings at 5 and 1 minutes. Stop writing when told to. Be sure to turn in ALL pages.
8. Each question is worth 1 point. An answer either is fully correct and gets all points or is wrong and gets no points.
9. The score from the tie-breaker question at the end will be used only in case of a tie.

# Helpful Hints:

1. The test is printed two-sided. Be sure to look at the back of the pages.
2. The pages may be separated during the testing period and worked on independently by both team members if so desired.
3. You can email Dr. Chalker at the address above for an electronic copy of this exam after the tournament. Note the email address is NOT OSU.EDU.
4. You may write on the blank areas available on the test to do calculations.
5. The test is intentionally long so that most teams will likely NOT complete all questions. I recommend quickly reviewing the questions before beginning and tackling the ones you know best first.

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## Part 1: Geometric Optics

1. Light traveling through air reaches quartz at an angle of incidence of $35^o$. The index of refraction of quartz is 1.54. At what angle of refraction does the light travel into the quartz? ($n_{air}$ = 1.0003)

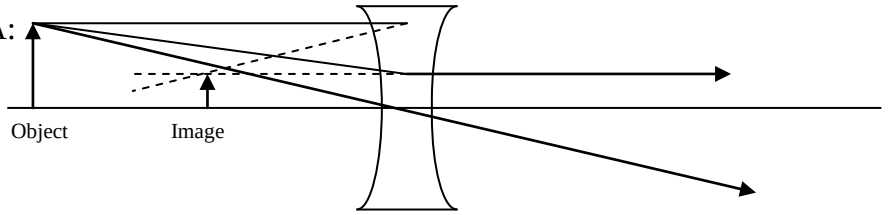
2. Light enters a substance from air at an angle of incidence of $55^o$. The light is refracted inside the substance to an angle of refraction of $35^o$. What is the index of refraction of the substance??

3. When a wave strikes a boundary at an angle from a more dense medium to a less dense medium the wave is refracted _____ the normal .

4. Diffuse reflection occurs when parallel light rays are _____ by a rough surface.

5. What basic type of mirror are most rearview car mirrors?

Diagram A:




6. Does diagram A form a real or virtual image?

7. Is the image in diagram A upright or inverted?

8. Is the image in diagram A larger, smaller or same size?

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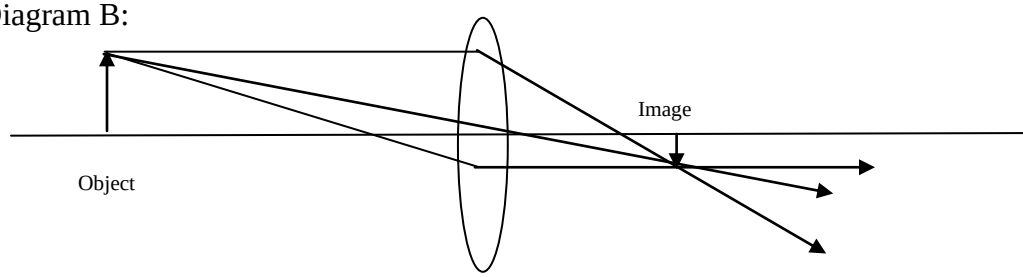
Diagram B:




9. Does diagram B form a real or virtual image?

10. Is the image in diagram B upright or inverted?

11. Is the image in diagram B larger, smaller or the same size?

12. Which color of visible light bends the most in a prism ?

13. A man is walking at 1.0 m/s directly towards a flat mirror. At what speed is his separation from his image decreasing?

14. A converging mirror with a focal length of 20 cm is used to create an image, using an object at a distance of 10 cm. Is the image real, or is it virtual?

15. What kind of lens curvature is used in most magnifying glasses?

## Part 2: Physical Optics

1. Where do far-sighted peoples' eyes focus?

2. What type of lenses do far-sighted people need?

3. If a person could travel at the speed of light, it would still take 4.3years to reach the nearest star, Proxima Centauri. How far away, in meters, is Proxima Centauri?

4. What is the speed of light in water compared to air?

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5. What is the range of wavelengths of the visible light spectrum?

6. The complementary color of green light is?

7. The three primary colors of light are?

8. On a bright day, the iris of the eye changes so the pupil?

9. Light with a frequency of $6.1 \times 10^{14}$ Hz is measured from a star. This type of star is known to produce light with a frequency of $6.0 \times 10^{14}$ Hz. How fast is the star moving away or toward Earth

Label the parts of the human eye.

10.

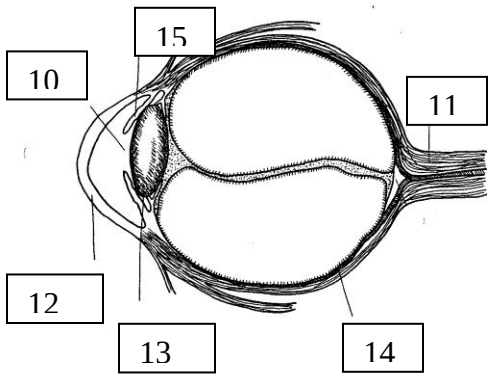
11.

12.

13.

14.

15.




## Tiebreaker Question

Name as many different types of optical instruments as you can.

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