**Science Olympiad**

**Optics Test Division B**

**Holt Invitational**

**School Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Team Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

* Please do not open this test until instructed to do so.

* All multiple point, fill-in-the-blank, and true/false questions are 1 point each
* Tiebreakers start with question #1 and go to end of test
* After starting, you will have the remainder of the period to complete the test, minus the time spent for the Laser Shoot.
* All numerical answers (non multiple choice) will require correct units and significant digits.

1. The splitting of visible light by a prism into the color spectrum is called
   1. Deviation
   2. Dispersion - Correct answer
   3. Reflection
   4. Filtering
2. If a human sees an object as Magenta, what primary color of light is being absorbed by the object (assume use of white light)?

Green

1. Sunlight reflecting off choppy water, without a clear image is an example of what type of reflection?
2. Secular
3. Diffuse - Correct answer
4. How many colors of light are being used on the screen shown below? Three



1. The mathematic relationship between the speed of light in various mediums to the index of refraction is N=c/v. In this equation, the variable v stands for:
   1. The speed of light in a vacuum
   2. The speed of sound in a vacuum
   3. The velocity of the mass the light is entering/leaving
   4. The speed of light in the medium being measured
   5. The wavelength of the light being used
2. What two primary colors of light make up yellow light?

Red and Green

1. Using the edges of this paper as plain mirrors, trace the path of light for a total of 4 reflections and circle which object it will then reach

rectangle

8-11: Identify the objects in the diagram below with the following terms:

1. Image\_\_\_\_\_\_\_\_\_A
2. Focal point\_\_\_\_\_\_\_\_\_\_C
3. Center of curvature\_\_\_\_\_\_\_\_\_B
4. Real object\_\_\_\_\_\_\_\_\_\_\_D

D

C:\Users\mlweiker\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\0LLPSFUD\stick-person-base[1].png

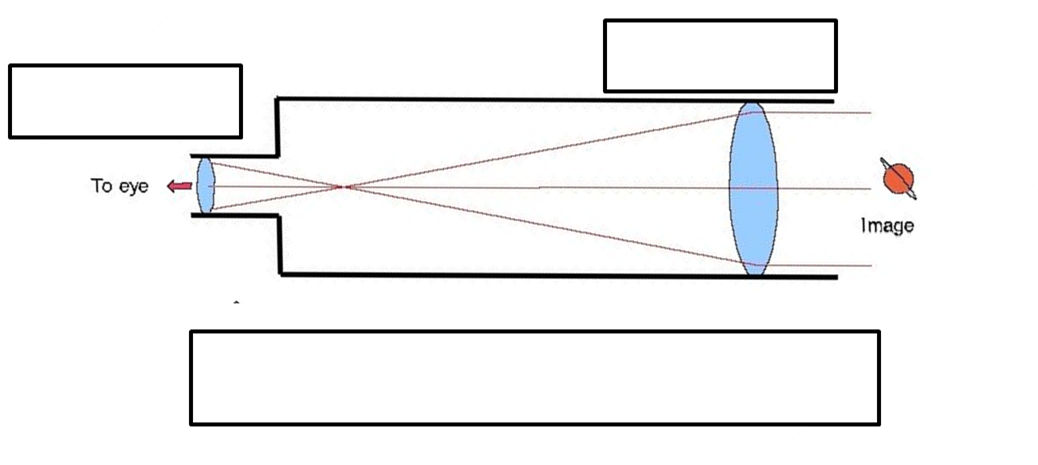
C

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B

A

1. The purpose of the cones in the human eye are to:
   1. Control the focus of the eye to be able to see sharp images
   2. Identify the frequency of the light hitting the retina
   3. Identify the intensity of the light hitting the retina
   4. Protect the eye from receiving too much light and being damaged
2. Using a triangular glass prism, a form of light with a longer wavelength will have a \_\_\_\_\_\_\_\_ angle of deviation.
   1. Higher
   2. Lower - Correct answer
3. Label the components of the telescope below. Describe the type of each optical object (convex or concave, lens or mirror). Also identify the type of telescope this represents.

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2 convex lenses (primary and eyepiece) in a refracting telescope

1. In the diagram above, describe the difference in the focal points of the two objects.

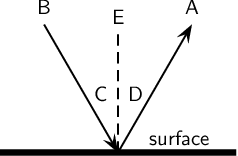
The Primary lens has a much longer focal length than the eyepiece lens.

1. A convex mirror always creates what type of image (real / virtual, orientation, size)?

Virtual, upright, miniature size

17-21:Identify the letter in the diagram with the name listed for each number.

1. Angle of Reflection\_\_\_\_\_\_\_D
2. Incident ray\_\_\_\_\_\_\_\_\_\_\_\_\_B
3. Normal line\_\_\_\_\_\_\_\_\_\_\_\_\_E
4. Angle of Incidence\_\_\_\_\_\_\_C
5. Reflection ray\_\_\_\_\_\_\_\_\_\_\_A



1. What is the relationship between the focal point and the center of curvature in a concave mirror?

The center of curvature is twice the distance from the mirror as the focal point.

1. When two polarizing lenses with parallel alignments are placed over one another, no light is visible.
   1. True
   2. False
2. If the speed of light in air is 2.9970 x 108 m/s, what is the index of refraction of water? Note: the speed of light in a vacuum is 2.99792458 x 108 m/s

N=c/v = 299700000/299792458 = 1.0003

N is the index of refraction for a substance, c is the speed of light in a vacuum (2.99792458 x 108 m/s), v is the velocity of light in the substance

1. True / False: A convex lens always produces a virtual image.
2. If the object in front of a concave mirror is between the center of curvature and the focal point, what an observer sees is an \_\_\_\_\_\_\_\_\_\_\_\_.
   1. Inverted, miniature, real image
   2. Upright, miniature, virtual image
   3. Inverted, magnified, real image - Correct answer
   4. Upright, magnified, real image
3. A pure pigment is a substance that absorbs a single frequency of light. What color does a pure yellow pigment absorb?

Blue, the pigment’s complementary color

1. Trace three rays for the man and the convex lens below, and draw the image. The points closest to the lens are **F** and **F’**, the outside points are **2F** and **2F’**.

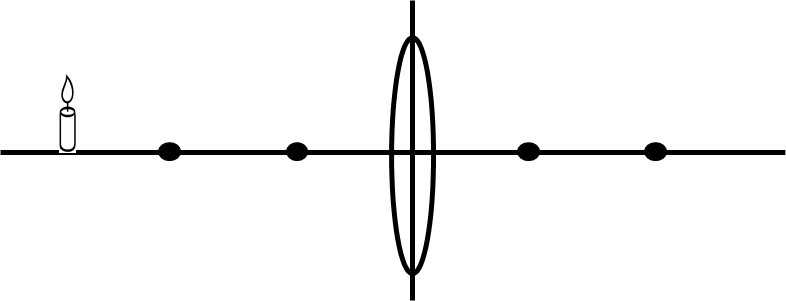
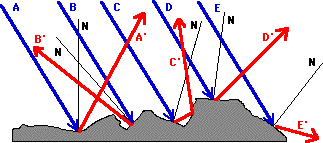
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Image should be inverted, on right, identical size, at the 2F points

1. If an object is placed outside the center of curvature of a convex mirror, what type of image is formed?
   1. Inverted, miniature, real image - Correct answer
   2. Upright, miniature, virtual image
   3. Inverted, magnified, real image
   4. Upright, magnified, real image
2. Name the secondary colors of light for the human eye.

Yellow, Cyan, Magenta

1. True or False: The image below is a diagram showing diffuse reflection.



1. The approximate index of refraction for the human cornea is:
   1. 1.03
   2. 1.80
   3. 1.53
   4. 1.38
2. If an object 8.7 cm tall is placed 9.0 cm in front of a convex lens with a focal point distance of 6.0 cm, how far from the mirror is the image located?

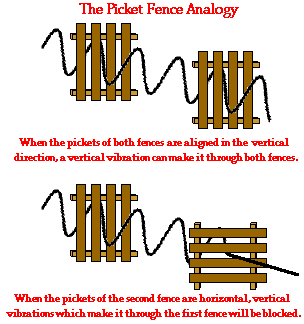
**, Di = 1 / (1/6 – 1/9) = 18 cm**

1. In the same scenario from previous question, what is the size of the image formed?

**= 18 / 9.0 = 2.0,**

**= M \* = 2.0 \* 8.7 = 17.4 cm (17 cm with sig fig)**

1. Since the cornea and lens combination acts as a converging lens (or a double convex lens), and the objects being viewed are more than twice the focal length away, the images formed on the retina are:
   1. Real
   2. Inverted
   3. Magnified (enlarged)
   4. A and B
2. The picket fence analogy shown below is similar to polarization via a \_\_filter\_\_\_\_\_\_. In making a film of this type, long molecules are stretched across the surface in parallel lines that block waves that are aligned perpendicular to the molecules.



1. True / False: A difference between a converging lens and a diverging lens is that a diverging lens is thicker in the middle than at the ends and a converging lens is thicker at the ends than in the middle.
2. Film coatings can be used to protect human eyes from damaging light sources.
   1. True
   2. False

<http://www.interactagram.com/physics/optics/refraction/>

<http://www.physicsclassroom.com/class/refln/Lesson-2/Ray-Diagrams-for-Plane-Mirrors>

<http://www.physicsclassroom.com/Class/refln/u13l1d.cfm> - law of reflection

<http://www.physicsclassroom.com/Class/refrn/U14l3c.cfm> - critical angle

<http://www.physicsclassroom.com/class/refrn/Lesson-4/Dispersion-of-Light-by-Prisms>

<http://www.physicsclassroom.com/class/refln/Lesson-3/The-Mirror-Equation>

<http://www.physicsclassroom.com/class/refln/Lesson-4/Reflection-and-Image-Formation-for-Convex-Mirrors>

<http://www.physicsclassroom.com/Class/refrn/U14L5a.cfm> - lenses

<http://www.physicsclassroom.com/class/refrn/Lesson-6/The-Anatomy-of-the-Eye>

<http://www.physicsclassroom.com/class/refrn/Lesson-6/The-Anatomy-of-the-Eye>