

Encode your **name** (last name, first name) and the **test number** shown above, on the scan sheets provided, leaving a space between your last and first name. Select the **best answer** for each of the questions below and encode your choice on the scan sheet. There is an equation sheet attached to this exam which you may tear off and keep (if you wish).

- What is the wavelength of South Dakota Public Radio's waves that are broadcast at a frequency of 88.3 MHz?
a.) 0.29 m c.) 2.96 m e.) 4.6 m
b.) 2.55 m d.) 3.40 m
- What is the speed of light in water (index of refraction for water is 1.33) ?
a.) 1.51×10^8 m/s c.) 2.41×10^8 m/s e.) 3.00×10^8 m/s
b.) 2.25×10^8 m/s d.) 2.50×10^8 m/s
- Light in air, with a frequency of 5.66×10^{14} Hz enters water of index of refraction 1.33. What is the frequency of the light in the water
a.) 4.25×10^{14} Hz c.) 1.89×10^6 Hz 1.89×10^{12} Hz
b.) 5.66×10^{14} Hz d.) 3.78×10^{14} Hz
- A beam of laser light ($\lambda_0 = 632.8$ nm) is incident from air ($n_{\text{air}} = 1$) on a smooth surface of water ($n_{\text{water}} = 1.33$) at an angle of $\theta_1 = 40.0^\circ$ with respect to the perpendicular direction. Determine the angle, with respect to the perpendicular, the transmitted ray makes in the water.
a.) 48.3° c.) 25.4° e.) 28.9°
b.) 40.0° d.) 64.6°
- A beam of laser light ($\lambda_0 = 632.8$ nm) is incident from air ($n_{\text{air}} = 1$) on a smooth surface of water ($n_{\text{water}} = 1.33$) at an angle of $\theta_1 = 40.0^\circ$ with respect to the perpendicular direction. Determine the angle, with respect to the perpendicular, the reflected ray makes as it reflects back into the air.
a.) 48.3° c.) 25.4° e.) 28.9°
b.) 40.0° d.) 64.6°
- Suppose an object 6 cm tall is placed 20 cm in front of a lens of focal length of + 10 cm. Suppose further that the image is +20 cm on the side of the lens opposite of the object. The image is
a.) real and inverted c.) real and upright e.) virtual and at infinity
b.) virtual and inverted d.) virtual and upright
- An object 6 cm tall is placed 20 cm in front of a concave mirror of radius of curvature of 40 cm. Where is the image?
a.) 20 cm behind the mirror d.) 20 cm in front of the mirror
b.) at - infinity e.) 40 cm in front of the mirror
c.) at + infinity

8. In order to read his book, Stephen uses a pair of reading glasses. When he holds the book at a distance of 25 cm from his eyes, the glasses form an upright image a distance of 75 cm from his eyes. What type of lens is this, and what is the magnification?
- a.) converging, $1/3$ c.) diverging, $-1/3$ e.) converging, 3
 b.) converging, $-1/3$ d.) converging, -3
9. In order to read his book, Stephen uses a pair of reading glasses. When he holds the book at a distance of 25 cm from his eyes, the glasses form an upright image a distance of 75 cm from his eyes. What type of lens is the dioptic power of his lenses?
- a.) +0.027 D c.) -2.67 D e.) + 2 D
 b.) + 2.67 D d.) - 2 D
10. A dentist holds a small mirror 2.5 cm from a surface of a patient's tooth. The image formed is upright and 5.0 times as large as the object. What is the focal length of the mirror?
- a.) 3.13 cm c.) 3.75 cm e.) 5.23 cm
 b.) 3.50 cm d.) -3.75 cm
11. Two thin lenses of focal lengths + 10 cm and - 25 cm are placed in contact. What is the dioptic power of the combination of two lenses?
- a.) + 2 D c.) + 6 D e.) - 6 D
 b.) + 4 D d.) + 8 D
12. The lens in your eye forms an image on the back surface (retina) of your eye. The image is
- a.) real and upright c.) virtual and upright
 b.) real and inverted d.) virtual and inverted
13. The rear-view mirror on the right side of a car produces a magnification of $+3/4$. If a pickup is seen in the mirror appears 3 meters away, how far behind you is the pickup actually, as measured from the mirror?
- a.) 3.0 meters c.) 3.75 meters e.) 4.25 meters
 b.) 3.5 meters d.) 4.00 meters
14. A farsighted person cannot see clearly closer than 2.0 m. What power contact lenses would correct this near point to 25 cm?
- a.) 2.0 D c.) -0.5 D e.) -3.5 D
 b.) 0.5 D d.) 3.5 D
15. A small object has an angular diameter of 0.50° . When viewed through a magnifier, it has an angular diameter of 8.0° . What is the angular magnification in this case?
- a.) 16 b.) 4.0 c.) 8.0
 b.) 32 c.) 8.5