Test_1,

James

Keep this exam **CLOSED** until advised by the instructor.

Fill out the bubble sheet: last name, first initial, student number, section number. Leave the code area empty.

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50 minute long closed book exam.

One 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **exam** and your **bubble sheet**.

Thank you and good luck!

Possibly useful constant(s):

- $c = 3.00 \times 10^8$ m/s

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8 pt A laser beam enters a 16.5 cm thick glass window at an angle of 40.0^o (from the normal). The index of refraction of the glass is 1.45. At what angle from the normal does the beam travel through the glass (in degrees)?

1.**A**◯ 6.90 **B**◯ 8.62 **C**◯ 1.08×10^1
D◯ 1.35×10^1 **E**◯ 1.68×10^1 **F**◯ 2.11×10^1
G◯ 2.63×10^1 **H**◯ 3.29×10^1

4 pt How long does it take the beam to pass through the plate?
(in s*)*

2.**A**◯ 5.03×10^{-10} **B**◯ 6.69×10^{-10}
C◯ 8.90×10^{-10} **D**◯ 1.18×10^{-9}
E◯ 1.57×10^{-9} **F**◯ 2.09×10^{-9}
G◯ 2.78×10^{-9} **H**◯ 3.70×10^{-9}

8 pt Consider a spherical concave mirror with a radius of curvature of 46.0 cm. A 31.0 cm long fluorescent lamp is placed at a distance of 69.0 cm from the mirror, perpendicular to its optical axis. At what distance from the mirror will the image be formed?
(in cm*)*

3.**A**◯ 15.7 **B**◯ 18.4 **C**◯ 21.5 **D**◯ 25.2
E◯ 29.5 **F**◯ 34.5 **G**◯ 40.4 **H**◯ 47.2

8 pt A person is using a converging lens (f = 39.0 cm) to focus an image of the Moon onto a piece of paper. The diameter of the Moon is 3.48×10^6 m, and its distance from the Earth is 3.85×10^8 m. What is the diameter of the Moon's image on the paper?
(in cm*)*

4.**A**◯ 0.150 **B**◯ 0.199 **C**◯ 0.265 **D**◯ 0.353
E◯ 0.469 **F**◯ 0.624 **G**◯ 0.829 **H**◯ 1.103

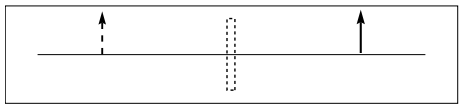
4 pt A large piece of cardboard is inserted between an object and a convex mirror. The image:

5. **A**◯ Forms at the same position as without the cardboard.
B◯ Forms on the side of the cardboard toward the object.
C◯ No longer forms anywhere.
D◯ Forms on the side of the cardboard toward the mirror.
E◯ Forms on the opposite side of the mirror as it would without the cardboard.

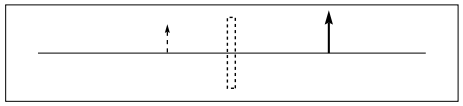
4 pt An object is placed between a concave mirror and the focal point of the mirror. Which of the following is true?

6. **A**◯ The image is smaller than the object, virtual and inverted.
B◯ The image is bigger than the object, virtual and upright.
C◯ The image is bigger than the object, real and inverted.
D◯ The image is bigger than the object, real and upright.
E◯ The image is smaller than the object, real and upright.
F◯ The image is smaller than the object, virtual and upright.
G◯ The image is smaller than the object, real and inverted.
H◯ The image is bigger than the object, virtual and inverted.

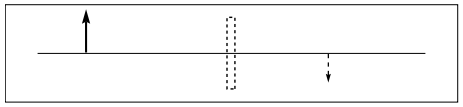
16 pt In the four diagrams below, the solid arrow represents the object and the dashed arrow the image. The rectangle shows the position of an SINGLE OPTICAL ELEMENT. Match each diagram with the appropriate optical element.

▷ 

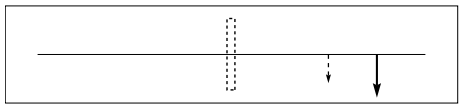
7. **A**◯ Plane Mirror **B**◯ Concave Mirror **C**◯ Convex Mirror **D**◯ Converging Lens **E**◯ Diverging Lens

▷ 

8. **A**◯ Plane Mirror **B**◯ Concave Mirror **C**◯ Convex Mirror **D**◯ Converging Lens **E**◯ Diverging Lens

▷ 

9. **A**◯ Plane Mirror **B**◯ Concave Mirror **C**◯ Convex Mirror **D**◯ Converging Lens **E**◯ Diverging Lens

▷ 

10. **A**◯ Plane Mirror **B**◯ Concave Mirror **C**◯ Convex Mirror **D**◯ Converging Lens **E**◯ Diverging Lens

8 pt Two narrow slits are illuminated by a laser with a wavelength of 548 nm. The interference pattern on a screen located x = 4.60 m away shows that the fourth-order bright fringe is located y = 8.30 cm away from the central bright fringe. Calculate the distance between the two slits.
(in `cm`*)*

11. **A**◯ 5.78×10^{-3} **B**◯ 8.38×10^{-3} **C**◯ 1.22×10^{-2}
D◯ 1.76×10^{-2} **E**◯ 2.55×10^{-2} **F**◯ 3.70×10^{-2}
G◯ 5.37×10^{-2} **H**◯ 7.79×10^{-2}

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8 pt A thin film of soap with n = 1.35 hanging in the air reflects dominantly red light with $\lambda = 678$ nm. What is the minimum thickness of the film?
(in `nm`*)*

12. **A**◯ 1.26×10^{2} **B**◯ 1.47×10^{2} **C**◯ 1.72×10^{2}
D◯ 2.01×10^{2} **E**◯ 2.35×10^{2} **F**◯ 2.75×10^{2}
G◯ 3.22×10^{2} **H**◯ 3.77×10^{2}

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8 pt A 79 year old woman has a near point of 117 cm. What power lens (in diopters) does the woman need in order to be able to see an object clearly at the normal near point of 25 cm? Assume that the woman will get contact lenses, that is neglect the two centimeters that glasses would be away from the eye.

13. **A**◯ 2.01 **B**◯ 2.52 **C**◯ 3.15 **D**◯ 3.93
E◯ 4.91 **F**◯ 6.14 **G**◯ 7.68 **H**◯ 9.60

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4 pt When the power (in units of diopters) of a converging lens is increased:

14. **A**◯ The focal length is increased.
B◯ The image formed includes more light.
C◯ The image location is changed, but the magnification is unchanged.
D◯ The image location is unchanged if the object location is unchanged.
E◯ The focal length is decreased.

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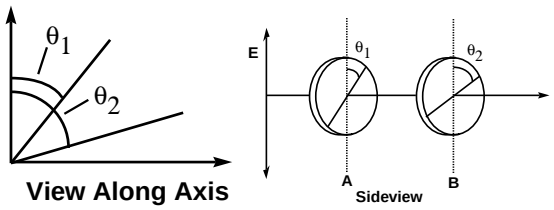
6 pt A linearly polarized electromagnetic wave has an average intensity of 195 W/m^2. This wave is directed towards two ideal polarizers. Polarizer A is oriented with its transmission axis at an angle of $\theta_1 = 33.5^o$ with the incident electric field. Polarizer B has its axis at an angle of $\theta_2 = 71.0^o$ with the incident electric field, as shown in the figure.



What is the average intensity of the wave after it passes through polarizer A?
(in `W/m^2`*)*

15. **A**◯ 1.16×10^{2} **B**◯ 1.36×10^{2} **C**◯ 1.59×10^{2}
D◯ 1.86×10^{2} **E**◯ 2.17×10^{2} **F**◯ 2.54×10^{2}
G◯ 2.97×10^{2} **H**◯ 3.48×10^{2}

6 pt What is the average intensity of the wave after it passes through polarizer B?
(in `W/m^2`*)*

16. **A**◯ 1.33×10^{1} **B**◯ 1.93×10^{1} **C**◯ 2.80×10^{1}
D◯ 4.06×10^{1} **E**◯ 5.89×10^{1} **F**◯ 8.53×10^{1}
G◯ 1.24×10^{2} **H**◯ 1.79×10^{2}

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8 pt A converging lens with a diameter of 22.2 cm forms an image of a satellite passing overhead. The satellite has two green lights ($\lambda = 520$ nm) spaced 1.16 m apart. If the lights can be just resolved according to the Rayleigh criterion, what is the altitude of the satellite?
(in `km`*)*

17. **A**◯ 2.29×10^{2} **B**◯ 3.05×10^{2} **C**◯ 4.06×10^{2}
D◯ 5.40×10^{2} **E**◯ 7.18×10^{2} **F**◯ 9.55×10^{2}
G◯ 1.27×10^{3} **H**◯ 1.69×10^{3}