Name:

Your code is: AAAAAA

Put your name here:

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

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

60 minute long closed book exam.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

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

Possibly useful constants:

- $k_e = 8.99 \times 10^9$ Nm^2/C^2
- $\epsilon_0 = 8.85 \times 10^{-12}$ As/(Vm)
- $\mu_0 = 4\pi \times 10^{-7}$ Vs/(Am)
- $c = 3.00 \times 10^8$ m/s
- $g = 9.81$ m/s^2
- $e = 1.60 \times 10^{-19}$ C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- $h = 6.63 \times 10^{-34}$ Js
- $h = 4.14 \times 10^{-15}$ eVs
- $hc = 1240$ eVnm
- $\sigma = 5.67 \times 10^{-8}$ W/(m^{2}K^4)
- Wien's constant $= 2.898 \times 10^{-3}$ Km
- $R_H = 1.097 \times 10^7$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV $= 1.60 \times 10^{-19}$ J
- 1 AMU (1 u) $= 931.494$ MeV/c^2 $= 1.67 \times 10^{-27}$kg
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page
- 1 pico (p) $= 10^{-12}$

Sometimes a person cannot clearly see objects close up or far away. To correct this type of vision, bifocals are often used. The top half of the lens is used to view distant objects and the bottom half of the lens is used to view objects close to the eye. A person can clearly see objects only if they are located between 42 cm and 164 cm away from her eyes. Bifocal lenses are used to correct her vision.

8 pt

What focal length lens (in cm) should be used in the bottom half of the lens to allow her to clearly see objects 25 cm away?

1. **A**◯ -206 **B**◯ -164 **C**◯ -62 **D**◯ -42
E◯ 42 **F**◯ 62 **G**◯ 164 **H**◯ 206

8 pt What focal length lens (in cm) should be used in the top half of the lens to allow her to clearly see distant objects?

2. **A**◯ -206 **B**◯ -164 **C**◯ -62 **D**◯ -42
E◯ 42 **F**◯ 62 **G**◯ 164 **H**◯ 206

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15 pt Select True or False for the following statements about diffraction of light on a diffraction grating.

▷ If the distance between the screen and the grating is doubled, then the distance between the bright fringes halves.
3. **A**◯ True **B**◯ False

▷ If the wavelength of the light is increased, then the distance between the bright fringes decreases.
4. **A**◯ True **B**◯ False

▷ If the line density of the grating is halved, then the distance between the bright fringes doubles.
5. **A**◯ True **B**◯ False

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8 pt A thin layer of oil of refractive index 1.27 is spread on the surface of water (n = 1.33). If the thickness of the oil is 235 nm, then what is the wavelength of light in air that will be predominantly reflected from the top surface of the oil?
(in `nm`*)*

6. **A**◯ 2.33×10^2 **B**◯ 2.72×10^2 **C**◯ 3.19×10^2
D◯ 3.73×10^2 **E**◯ 4.36×10^2 **F**◯ 5.10×10^2
G◯ 5.97×10^2 **H**◯ 6.98×10^2

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12 pt

Figure 1

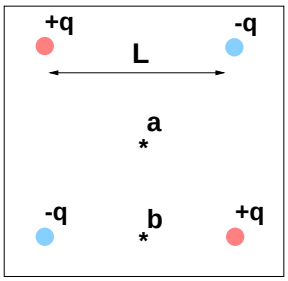
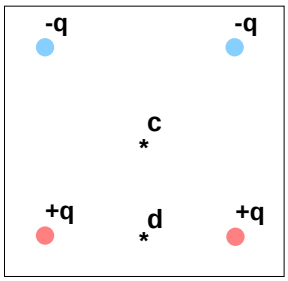


Figure 2



Consider two separate systems, each with four charges of magnitude **q** arranged in a square of length L as shown above. Points **a** and **c** are in the center of their squares while points **b** and **d** are half way between the lower two charges. Select True or False for the following statements.

▷ The electric potential at **b** is NOT zero.
7. **A**◯ True **B**◯ False

▷ The electric field at **c** is zero.
8. **A**◯ True **B**◯ False

▷ The direction of the electric field at **d** is to the top of the page.
9. **A**◯ True **B**◯ False

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8 pt The resonant LC circuit in your radio contains a coil with L = 0.226 mH inductance. By turning the radio knob you adjust the capacitor to C = 29.2 pF. What is the wavelength of the radio waves your radio is receiving?
(in `m`*)*

10. **A**◯ 1.65×10^1 **B**◯ 2.39×10^1 **C**◯ 3.46×10^1
D◯ 5.02×10^1 **E**◯ 7.28×10^1 **F**◯ 1.06×10^2
G◯ 1.53×10^2 **H**◯ 2.22×10^2

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10 pt Starting with a real object, answer the following statements (True or False) about the image formed by a single optical element.

▷ A converging lens can never produce a virtual, upright and reduced image.
11. **A**◯ True **B**◯ False

▷ An object placed between a concave mirror and its focal point will produce an image which is bigger than the object, virtual and upright.
12. **A**◯ True **B**◯ False

15 pt In a rainy Summer day you observe a beautiful rainbow. Complete the following statements.

▷ The speed of the light inside a raindrop is ... the speed of light in air.

13. **A**◯ less than **B**◯ equal to **C**◯ greater than

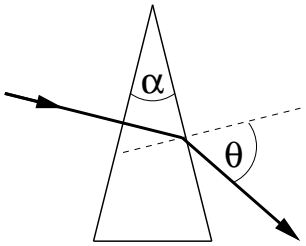
▷ The wavelength of the light inside a raindrop is ... the wavelength of the same light in air.

14. **A**◯ less than **B**◯ equal to **C**◯ greater than

▷ The frequency of the light inside a raindrop is ... the frequency of the same light in air.

15. **A**◯ less than **B**◯ equal to **C**◯ greater than

8 pt A light ray is incident at a right angle on one of the surfaces of a glass prism as shown in the figure.

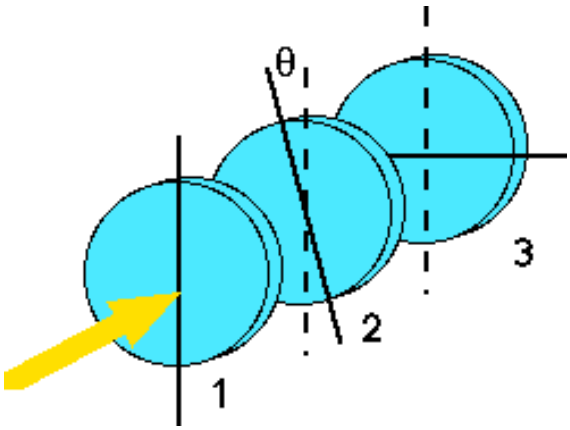


The top angle of the prism is $\alpha = 24°$. The index of refraction of the glass is n = 1.35. At what angle θ will the light ray exit the other surface of the prism?
(in `deg`*)*

16. **A**◯ 2.43×10^1 **B**◯ 2.85×10^1 **C**◯ 3.33×10^1
D◯ 3.90×10^1 **E**◯ 4.56×10^1 **F**◯ 5.33×10^1
G◯ 6.24×10^1 **H**◯ 7.30×10^1

8 pt

Due on Saturday, Aug 2 2008 at 12:02 am (EDT)



Polarizers 1 and 3 have their axes of polarization, indicated by the black solid lines, perpendicular to each other. If you try to shine light through only the combination of 1 and 3, you will find that none passes through. However, now we put in another polarizer (number 2 in the figure) between number 1 and number 3. This polarizer has an axes of polarization that has an angle of $\theta = 39°$ with respect to the polarization axes of polarizer 1. Surprisingly, now some light passes through the combination 1+2+3. What percentage of the initial (unpolarized) light intensity passes through?

17. **A**◯ 6.761 **B**◯ 8.992 **C**◯ 11.960
D◯ 15.906 **E**◯ 21.155 **F**◯ 28.137
G◯ 37.422 **H**◯ 49.771