

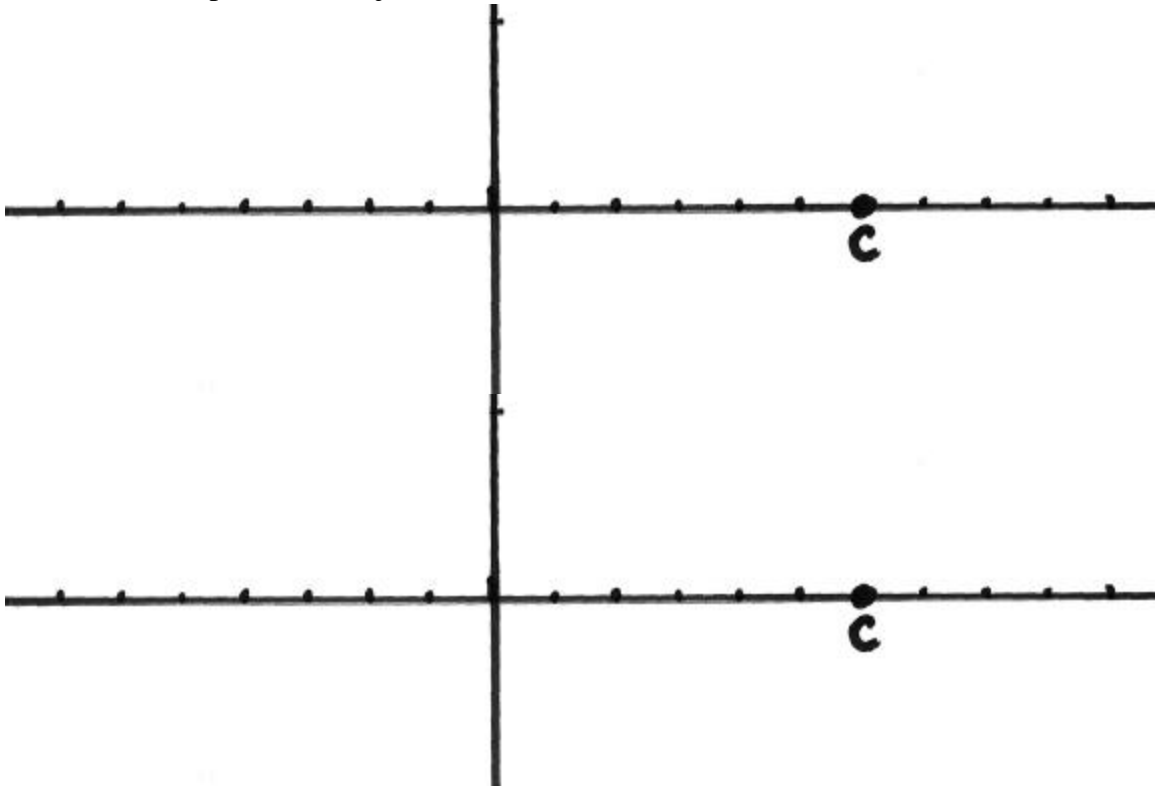
29:029 Physics III

Exam II

October 27, 2000

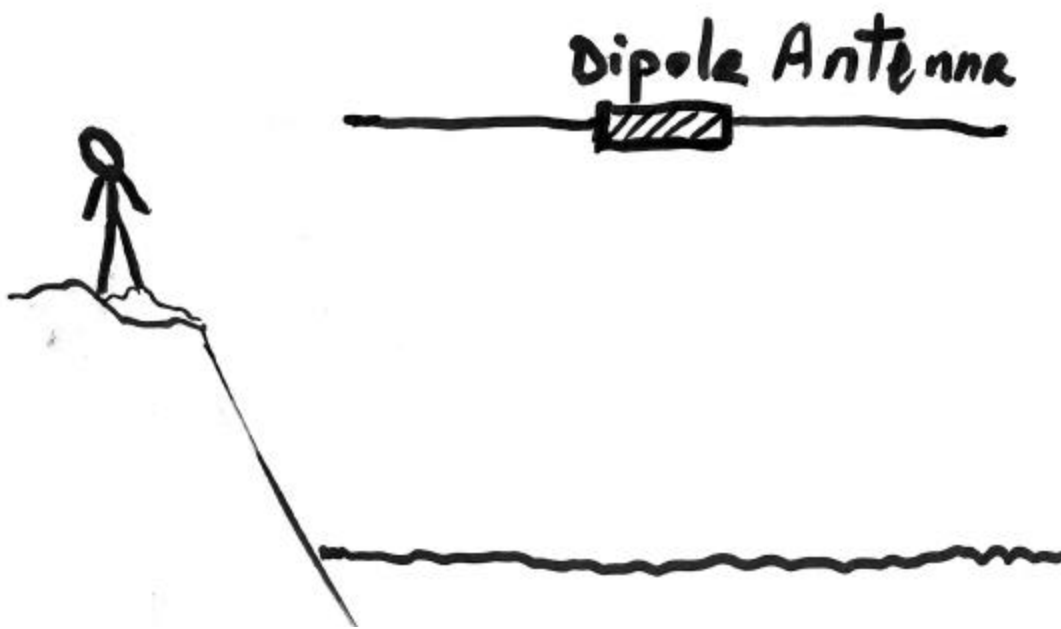
Closed book exam. Please show all work to get full credit. Point values for each problem are indicated. Please ask questions if you need clarification. If you don't show your work, or make written comments, then there is no way for me to give partial credit.

- 1) (12 points) A concave spherical mirror has a radius of curvature of 6 cm.
- a) Sketch a ray diagram and find the location and magnification of the image from an object located at 9 cm. Is the image real or virtual? (You can use equations to help.)
- b) Same as a) except that the object is located 2 cm in front of the mirror.



- 2) (12 points) A fish is 10 cm from the front surface of a fish bowl of radius 20cm. Take the index of refraction of water to be $n=4/3$.
- a) Where does the fish appear to be to someone in air viewing it from in front of the bowl?
- b) Where does a cat that is 10 cm from the outside surface of the bowl appear to be to the fish?

- 3) (12 points) Consider the problem of sending electromagnetic waves so that they will penetrate the surface of water. Take the index of refraction of water to be $n=4/3$.
- What should the orientation of the electric, magnetic, and wave vectors of the electromagnetic wave be to obtain the strongest transmission?
 - If the transmitter has a dipole antenna like the one used as a lecture demonstration (see the figure, it is a straight wire antenna), how should the transmitter be oriented in order to obtain the desired electromagnetic wave?



- 4) (12 points) Television viewers in rural areas often find that the picture flickers (fades in and out) as an airplane flies across the sky in the vicinity. The flickering is due to interference between the waves directly received by the television and waves which reflect off of the airplane before being received. If the television receiver is 40 km away from the transmitter, the waves are at 100 MHz, the airplane is at an altitude of 600m above the receiver and is headed away from the transmitter, and the flicker frequency is 4 Hz when the plane is directly overhead, then:
- What is the speed of the plane?
 - If the planes speed is constant, will the flicker rate increase, decrease, or stay the same as the plane continues past the location of the house? (Hint, you can figure this out without a lot of calculation.)