Problem 31.24

We know that charge moving perpendicular to a magnetic field will feel a maximum magnetic force. As the earths B-fld is northerly, that means the antenna will experience its maximum magnetic force when moving east/west.

We have derived several times the expression for the motional EMF. That expression is:

$$\varepsilon = BLv\cos\theta$$

where θ is the angle between B and v.

So what velocity will be required to get a maximum EMF of $4.5\mathrm{x}10^{-3}$ V across the antenna's length. Putting in the numbers yields:

$$v = \frac{\varepsilon}{BL\cos\theta}$$
$$= \frac{\left(4.5\mathrm{x}10^{-3}\ \mathrm{V}\right)}{\left(50\mathrm{x}10^{-6}\ \mathrm{T}\right)\left(1.2\ \mathrm{m}\right)\left(\cos 65°\right)}$$
$$= 177\ \mathrm{m/s}$$

1.)

Is it reasonable for a car to do this on a curved road?

As 177 m/s is approximately 400 miles/hour, the chance you are going to find a car that can do this on a curved road are not good . . . in fact, the possibility of finding a car that can do this on a straight-away are not very good . . .

2.)