

## Homework 5

Due February 29th

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1. (a) For the line element discussed in class that was just an inversion of flat space,

$$ds^2 = a^4/r^4 (dr^2 + r^2 d\theta^2) ,$$

show that the distance between the origin ( $r = 0$ ) and any finite point is infinite.

- (b) Find the distance between  $r = R$  and  $r = \infty$  along the line  $\phi = 0$ .
2. The following line element corresponds to flat spacetime:

$$ds^2 = -dt^2 + 2dxdt + dy^2 + dz^2 .$$

Find a coordinate transformation that puts the line element in the usual flat space form.

3. Consider the two-dimensional spacetime spanned by coordinates  $(v, x)$  with the line element

$$ds^2 = -x dv^2 + 2dvdx .$$

- (a) Calculate the light cone at a point  $(v, x)$ .
- (b) Draw a  $(v, x)$  spacetime diagram showing how the light cones change with  $x$ .
- (c) Show that a particle can cross from positive  $x$  to negative  $x$  but cannot cross from negative  $x$  to positive  $x$ .