MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Physics Department

Physics 8.286: The Early Universe — November 4, 2009
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Errata for Lecture Notes 6 and Review Problems for Quiz 2

1) Eq. (6.43) should read:

$$A(\lambda,\alpha) = g_{ij}\left(\tilde{x}^k(\lambda)\right)\frac{\mathrm{d}\tilde{x}^i}{\mathrm{d}\lambda}\frac{\mathrm{d}\tilde{x}^j}{\mathrm{d}\lambda}\ , \tag{6.43}$$

(In the notes, one of the superscripts was mistyped as a u.)

2) Eq. (6.45) should read:

$$\frac{\mathrm{d}}{\mathrm{d}\alpha}g_{ij}\big(\tilde{x}^k(\lambda)\big)\bigg|_{\alpha=0} = \left.\frac{\partial g_{ij}}{\partial x^k}\right|_{x^k=x^k(\lambda)}\left.\frac{\partial\tilde{x}^k}{\partial\alpha}\right|_{\alpha=0} = \frac{\partial g_{ij}}{\partial x^k}\big(x^k(\lambda)\big)w^k\ , \tag{6.45}$$

(In the notes, the argument in the last term was written as $x^i(\lambda)$. The superscript is included only to convey the information that the function depends on all the coordinates. It doesn't matter what letter is used for the superscript, but it should match the superscript used in the first term of the same equation.)

3) Just above Eq. (6.72), it should read

$$\partial_r h(r) = R_S/r^2\ .$$

(In the notes the equation was mistyped, with a minus sign.)

4) Eq. (6.81) should read:

$$\frac{\mathrm{d}r}{\mathrm{d}t} \approx -c\left(\frac{r-R_S}{R_S}\right)\ . \tag{6.81}$$

(In the notes, the RHS had the opposite sign. Eq. (6.79) is written correctly, and the square root symbol in the equation is interpreted as the positive square root. Since $h^{-1}(r)$ blows up in this limit, the second term in the square root dominates over the first. But since $\mathrm{d}r/\mathrm{d}\tau$ is negative,

$$\sqrt{h^{-1}(r)+c^{-2}h^{-2}(r)\left(\frac{\mathrm{d}r}{\mathrm{d}\tau}\right)^2} \approx \sqrt{c^{-2}h^{-2}(r)\left(\frac{\mathrm{d}r}{\mathrm{d}\tau}\right)^2} = -c^{-1}h^{-1}(r)\frac{\mathrm{d}r}{\mathrm{d}t}\ .)$$

5) In Review Problems for Quiz 2, Problem 4 ("Anticipating a Big Crunch") is ambiguous, because the answer depends on whether the universe is expanding or contracting. The problem should have stated explicitly that the universe is expanding.