The deadline for submission is **Thursday, February 14th at 10am.** You may hand in your writeup either in the Wednesday’s tutorials session (Feb. 13th, 4pm) or by the start of the first lecture on Thursday (Feb. 14th, 10am). Late submissions without prior arrangement or a valid explanation will result in reduced marks. Late submissions after Wednesday 4pm in the following week will not be accepted, as the solutions will be discussed in tutorials each week after the submission deadline.

**Question**

1. A particle describes the ellipse

   \[ \frac{1}{r} = 1 + \frac{1}{8} \cos \theta \]

   in such a way that \( r^2 \dot{\theta} \) is always equal to 64.

   (a) What are the appropriate SI units for the expression \( r^2 \dot{\theta} = 64 \)? \([10p]\)

      **Hint:** The SI unit of length \( r \) is meter (m).

   (b) Prove that the transverse acceleration of the particle is equal to zero. \([20p]\)

   (c) Prove that the dependence of the time derivative of the \( r \) coordinate and the angle \( \theta \) has the following form: \( \dot{r} = c \sin \theta \), and determine the constant \( c \). \([30p]\)

   (d) Prove that the radial acceleration of the particle has the form \( \frac{A}{r^2} \) and determine the constant \( A \). \([40p]\)