Solutions to exercises in part 2D
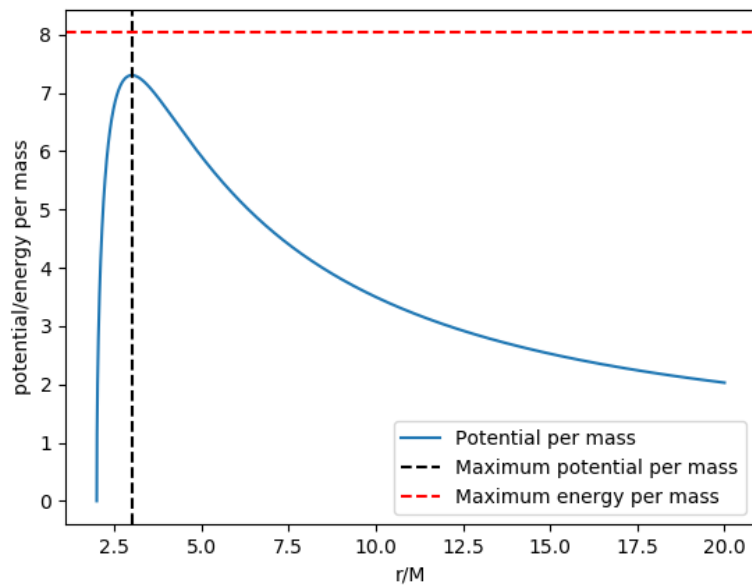
Exercise 2D.1

1. See lecture notes.

Figur 1: The potential and with the critical radius and the energy per mass for the rocket.
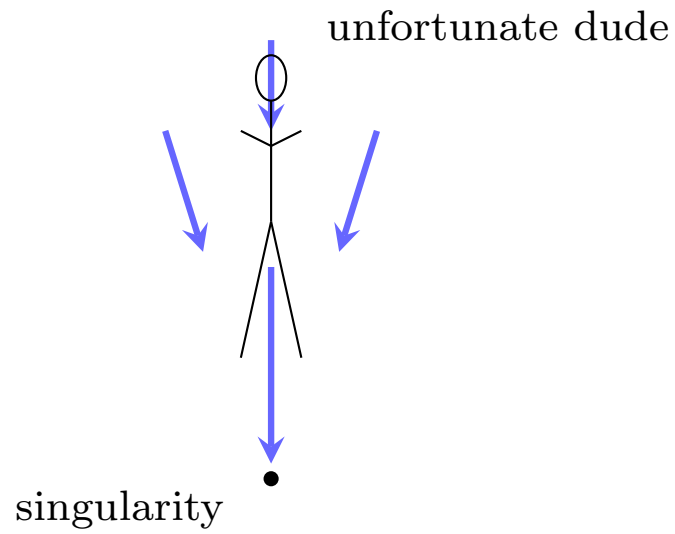
5. Since $E/m > E_{crit}$ the rocket will be swallowed by the black hole.

6.
$$\tau = 0.242M \cdot \frac{G}{c^3} = 4.77\text{s}. \tag{0.1}$$

7. You should get 1.46 seconds.

8.

Figur 2: How the gravitational 'force' will affect the astronaut.

What will happen is that the point closer to the singularity will experience greater gravitational pull thus the astronaut will be stretched. At the same time the 'forces' working at the sides will compress the person from the sides. This process is called spaghettification for a reason.

Exercise 2D.2
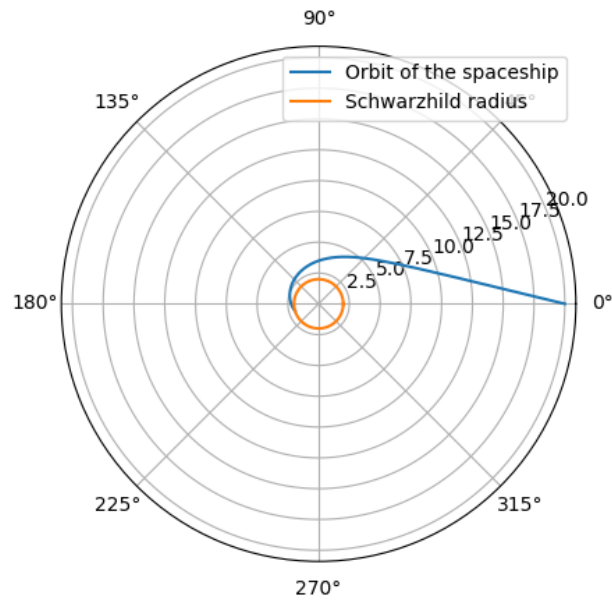
Figur 3: The trajectory of the space ship towards the black hole.