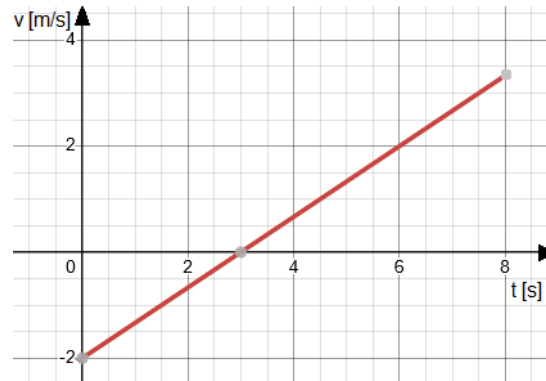


1. Midterm of Physics FRI

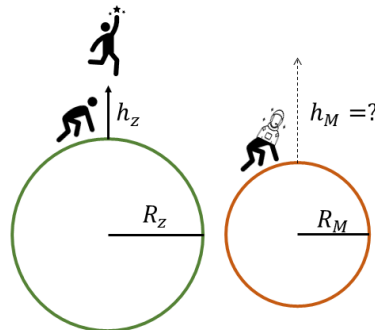
6 December 2023 at 19:15

1. A truck is driving on a straight road with a velocity vs time dependence as shown on the plot. Assume that the truck is moving in one dimension.

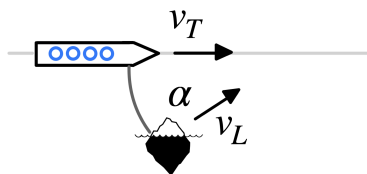
- What is the truck's acceleration?
- At which position is the truck located at $t = 8$ s relative to its initial position?
- Draw a plot of the time dependence of the truck's position.



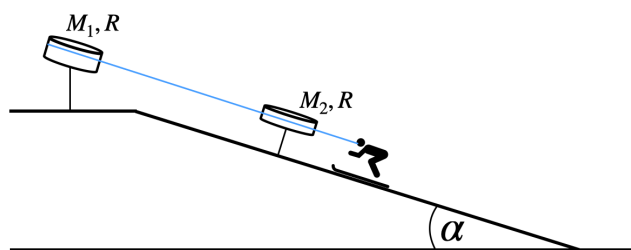
2. Matthew is an astronaut who is flying to Mars. Being an avid high jumper, he can jump as high as 2 m on Earth. How high can he jump on Mars, given that he puts in the same effort? Assume that both planets consist of the same rock with equal density. The radii of Earth and Mars are $R_Z = 6400$ km and $R_M = 3400$ km, respectively.



3. The Titanic, a huge ship of mass 100 t, is moving at a speed of $v_T = 10$ m/s at an angle $\alpha = 60^\circ$ towards a 500 t heavy iceberg, which is moving at a speed $v_L = 1$ m/s. At some point, the Titanic and the iceberg collide and merge.
- Which direction are the Titanic and the iceberg moving in after the collision?
 - At what velocity are they moving after the collision?



4. A skier with mass $m = 90$ kg rides a ski lift on a hill with slope $\alpha = 15^\circ$. Something goes wrong and the whole lift stops. Shortly afterwards, the steel cable snaps at the bottom of the lift. The skier, still tied to the lift, starts to slide down the hill. The lift is constructed from a light steel cable which passes over two cylindrical pulleys - one heavy at the top of the hill with a mass of $M_1 = 340$ kg and $R = 1$ m, and one lighter with a mass of $M_2 = 200$ kg and the same radius; the latter is located just in front of the skier as he begins to slide down the hill. With what acceleration does the skier slide down the hill? Note that the coefficient of friction between the skis and the snow is $k_{tr} = 0.01$, and that the steel cable is parallel to the ground and does not slip. How long does it take a skier to get to the bottom of the hill if the lighter pulley is 50 m away from the bottom?



5. During a thrilling air hockey match between Alice and Bob, a power outage suddenly occurs. This happens at the exact moment when Alice sends the deciding puck towards Bob's goal from a distance of $4/5$ table lengths away with a velocity of 5 m/s. At the same time, due to the waning air cushion, the coefficient of friction between the puck and the table starts increasing with a time dependence of $k(t) = \beta t$, where $\beta = 1$ s $^{-1}$. Does Alice score the deciding goal? The table is 3 m long.

