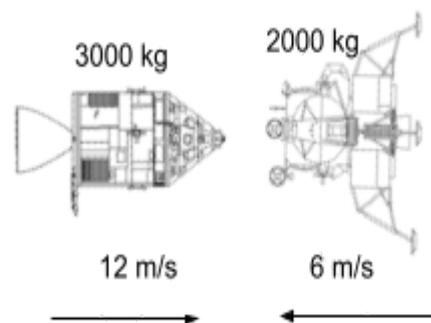


Higher Physics Masterclass 3



- 1) An experimental rocket is launched with a velocity of 95 ms^{-1} at an angle of 35° to the horizontal.
- Calculate the horizontal and vertical components of the rocket when launched
 - Calculate the total time the rocket was in the air.
 - Calculate the horizontal distance the rocket travelled. (Its range).
 - By finding the horizontal and vertical velocities of the rocket 4 s into its flight, find the speed of the rocket 4 s into the flight.

- 2) Two spacecraft are about to join together during a spaceflight. The masses and velocities of each craft are shown.



- Find the speed and direction of the combined spacecraft after they join together.
- The spacecraft on the left has an engine capable of 2000 N of thrust while the one on the right has an engine capable of 4000 N of thrust. Which engine should be fired and for how long to bring the combined spacecraft to rest?

- 3) The lunar module of mass 15000 kg descends with a downward acceleration of 0.2 ms^{-2} towards the surface of the Moon. The gravitational field strength of the Moon is 1.7 N/kg .

- Draw a diagram of the vertical forces acting on the Lunar Module.
- Calculate the upwards thrust produced by the descent engine while it is accelerating downwards at 0.2 ms^{-2}



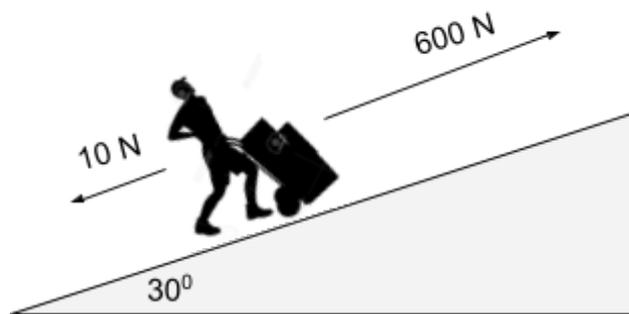
- 4) The Starship Enterprise has a length of 800 m when measured in its inertial reference frame. Calculate the observed length when it passes by a stationary space observatory at $0.85c$



5) A spectral line of hydrogen observed in the laboratory on Earth has a wavelength of 656 nm. The same hydrogen spectral line has a wavelength of 700 nm when observed on a distant galaxy.

- Calculate the redshift ratio for this galaxy.
- Determine the speed the galaxy is receding from Earth.
- Use the Hubble equation to determine how far the galaxy is from Earth.

6) A delivery man pushes his 100 kg barrow up an inclined plane with a force of 600 N. The force of friction acting against his sleigh is 10 Newtons. The slope has an angle of 30°



- Calculate the barrow's component of weight acting down the slope.
- Draw a free body diagram of the forces acting parallel to the slope
- Find the resultant force acting on the barrow.

7) Determine the voltage across the points A and B when the switch S is open and then when it is closed.

