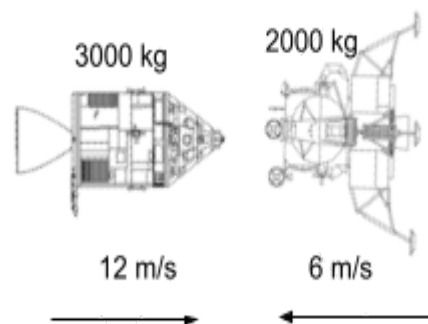


# Higher Physics Masterclass 3



- 1) An experimental rocket is launched with a velocity of  $95 \text{ ms}^{-1}$  at an angle of  $35^\circ$  to the horizontal.
  - a) Calculate the horizontal and vertical components of the rocket when launched
  - b) Calculate the total time the rocket was in the air.
  - c) Calculate the horizontal distance the rocket travelled.(Its range).
  - d) 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.



- a) Find the speed and direction of the combined spacecraft after they join together.
- b) 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 4000N 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  $0.2 \text{ ms}^{-2}$  towards the surface of the Moon. The gravitational field strength of the Moon is  $1.7 \text{ N/kg}$ .

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



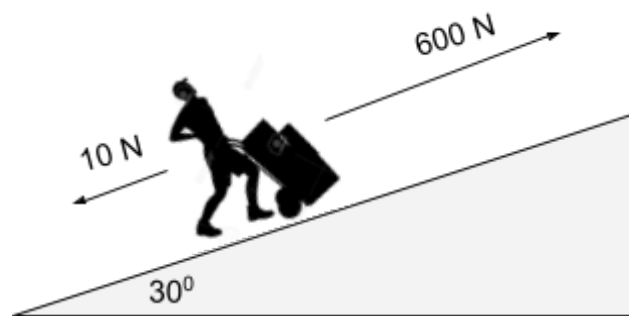
- 4) The Starship Enterprise has a length of 800 m when measured in its inertial reference frame.  
Calculate the observed length when it passes by a stationary space observatory at  $0.85c$



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  $30^\circ$



- 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.

