

# Higher Physics Masterclass 4



- 1) A skateboarder starts from rest and accelerates down a ramp reaching a speed of  $8 \text{ m s}^{-1}$  after 2.5 s.

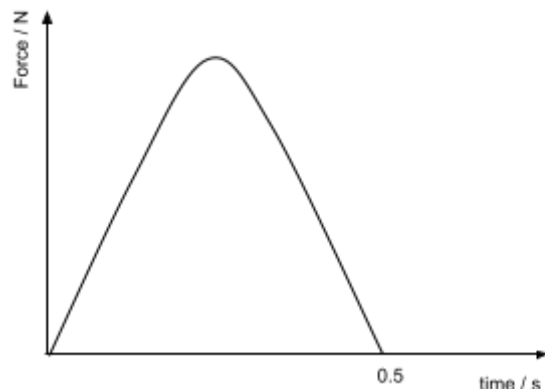


- Determine the acceleration of the skateboarder.
  - State what the term *acceleration* means.
  - Find the distance travelled by the skateboarder after 2.5 s
- 2) A flare was launched from the deck of a stationary ship. The flare had a velocity of  $30 \text{ m/s}$  at an angle of  $60^\circ$ . Calculate
- the maximum height reached by the flare from the deck. [34.4 m]
  - the total time of flight of the flare. [5.3s]
  - the range of the flare [79.45 m]
  - The angle that the flare was launched at is reduced to  $50^\circ$ .  
State how this change would affect the maximum height reached and the time of flight.

- 3) A cricketer throws a ball up and hits it with his bat while the ball is stationary in the air. The cricket ball leaves the bat with a speed of  $30 \text{ m s}^{-1}$ . The ball has a mass of  $0.16 \text{ kg}$ .



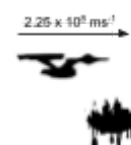
- Find the size of the momentum of the ball just as it leaves the bat.
- Determine the change of momentum of the ball.
- State the impulse given to the ball by the bat.
- The ball was in contact with the bat for 0.4 s. Find the average force given to the ball by the bat.
- The force given to the ball is shown on the graph on the right. State what the area of the graph represents.
- If the cricket ball is replaced with a softer ball and leaves the bat with the **same** momentum, sketch the force time graph for the softer ball.



- 4) A police car travelling at  $30 \text{ m s}^{-1}$  approaches a stationary pedestrian standing on a pavement. The police car siren has a frequency of 2,000 Hz.



- a) Determine the frequency that pedestrian A hears as the police car approaches.
- b) Sketch a diagram showing the sound waves from the police car as heard from pedestrian A and B.
- 5) A spectral absorption line from an element studied in a lab on Earth has a wavelength of 430.0 nm. The same spectral absorption line has a wavelength of 430.6 nm when viewed on a distant galaxy.
- a) Find the z shift ratio of this spectral line.
- b) Using the redshift ratio, find the recessional velocity of the galaxy.
- c) Determine the distance of the galaxy from Earth using Hubble's Law.
- 6) A starship in the 23rd century moves at a speed of  $2.25 \times 10^8 \text{ ms}^{-1}$  past a stationary space station. The starship has a length of 200 m measured in its own inertial reference frame



- a) Determine the length of the starship as observed by the stationary space station.
- b) The starship takes 5 hours to reach its destination. Determine the time it took the starship to reach its destination as observed from the space station.
- 7) Name and describe three discoveries that show evidence for the Big Bang Model.