

Higher Physics Masterclass 4



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

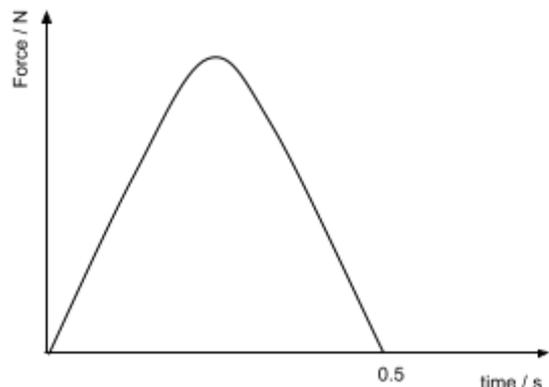


- a) Determine the acceleration of the skateboarder.
b) State what the term *acceleration* means.
c) Find the distance travelled by the skateboarder after 2.5 s
- 2) A flare was launched from the deck of a stationary ship. The flare had a velocity of 30 m/s at an angle of 60° . Calculate
- a) the maximum height reached by the flare from the deck. [34.4 m]
b) the total time of flight of the flare. [5.3s]
c) the range of the flare [79.45 m]
d) The angle that the flare was launched at is reduced to 50° .
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 m s^{-1} . The ball has a mass of 0.16 kg .



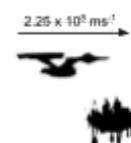
- a) Find the size of the momentum of the ball just as it leaves the bat.
b) Determine the change of momentum of the ball.
c) State the impulse given to the ball by the bat.
d) The ball was in contact with the bat for 0.4 s. Find the average force given to the ball by the bat.
- e) The force given to the ball is shown on the graph on the right. State what the area of the graph represents.
- f) 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 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.