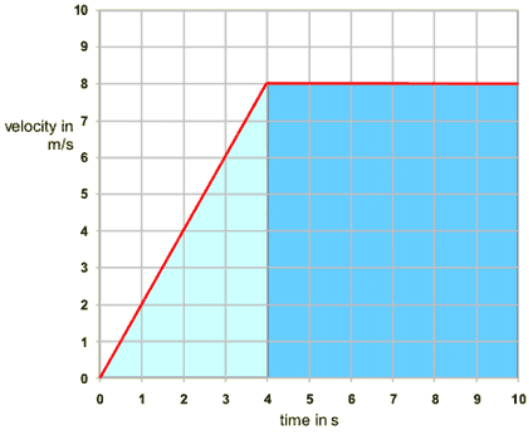
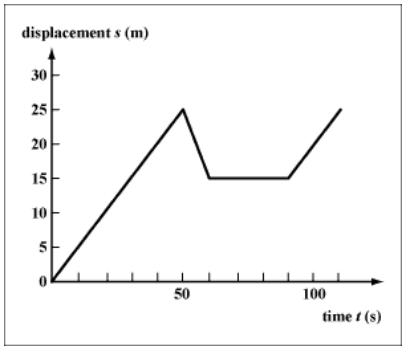
02 Mechanics review questions

Part A: Kinematics:



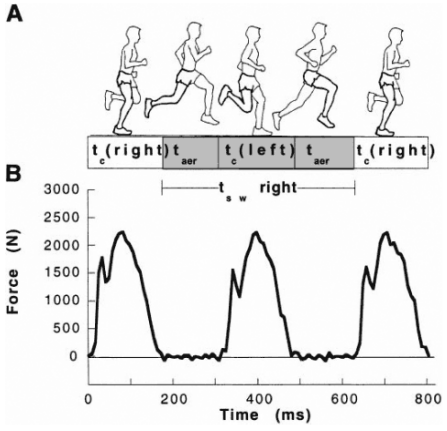
1. For the graph on the right state:
   a. The instantaneous velocity at t=3seconds
   b. The average velocity during the first 4 seconds
   c. The acceleration during the first 4 seconds
   d. The total distance travelled



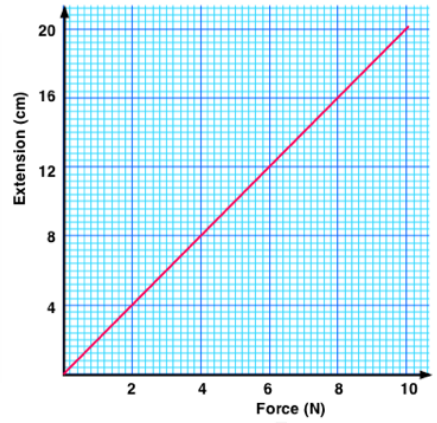
2. Plot a velocity-time graph for the motion represented by the graph on the left.
3. Explain, by considering acceleration why the graph you have drawn for question 5 is a simplification.
4. State what the area under an acceleration-time graph represents.
5. State the condition under which the equation ***s = (u+v)t/2*** is valid.
6. A ball is dropped near the surface of the Earth and hits the ground 3 seconds later.
   a) (Ignoring air resistance) How fast will the ball be travelling when it hits the ground?
   b) How far will the ball have travelled and what is its average speed?
   c) After how long did it take the ball to travel 9.81 metres?
   d) How fast was the ball travelling after it had fallen 19.62 metres?
7. Two balls are in motion. Ball A is travelling upwards at $12 ms^{-1}$ at an elevation of 30^0. Ball B is traveling vertically downwards at $2 ms^{-1}$. What is the velocity of A relative to B?

Part B: Forces and Dynamics

1. A 1kg block is sliding along a table. There is no force pushing it.
   a. Draw a force diagram for the block, labeling the forces and describe its motion.
   b. The block falls off the edge of the table, draw a force diagram for the block now.
   c. The block is caught and during the catch the maximum force on the ball was 30N at an angle of 10^0 to the vertical. Draw the force diagram now and calculate the acceleration.
2. State the conditions of a system that are needed for the law of conservation of linear momentum to apply.
3. A rifle can shoot a 4.20 g bullet at a speed of 965 ms^{-1}. The bullet is fired into a 50.0 kg torso of a dummy wearing a bullet proof vest of 2.5kg. Ignoring friction with what velocity will the bullet, vest and torso be moving after the impact?
4. Estimate the (vertical) impulse on the ground exerted by a footfall using the graph opposite. Compare the effect of this impulse on the ground and a person of mass 70kg.

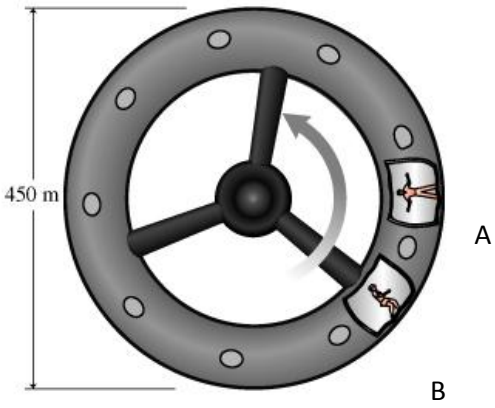


Part C: Work, Energy and Power



1) A child pulls a sledge by pulling on a rope at an angle of 30^{o} to the horizontal. If the sledge is dragged 30m in this way and the force used is 10N how much work has been done?
2) a) The extension-force graph of a spring is shown opposite. How much work is done stretching it 0.2m?
   b) What type of energy is transferred to the spring?
3) A 1100kg lorry travelling at $24ms^{-1}$ collides with a 600kg car travelling at $19ms^{-1}$ in the same direction.
   a) After the collision the new speed of the car is 23m/s what is the new velocity of the lorry?
   b) Calculate the total amount of kinetic energy before and after the collision.
4) An 80kg skier starts from a velocity of $0.5ms^{-1}$ at the top of a slope 35m high. If the average force of friction on the skier is 20N and the slope is 200m long how fast is the skier travelling at the bottom of the slope?
   If the skier uses a drag lift to get back up the slope how much work does the drag list do if the average frictional force remains 20N?

Part D Uniform Circular Motion.



1. A circular shaped space station has a 450m diameter and rotates to create an acceleration that results in a gravity like effect at its perimeter for the occupants.
   a. Add an arrow to show the direction of the force on person A.
   b. Calculate the angular velocity required to create a gravity effect equivalent to 0.5g.
   c. State the magnitude of the velocity of the perimeter relative to the centre of the station.
   d. State the magnitude and direction of the acceleration at the perimeter.
   e. Explain how this acceleration is created without the need for a resultant force on the space station.