Saturday X-tra **X-Sheet: 1**

Revision of Grade 11 Mechanics

Key Concepts

In this session we will focus on what you need to know about;

- Resultant force
- Displacement and distance
- Velocity and speed
- acceleration
- Momentum and Impulse

Terminology & definitions

Resultant Force: a single force that has the same effect as a number of forces acting together

Displacement: the change in position of an object in a straight line.

Velocity: the rate of change of displacement

Distance: the actual path traveled by an object from its initial position to the final position.

Speed: the rate of change of distance

Acceleration: the rate of change of velocity

Momentum: the product of mass and velocity. Measured in kilograms metres per second ($kg \cdot m \cdot s^{-1}$). momentum is a vector quantity.

Impulse: the change in momentum in a given time interval. Measured in kilograms metres per second($kg \cdot m \cdot s^{-1}$). Impulse is a vector quantity.

X-planation of key concepts and terminologies

Displacement, velocity and acceleration are ***vector*** quantities. Vector quantities are physical quantities with both magnitude (size) and direction.

Distance, speed and time are ***scalar*** quantities. Scalar quantities are physical quantities with magnitude only.

The following equations of motions can be used to solve motion problems. These equations are provided for use during examinations. However, it is advisable for you to practice using the equations more often without copying them from the given table so as to save time during examinations.

TABLE 2: FORMULAE

MOTION

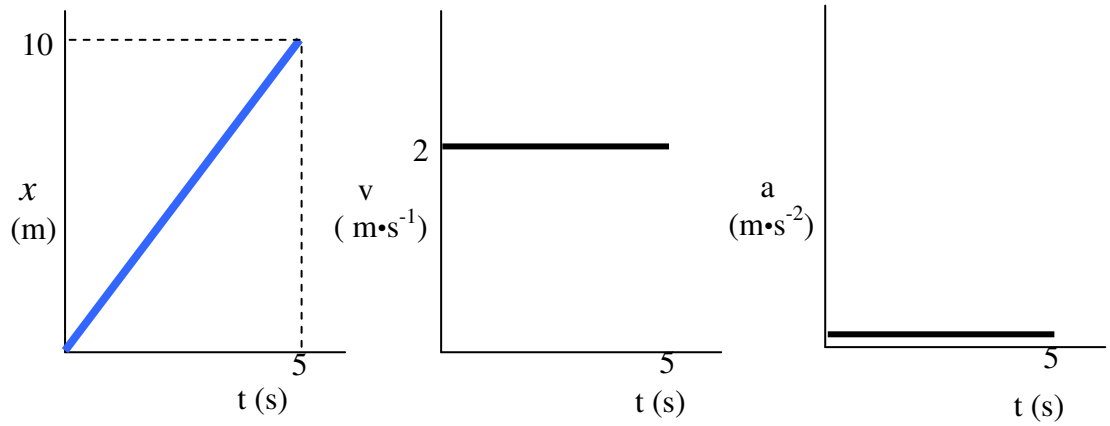
$v_f = v_i + a\,\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_f + v_i}{2}\right)\Delta t$

FORCE

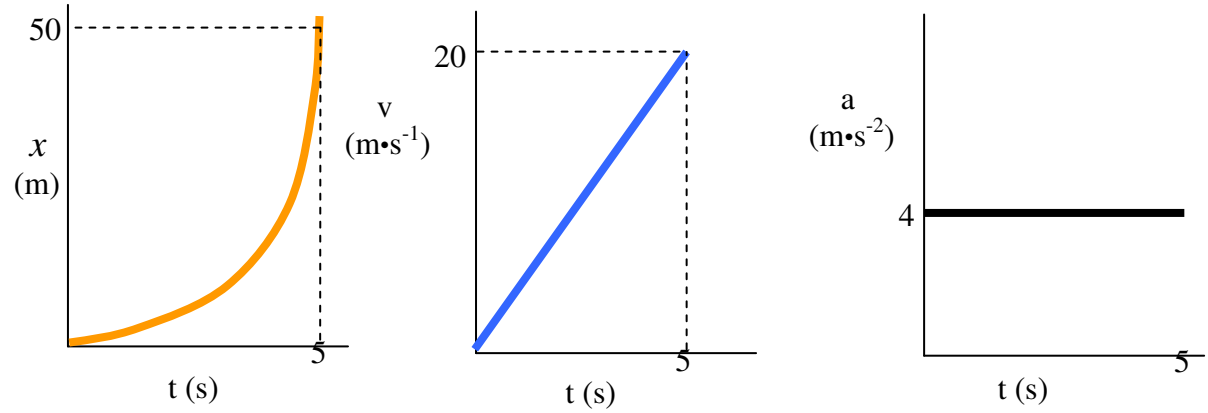
$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p = mv_f - mv_i$	$F_g = mg$

An object can move in a ***uniform*** velocity. The word 'uniform' implies that the quantity is not changing. If the velocity is uniform, the object undergoes the same change in displacement in equal time intervals. The following graphs represent the motion of this object;

An object can move with uniform velocity. Suppose a certain car moves at a constant velocity of
2 m•s^{-1} for 5s. The motion of the car can be represented graphically in the following way;



An object can also move with uniform acceleration. Suppose a car starting from rest accelerates at uniform acceleration of 4m•s^{-2} for 5s.



X-ample Questions

1. An object of mass 200 kg moving at 4 $m \cdot s^{-1}$ changes its velocity to 10 $m \cdot s^{-1}$ in 2 seconds. Calculate
   1.1 the acceleration of the object during the 2 seconds time interval.
   1.2 the initial momentum of the object.
   1.3 the final momentum of the object.
   1.4 change in momentum.
   1.5 the magnitude of the force that caused the change in momentum of the object.

2. A lorry travels in a southward direction at 12 $m \cdot s^{-1}$. It then accelerates at 4 $m \cdot s^{-2}$ for 200 m.
   2.1 Calculate the lorry's velocity after traveling for 200 meters.
   2.2 Calculate the average velocity of the lorry over the 200 m journey.
   2.3 Calculate the time taken by the lorry to travel the 200 m journey.
   2.4 Draw a velocity-time graph for the motion of the lorry over the 200m.

X-ercise

1. Define the following terms;
   (a) displacement
   (b) velocity
   (c) acceleration

2. An object of mass 300 kg is moving at 5 $m \cdot s^{-1}$ to the right. A resultant force causes the object to change its velocity to 13 $m \cdot s^{-1}$ in 4 seconds. Calculate
   2.1 the acceleration of the object
   2.2 change in momentum of the object during the 4 seconds
   2.3 the magnitude of the force that caused the change in momentum

3. A motorbike of mass 500 kg accelerates from 10 $m \cdot s^{-1}$ to 15 $m \cdot s^{-1}$ in 4 seconds. Calculate
   3.1 the initial momentum of the object
   3.2 the final momentum of the object
   3.3 the net force that caused the change in momentum
   3.4 the acceleration of the object during the 4 seconds time interval.

Answers

1
1.1 The change in position of an object.
1.2 The rate of change of displacement
1.3 The rate of change of velocity

2.
2.1 2 $m \cdot s^{-2}$
2.2 2 400 kg• $m \cdot s^{-1}$
2.3 6 00 N

3.
3.1 5 000 kg• $m \cdot s^{-1}$
3.2 7 500 kg• $m \cdot s^{-1}$
3.3 625 N
3.4 1,25 $m \cdot s^{-2}$