8A Constructing Models

1. The motion of a basketball as it leaves a player's hand and passes through the net can be modelled using the equation $h = 2 + 1.1x - 0.1x^2$, where h is the height of the ball above the ground, and x is the horizontal distance travelled (both in metres).

a) Find the height of the basketball;

i) When it is first released

ii) After it has travelled a horizontal distance of 0.5m

b) Use the model to predict the height of the basketball when it is at a horizontal distance of 15m from the player

c) Comment on the validity of this prediction

8B Modellings Assumptions

Model
Particle – Dimensions of the object are negligible.
Rod – All dimensions but one are negligible, like a pole or a beam.
Lamina – Object with area but negligible thickness, like a sheet of paper.
Uniform body – Mass is distributed evenly.
Light object – Mass of the object is small compared to other masses, like a string or a pulley.
Inextensible string – A string that does not stretch under load.
Smooth surface
Rough surface – If a surface is not smooth, it is rough.
Wire – Rigid thin length of metal.
Smooth and light pulley – all pulleys you consider will be smooth and light.
Bead – Particle with a hole in it for threading on a wire or string.
Peg – A support from which a body can be suspended or rested.
Air resistance – Resistance experienced as an object moves through the air.
Gravity – Force of attraction between all objects. Acceleration due to gravity is denoted by g. 

1. A mass is attached to a length of string which is fixed to the ceiling. The mass is drawn to the side with the string taut and allowed to swing.

State the effect of the following assumptions on any calculations to be made:

a) The string is light and inextensible

b) The mass is modelled as a particle

8C SI Units

Quantity	Unit	Symbol
Mass	Kilogram	kg
Length / displacement	Metre	m
Time	Seconds	t

Quantity	Unit	Symbol
Speed / velocity	Metres per second	ms^{-1}
Acceleration	Metres per second per second	ms^{-2}
Weight / force	Newton	N (= kg ms^{-2})

The Normal Reaction

Frictional Force

Tension

Thrust

Resistance

Gravity

Weight

Buoyancy

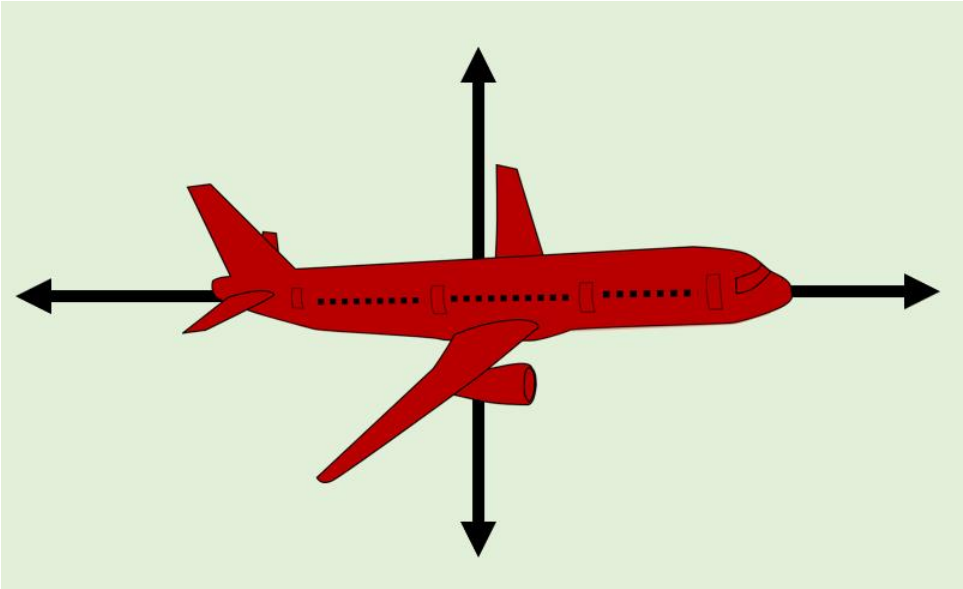
1. Write the following quantities in SI units:

a) 4km

b) 0.32g

c) 5.1×10^6 kmh^{-1}

2. The plane below is mid-flight. State the names of the labelled forces acting on it.



8D Vectors

Scalar quantities (magnitude only)

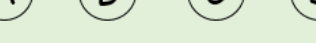
Quantity	Description	Unit
Distance	Measure of length	m
Speed	Measure of how quickly something moves	ms^{-1}
Time	Measure of ongoing events	s
Mass	Measure of the quantity of matter in an object	kg

Vector quantities (magnitude and direction)

Quantity	Description	Unit
Displacement	Distance in a specific direction	m
Velocity	Rate of change of displacement	ms^{-1}
Acceleration	Rate of change of velocity	ms^{-2}
Force / weight	Described by magnitude, direction and point of application	N

1. Fully describe the motion of the particles below:

	A	B	C	D
Velocity	+ve	+ve	-ve	-ve
Acceleration	+ve	-ve	-ve	+ve



2D Notation

2. The velocity of a particle is given by $v = 3\boldsymbol{i} + 5\boldsymbol{j}\ ms^{-1}$

Find:

a) The speed of the particle

b) The angle the direction of motion of the particle makes with the unit vector **i**.

3. A man walks from A to B and then from B to C. His displacement from A to B is 6**i** + 4**j** km. His displacement from B to C is 5**i** – 12**j** km.

a) What is the magnitude of the displacement from A to C?

b) What is the total distance the man walked in getting from A to C?