Intermediate 2 Unit 1

Mechanics & Heat

Revision of Formulae and Definitions

$\overline{v} = \frac{s}{t}$ Rearranging t = s =

Quantity	Units	Velocity is a vector quantity and requires direction. Displacement is a vector quantity and requires direction.
$\overline{v}$ = average velocity	m/s	
s = displacement		
t =		

$$\text{instantaneous speed} = \frac{\text{length of card}}{\text{time taken to pass through light beam}}$$

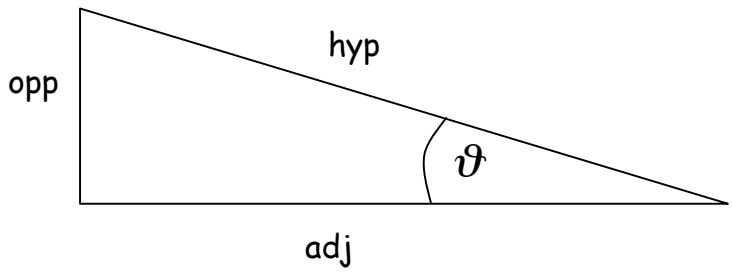
Quantity	Units
instantaneous speed	
length of card	
time taken to pass through light beam	

$\text{average speed} = \frac{\text{distance}}{\text{time}}$ Rearranging t = d=

Quantity	Units
average speed	
distance	
time	

Pythagoras : $hyp^2 = opp^2 + adj^2$

Trigonometry : $\tan\vartheta = \frac{opp}{adj}$



$a = \frac{v - u}{t}$ Rearranging v = u =

Quantity	Units
a = acceleration	
v =	
u = initial speed	
t =	

$W = mg$ Rearranging m = g =

Quantity	Units
W =	
m =	
g =	

$F = ma$ Rearranging m = a =

Quantity	Units
F = unbalanced force causing acceleration	
m =	
a =	

Projectile Motion – Horizontal Component

$d = v_h t$ Rearranging t = v_h =

Quantity	Units
d =	
v_h =	
t =	

Graph of horizontal speed with time

Projectile Motion – Vertical Component

$v = u + at$ Rearranging t = a =

Quantity	Units
v =	
u =	
t =	
a =	

Graph of vertical velocity with time

Momentum

$momentum = mv$

Quantity	Units
momentum	
m =	
v =	

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Quantity	Units
m_1 = mass of vehicle 1	
u_1 = initial velocity of vehicle 1	
m_2 =	
u_2 =	
v_1 = final velocity of vehicle 1	
v_2 =	

$E_w = Fd$ Rearranging F = d =

Quantity	Units
E_W =	
F =	
d =	

$$P = \frac{E}{t}$$ Rearranging E = t =

Quantity	Units
P =	
E =	
t =	

$E_p = mgh$ Rearranging m = g = h=

Quantity	Units
E_P =	
m =	
g =	
h =	

$$E_K = \frac{1}{2}mv^2$$ Rearranging m = v =

Quantity	Units
E_K =	
m =	
v =	

$$\% \text{ efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} x \frac{100}{1}$$

$$\% \text{ efficiency} = \frac{\text{power output}}{\text{power input}} x \frac{100}{1}$$

$E_H = cm\Delta T$ Rearranging m = □T =

Quantity	Units
E_H =	
m =	
c =	
□T	

$E_H = ml$ Rearranging m = l =

Quantity	Units
E_H =	
m =	
l	

Definitions:

Instantaneous speed is the speed over a very short time or distance e.g. the speed on a car's speedometer. Average speed is the speed over a longer time or distance e.g. average speed of car between Perth and Dundee.

Scalar quantity is completely described by magnitude (number and units) e.g. distance, time, temperature, speed.
Vector quantity is completely described by magnitude and direction e.g. displacement, weight, force, velocity.

Distance is the total ground covered, no matter in which direction.
Displacement is the length measured from starting to finishing point in a straight line. It is a vector. Its direction must be stated.

Acceleration is the change in velocity in one second.

Area under a speed time graph = distance

Area under a velocity tie graph = displacement (and direction is required!)

A force can change

- the shape of an object
- the speed of an object
- the direction of movement of an object

Weight is the force of gravity acting on a mass. It is measured in newtons.

Mass is how much matter an object is made of. It is measured in kilograms.

Gravitational field strength is the force of gravity acting on a 1kg mass. It is measured in newtons per kilogram.

Frictional force acts to oppose motion.

Newton's 1st law: an object remains stationary, or moves in a straight line at constant speed, unless acted upon by an unbalanced force.

Newton's 2nd law: when an object is acted on by a constant unbalanced force, the body moves with constant acceleration in the direction of the unbalanced force.

Newton's 3rd law: for every action there is an equal and opposite reaction. e.g. a bullet fired from a gun – the gun exerts a forward force on the bullet, the bullet exerts an equal and opposite force on the gun; rocket propulsion – the rocket exerts a downward force on the gases, the gases exert a equal and opposite force on the rocket.

Conservation of Momentum: total momentum before collision = total momentum after collision providing no external forces are acting.

Work done: when a force acts upon an object to cause displacement of that object, it is said that work was done upon the object.

Specific heat capacity of a substance is the heat energy required to change the temperature of 1kg of the substance by 1°C.

Specific latent heat of vaporisation is the heat energy required to change 1kg of liquid at its boiling point to 1kg of gas (vapour) at the same temperature.

Specific latent heat of fusion is the heat energy required to change 1kg of solid at its melting point to 1kg of liquid at the same temperature.

Principle of Conservation of Energy – energy can neither be created nor destroyed, simply transformed from one form to another.

Techniques

Measurement of average speed

- measure distance travelled with metre stick
- measure time taken with stop clock
- calculate speed using speed =

Measurement of instantaneous speed

- measure length of card attached to vehicle using a ruler
- measure time using light gate and electronic timer
- calculate instantaneous speed using

Using a newton balance to measure force

Scale diagram – six step process

Vector diagrams

Free body diagrams

Solving projectile motion problems by separating horizontal and vertical components.