**Motion revision**

**Revise Law of conservation of Energy and Vectors (see back of booklet) holiday hwk**

**Generalised method for tackling motion problems.**

1. Draw a diagram.
2. Assign values to variables (v, u, t, a, s etc.).
3. Assign direction (typically up is positive, down is negative, right is positive, left is negative).
4. Select appropriate equation, substitute variables, solve for unknown.
5. Write answer to 3 significant figures with direction as appropriate.

**Examples**

1. A rock is dropped out of a hot air balloon that is hovering stationary 200m above the ground.
   1. With what speed does the rock hit the ground?

v = = 62.6ms-1

* 1. How long does the rock take to fall?

–62.6 = 0 – 9.8t

t = 6.39s

* 1. If the hot air balloon is moving upwards at 5.00 ms-1 how long would the rock take to drop 200 m?

v = = –62.8ms-1

–62.8 = 5 – 9.8t

t = 6.92s

1. A rocket takes off vertically upwards at 15.0 m s-1.
   1. What is the maximum height reached by the rocket?

02 = 152 + 2(–9.8)s

s = 11.5m

* 1. How long will the rocket take to fall back to its original position?

0 = 15 – 9.8t

t1 = 1.53s

t = t1 + t2 = 2(1.53) = 3.06s

1. A boy takes a shot with a basketball with a vertical velocity of 6.50 m s-1 and watches as it comes down through the hoop, 1.05 m above his hand.
   1. Find the total flight time for the ball from hand to hoop.

s = 1.05 = 6.5t – 4.9t2

4.9t2 – 6.5t + 1.05

t = 1.14s

* 1. Find the velocity of the ball as it strikes the hoop.

v = = 4.66ms-1

* 1. An opponent is running towards the hoop at 35 km/h. He is 15.0 m away from being in position to grab the ball as it rebounds. Will he be there in time?

s = 1.14 = 11.1m

Hence no

1. A car is accelerated from 15.0 m s-1 to 48.0 m s-1 in 12.0 s.
   1. Calculate the average velocity.

= 31.5ms-1

* 1. Calculate acceleration.

a = = 2.75ms-2 in the direction of the car

* 1. Calculate displacement.

s = (15)(12) + (2.75)(12)2

s = 378m in the direction of the car

**Revision – Equations of motion**

1. A ball is thrown vertically upwards at 20 ms-1.
2. What is the maximum height reached by the ball?

02 = 202 – 2(9.8)s

s = 20.4m

1. How long will the ball take to fall back to its original position.

0 = 20 – 9.8t1

t1 = 2.04s

t = t1 + t2 = 2(2.04) = 4.08s

1. A thrill seeker falls off a bungy jumping tower.
   1. What is their velocity 1.10s after they left the platform? Assume elastic has not applied a force yet.

v = 0 – 9.8(1.1) = 10.8ms-1

* 1. How far has the bungy jumper fallen during the 1.10s?

s = (–9.8)(1.10)2 = 5.93m down

* 1. What is the maximum velocity the bungy jumper achieves before beginning to slow down? He falls 10.4m before the elastic applies a force.

v = = 14.3ms-1

* 1. If a bungy jumper jumps upwards a distance of 0.500m, what initial velocity is necessary to reach that height?

02 = u2 – 2(9.8)(0.5)

u = 3.13ms-1

1. A boy standing on a bridge throws a ball vertically upwards at 3.00 ms-1 and watches as it lands in the river 6.50m below.
2. Find total time stone in flight.

s = –6.5 = 3t – 4.9t2

4.9t2 – 3t – 6.5

t = = 1.50s

1. Find the velocity of stone as it strikes the water.

v = = 11.7ms-1

1. A boat 50m away as the boy throws the stone, is travelling at 50km/h towards the bridge. Will the stone hit the boat if it passes the exact spot where the stone will land?

t = = 3.6

Hence no

1. A rocket is uniformly accelerated from rest at 8 ms-2 for a period of 12 s. Find:
2. final velocity.

v = 0 – 8(12) = 96.0ms-1 up

1. displacement.

s = (8)(12)2 = 576m up

1. Average velocity.

v = = 48.0ms-1 up

1. A car is accelerated from 17 ms-1 to 44 ms-1 in 18 s. Calculate the :
2. Average velocity

= 30.5ms-1 in the direction of the car

1. Acceleration

a = = 1.50ms-2 in the direction of the car

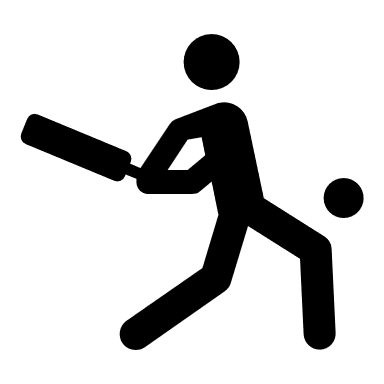
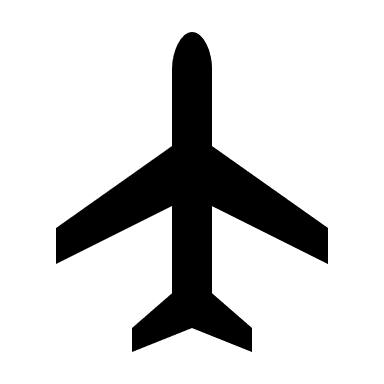
1. Displacement in this time.

s = 17(18) + (1.5)(18)2 = 549m in the direction of the car

Ans: 1a) 20.4 m b) 4.08 s 2a) 10.8 m s-1 down b) 5.93 m down c) 14.2 m s-1 down d) 3.13 m s-1 up 3a) 1.50 s b) 11.7 m s-1 down c) no 4a) 96 ms-1 b) 576m c) 48 ms-1 5a) 30.5 ms-1 b) 1.5 ms-1 c) 549 m

1. Label all the forces acting on the objects below: **Free body diagram**

**Lift**



**Drag**

**Thrust**

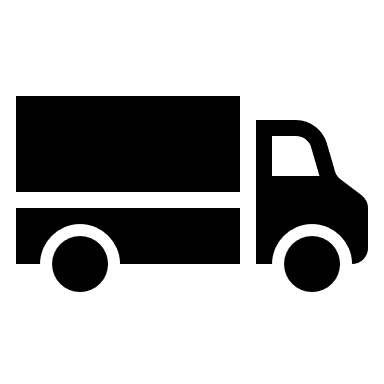
**Drag**

**Weight**

**Thrust**

**Normal force**

**Weight**



**Friction**

**Weight**

**Vector rules:**

**Adding Vectors:**

* Add vectors head to tail and resultant is the vector drawn from the base of the first to tip of the final vector.
* If an object is in equilibrium, no NET force exists and the vector diagram will be a closed figure.

**Subtracting Vectors:**

* Add the negative vector (same size direction reverse)

**Components of Vectors:**

* Resolve a vector into its components (use sin/cos).
* Components are perpendicular to one another and operate independently of one another.

**Motion on an inclined plane**

g

gperpendicular

gparallel

θ

* Vertical gravitational acceleration is at 9.8 ms-2
* An object on a slope will accelerate at a slower rate
* The acceleration down the slope is the component of gravitational acceleration acting parallel to the slope
* Should always be less than 9.8 ms-2
* Force down a slope due to gravity is the component of Weight acting parallel to the slope (ignore friction)

g

gperpendicular

gparallel

θ

**Example:**

Determine the driving force applied to a 1 580 kg car moving at 60.0 kmh-1 up a slope with an angle of 5.800 The friction is 1020 N.

ΣF = Fd – Ff – Wparallel = 0

Fd = 1020 + (1580)(9.8)sin5.8 = 2.58 x 103N up the slope