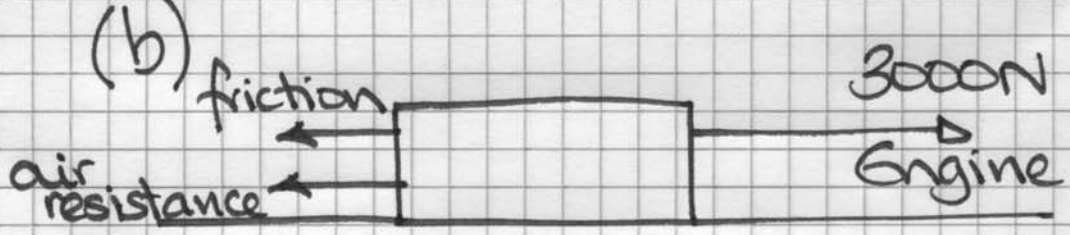
Homework - Newton I & II.

1. (a) The forces acting against the car are friction and air resistance.

(b)



(c) The combined friction & air resistance will come to 3000N.

This is because the car is travelling at a constant speed, so the forces acting on it must be balanced.

2. Using Newton's 2nd law, $F = Ma$

$F = 0.03 \times 1.75$

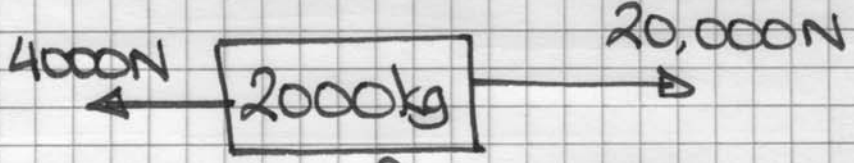
$\rightarrow F = 0.0525N$

$M = 30g = 0.03kg$

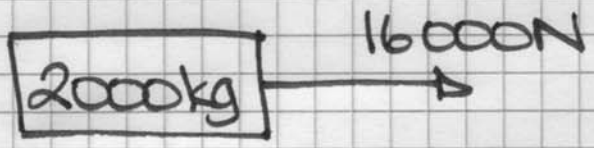
$a = 1.75 m/s^2$

3. Draw a free-body diagram showing all of the forces on the boat.

Then resolve the forces to find the unbalanced force acting on the boat.



resolving the forces gives



and use the 16000N force to find the acceleration

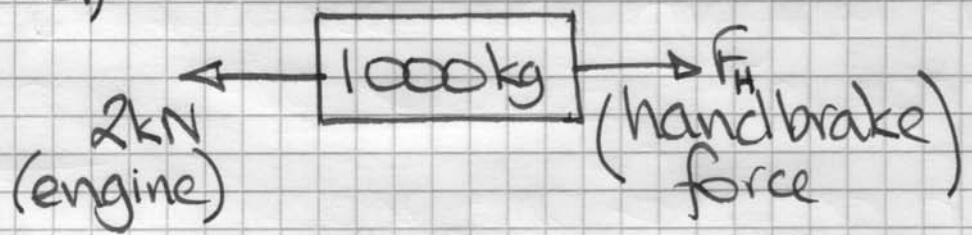
$$F = Ma$$

rearrange to get

$$a = \frac{F}{M} = \frac{16000}{2000} = 8 \text{ M/s}^2$$

So the acceleration of the boat is $\underline{8 \text{ M/s}^2}$.

4. a)



The unbalanced force on the car is given by

$$U.F. = (2kN - F_H)$$

But the unbalanced force is the force responsible for the acceleration so we can use

$$F = Ma = 1000 \times 1.8$$

so $F = 1800N$.

Putting the unbalanced force back into our equation gives

$$1800N = 2kN - F_H$$

$$\text{so } F_H = 2000N - 1800N$$

$$\rightarrow F_H = 200N$$

The handbrake exerts a force of <u>200N.</u>

4. b) If the handbrake is off, then $f_H = 0$ and the unbalanced force is simply

$$U.f. = 2kN - f_H = 2kN - 0$$

$$= 2kN.$$

Use $F = Ma \rightarrow a = \frac{F}{M}$

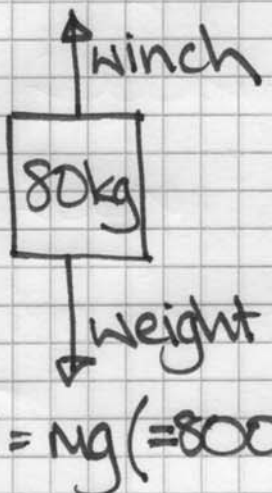
so $$a = \frac{F}{M} = \frac{2kN}{1000kg} = \frac{2000}{1000}$$

$$\rightarrow a = 2M/s^2.$$

If the handbrake is off, the car can achieve an acceleration of $\underline{2M/s^2.}$

5. a) Your free body diagram should show the winch force acting upwards and the weight force acting downwards.

i.e.



$W = Mg (= 800N)$

5. b) Use $F = Ma$

$M = 80kg$

$a = 1.9 m/s^2$

$F = 80 \times 1.9$

$\rightarrow F = 152N$

The force required is <u>152N.</u>

c). The unbalanced force is 152N (see part b above). This is the difference between the weight force and the lifting force of the winch.

unbalanced = (winch force) − Weight force

$152N = \text{winch force} - (Mg)$

$152N = \text{winch force} - (80 \times 10)$

$152N = \text{winch force} - 800N$

so $\text{winch force} = 800N + 152N = 952N$

The total force provided by the winch is <u>952N.</u>