Forces & Motion - Self-Check Solutions

SELF-CHECK 1

1) $v = \frac{d}{t}$

$v = \frac{100}{10}$

$v = 10\ m/s$

2) $v = \frac{d}{t}$

$v = \frac{200}{25}$

$v = 8\ m/s$

3) $v = \frac{d}{t}$

$v = \frac{50}{100}$

$v = 0.5\ m/s$

4)

Speed	Distance	Time
100 m/s	200 metres	2 seconds
5 m/s	25 metres	5 seconds
50 m/s	150 metres	3 seconds
40 km/s	120 km	3 seconds
0.5 m/s	500 metres	1000 seconds
10 mph	100 miles	10 hours
1 km/s	5 km	5s
20 ms^{-1}	100 m	4s
3 m/s	12 m	4s

5a) $t = 30$ minutes

SET 1

$t = 30 \times 60$

$t = 1800$ s

b) 30 minutes $= 0.5$ hours

c) (i) In miles per hour:

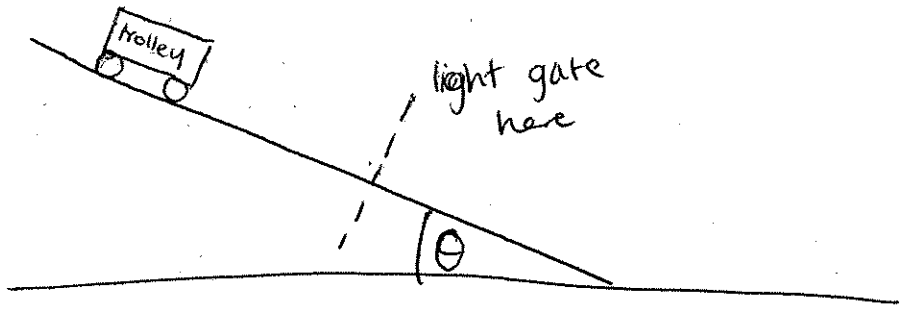
$$V = \frac{d}{t} = \frac{8 \text{ miles}}{0.5 \text{ hours}} = 16 \text{ mph}$$

(ii) In metres per second:

$$V = \frac{d}{t} = \frac{12\,800 \text{ metres}}{1800 \text{ seconds}} = 7.1 \text{ m/s}$$

SELF-CHECK 2

1)



- θ is the angle of the ramp, which will be changed.
- everything else must stay the same (trolley mass, release height, etc)
- at the same point each time, there will be a light gate
- to find instantaneous speed of the trolley at the light gate:
  - $V = \frac{d}{t}$ where d = length of trolley, measured with a ruler
    t = time for trolley to pass through light gate (measured by the light gate)

2a) Fernando Alonso

b) Kimi Raikkonen

c) average speed = $\frac{\text{total distance}}{\text{time taken}}$ and since they all drove the same distance, KR's longest time ⇒ slowest av. speed

3a) $v = \frac{d}{t}$

$v = \frac{4}{0.32}$

$v = 12.5 m/s$

b.) No

c) Allows them to find the speed of the car at that moment - which is important near dangerous corners/junctions etc.
+ is quick.

4) $V = \frac{d}{t}$

$V = \frac{1.25}{0.65}$

$V = 1.92 m/s$

SELF-CHECK 5

1a) 60 m/s

b) (i) accelerating: between A+B, between C+D

(ii) decelerating: between D+E, between F+G

c) accel. of zero = constant speed

↳ between B+C, between E+F

2) 0s → 3s accelerating

3s → 6s constant speed

6s → 7s accelerating

7s → 10s constant speed

SELF-CHECK 4

1a) Newton balance

b) The spring stretches more when pulled with a larger force — we can use it to measure the force applied.

2) Shape, speed, direction of movement

3a) Twist b) Push c) Pull

4a) A force that is applied to a object without touching it.

b) · Magnetic force
· Weight (force due to gravity)

5a) Mass is the amount of matter an object is made of (kg)
whereas weight is the force which the object feels pulling it to the ground.

b) $W = mg$ $W = 70 \times 9.8$ $W = 686\,N$

c) She has a force of 450N pulling her down (due to gravity)

SELF-CHECK 5

1) Friction is a force which opposes motion.

2a) Friction is useful between the tyres and the road (so you don't skid).

b) Friction is a nuisance as air resistance can slow you down / make you need to pedal harder.

c) Oil it.

3a) To reduce friction (air resistance)

b) Crouching down (body has less surface area, therefore less air resistance).

c) Stand up (more surface area = more air resistance) OR dig skis into snow (surface is no longer smooth)

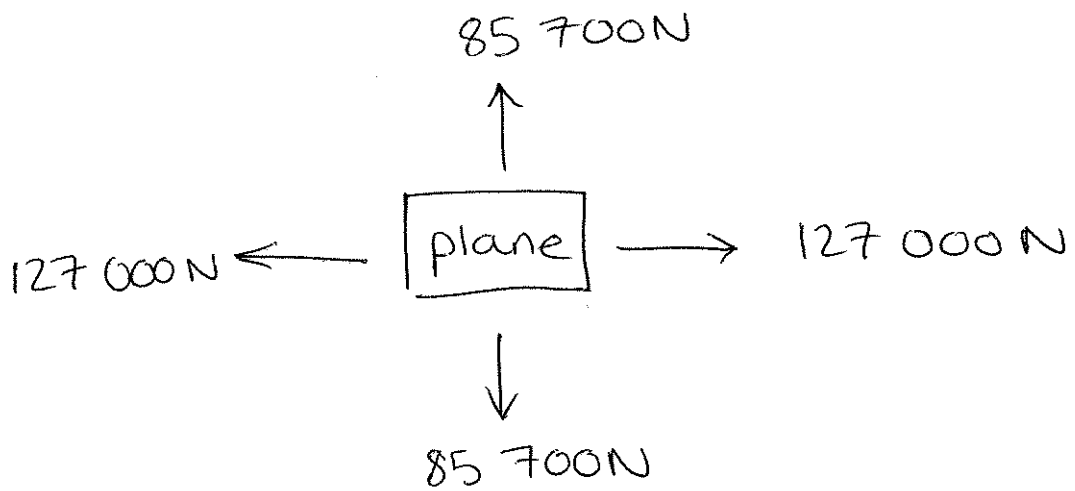
4a) Car tyres + road, shoes + floor (stops slipping), Skydiving (slows you down), any other situation where you want to slow down / not slip.

b) Ice skating, air hockey, waterslides, car + air resistance, bike + air resistance, etc.

SELF-CHECK 6

1) forces are balanced

2)



3). Student A is correct

. Student B is incorrect - if the forces acting on the object are balanced, then it won't accelerate (will move at a constant speed)

• Student C is correct.

4a) 70 mph

b) Seatbelt (by applying a safe backwards force)

c) They will continue to travel at 70 mph until something stops them (the dashboard/windscreen).

5a) The only force acting on it is gravity (weight), to pull it down, while it keeps travelling horizontally.

b) Launch at 45°, maximum applied force/launch speed.

EXTRA WORK SELF-CHECK 1

1a) $v = \frac{d}{t}$

$v = \frac{25}{2.25}$

$v = 11.1 m/s$

b) $v = \frac{d}{t}$

$10 = \frac{25}{t}$

$\frac{25}{10} = t$

$t = 2.5s$

2) $v = \frac{d}{t}$

$v = \frac{25000}{14400}$

$v = 1.74 m/s$

$t = 4 hours = 4 \times 60 \times 60 = 14400s$

$d = 25km = 25000m$

3a) Athlete A - $v = \frac{d}{t}$ d is the same, t is smaller } therefore v is greater

b) $v = \frac{d}{t}$

$v = \frac{400}{55.53}$

$v = 7.20 m/s$

c) Yes - average speed only considers the total distance and total time, the speed of the athletes will vary throughout the journey. Average is a value in the middle.

EXTRA WORK SELF-CHECK 2

1a) Instantaneous speed - the light gate at the bottom will measure the time for the card to pass through it.

$$V_{instantaneous} = \frac{\text{length of object (card)}}{\text{time to pass a certain point (light gate)}}$$

b)

$$V = \frac{d}{t}$$

$$V = \frac{0.04}{0.246}$$

$$V = 0.163 \text{m/s}$$

$d = 4\text{cm} = 0.04\text{m}$
$t = 0.246\text{s}$
$V =$

c) (i) Repeating the experiment makes the results more reliable - average values are used.

(ii) $$t_{average} = \frac{0.246 + 0.249 + 0.246 + 0.243 + 0.244 + 0.247}{6}$$

$$t_{average} = 0.246\text{s}$$

(iii) $$V = \frac{d}{t}$$

$$V = \frac{0.04}{0.246}$$

$$V = 0.163 \text{m/s}$$

EXTRA WORK SELF-CHECK 5

1a) 16 m/s

b) $v = \frac{d}{t}$

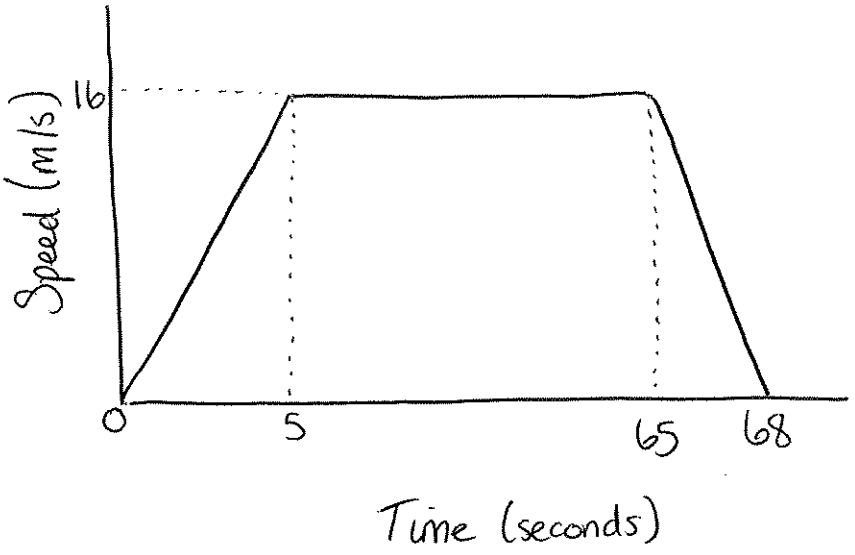
$v = \frac{1000}{65}$

$v = 15.4 \text{ m/s}$

$d = 1 \text{ km} = 1000 \text{ m}$

$t = 65 \text{ s}$

c)



EXTRA WORK SELF CHECK 4

1a) Air resistance / friction / drag

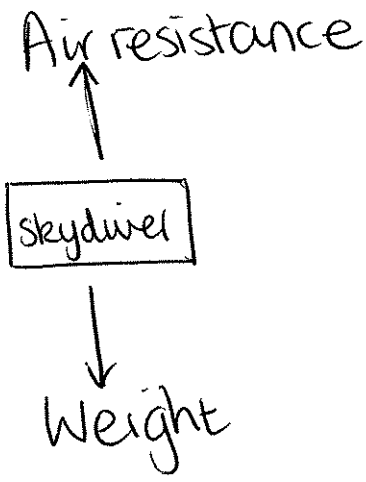
b) (i) $W = mg$

$W = 1100 \times 9.8$

$W = 10\,780N$

(ii) Yes, it weighs less than the maximum lifting force ($W < 14000N$)

2a)



b) $W = mg$

$W = 75 \times 9.8$

$W = 735N$

c) (i) forces are balanced

(ii) 735N

EXTRA WORK SELF-CHECK

1a) To reduce friction (air resistance).

b) To increase frichon between the tyres + road (less likely to slip).

c) Add oil / lubricant (which reduces friction).

2a) To increase friction (stop slipping).

b) Friction is a nuisance if they want to slide - e.g. to tackle.

3a) 30mph.

b) To apply a force to stop the passengers.

c) To reduce frichon.

d) $W = mg$

$W = 5000 \times 9.8$

$W = 49\,000\,N$