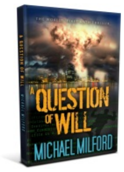


This worksheet is based on events in the mathematical thriller A Question of Will. Get it now at:

www.MathNovel.com

Escape the Nuke Worked Solution

Question 1

First let us calculate how long it will take to run up 500 metres of stairs at 10 km/hr. Let's convert the speed into m/s:

Speed = 10 km/hr × 1000 m/km / 3600 s/hr

Speed = 2.78 m/s **(1 mark)**

Then we can work out how many seconds it will take to run up the stairs:

Time to run up stairs = 500 m / 2.78 m/s

Time to run up stairs = 180 seconds

Time to run up stairs = 3 minutes **(1 mark)**

So it will take 3 minutes to run the stairs, leaving (6 – 3) = 3 minutes to cycle down the road.

At an average downhill cycling speed of 50 km/hr, we can calculate how far Will would get in 3 minutes:

Cycling distance = speed × time

Cycling distance = 50 km/hr × 3 minutes

We need to convert everything into consistent units, I'm going to pick units of *metres* and *seconds*:

Cycling distance = 50 km/hr × 1000 / 3600 × 3 minutes × 60 s/min **(1 mark)**

Cycling distance = 2500 metres **(1 mark)**

Question 2

First let's convert the speed of 120 km/hr into m/s:

Speed = 120 km/hr × 1000 m/km / 3600 s/hr

Speed = 33.33 m/s **(1 mark)**

Then we can work out how far the wingsuit will travel sideways over 100 seconds:

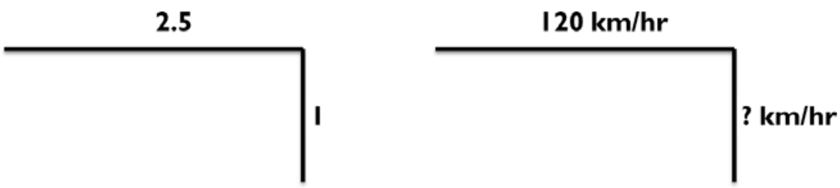
Wingsuit distance = speed × time

Wingsuit distance = 33.33 × 100

Wingsuit distance = 3333 m **(1 mark)**

Question 3

We can draw two similar triangles, one based on the wingsuit glide ratio, and one based on the wingsuit's horizontal and vertical velocity components:



Since the two triangles are similar, to calculate the vertical velocity of the wingsuit, all we need to do is divide the horizontal velocity by the glide slope ratio:

Vertical wingsuit (falling) velocity = 120 km/hr / 2.5

Vertical wingsuit (falling) velocity = 48 km/hr **(1 mark)**

A quick search on the internet suggests that the terminal velocity of a free falling human with arms and legs outstretched (to create as much air resistance as possible) is approximately 200 km /hr. We can calculate the speed ratio between our wingsuit descent rate and that of a free falling human without a wingsuit:

Speed ratio = 200 / 48

Speed ratio = 4.17 **(1 mark)**

So the wingsuit eventually slows the vertical rate of fall to about 4 times slower than that of a free falling human with arms and legs outstretched.

Question 4

To draw the graph of altitude versus time, we need to make sure we get a few points right:

1. At the moment of jumping, the vertical velocity is zero, and increases rapidly after this point in a quadratic manner **(1 mark)**
2. Sometime between 5 and 15 seconds the vertical velocity actually decreases as the wingsuit starts generating lift, and the horizontal velocity increases **(1 mark)**
3. After 15 seconds, the vertical and horizontal velocities of the wingsuit flyer are constant, which means the graph line should be a straight, downwards pointing line. **(1 mark)**