

Hints for Problem Set #1: Think like a physicist

1. **Warm Up:** I ask this question every year, but I always add one more runner, the answer is always the same.
It may be useful to not focus on the numbers – why not label the winners A, B, C instead?
2. **Fetching Water:** What is the quickest way between any two points?
Can you ask an equivalent question following the path of a ray of light?
One approach would be to find the minimum distance using calculus, but there is a much neater solution.
3. **Coach Ride:** Split the journey into 3 sections of length x , y and z . What happens to the downhill sections on the return journey? What are you trying to find in terms of x , y and z ? Do you care what each of them are? The numbers have been chosen carefully – can you tidy up awkward fractions?
4. **Pirate v Ninja:** One approach would be to find the positions where the parrot changes direction. Given the speed, but asked to find distance – what else would it be useful to know?
5. **Trams in Geneva:** A diagram is very useful – remember to include how far you walk in between each tram passing you. Try switching into your frame-of-reference, i.e. when you are stationary – what's the relative velocities of the trams now? This might be similar to a Doppler shift.
6. **Marble in a Fishbowl:** Identify the physics principles involved. Draw a large, clear diagram with all key information labelled. Plan your route through the problem. THEN solve.
7. **Trusses:** Think about if you can simplify the problem, where might be the best place to take moments about? Make sure you have a clear diagram with all forces labelled.
8. **Race against gravity:** What are the forces acting on A and B immediately after they are released? How do these change over time? Could this be related to the Chain Fountain (aka Mould¹ effect)?

¹ <https://www.youtube.com/watch?v=qTLR7FwXUU4>