For these questions, use the simulation "Probabilistic analysis of a block on a track" in the QuVis HTML5 collection.
www.st-andrews.ac.uk/physics/quvis/simulations_html5/sims/block-on-track/block-on-track.html

1) Have a play with the simulation for a few minutes, getting to understand the controls and displays. Note down three things about the displayed quantities that you have found out.

2) Set up the track so that the left height $h_1 = 0m$, the right height $h_2 = 2m$, the left width is 8m ($0m \leq x < 8m$) and the right width is 4m ($8m < x \leq 12m$) with respect to the midpoint of the block.

a) Sketch the gravitational potential energy $V(x)$ for $0m \leq x \leq 12m$.

b) Describe qualitatively the speed of the block as it moves back and forth along the track.

c) If a snapshot of the block were made at a random time, is it possible without calculation to say whether it would be more likely to find the block in the left ($0m \leq x < 8m$) or right ($8m < x \leq 12m$) region of the track? Explain.

d) From the mass and total energy given (see the introductory text in the simulation), calculate the speed of the block in the two regions. Calculate the probabilities $Prob_1$ and $Prob_2$ of finding the block in the left and the right regions by considering the time spent traversing one region compared with the time needed for a total traversal. Which of the two probabilities is larger? Check your results with the simulation.

e) From the probabilities in the two regions, calculate the classical probability densities $P_1(x)$ and $P_2(x)$, and sketch $P(x)$. Which of the two probability density values is larger? Does this result make sense? Check your results with the simulation.

f) Suppose a large number of snapshots of the block are made at random times, and the position of the block is measured in each snapshot. The average of all these positions is determined. Using the theoretical probability densities, calculate this average position in the limit that the number of snapshots tends to infinity. Check your units. Evaluate your result.

g) Calculate the classical position uncertainty Δx_{CL} of the block. Is this classical position uncertainty Δx_{CL} the same kind of uncertainty as Δx for the quantum particle in an energy eigenstate in an infinite square well? Explain your answer.

3) Which of the challenges in the Challenges tab did you find most difficult and why? Explain how you solved this challenge. If none of the challenges were difficult, choose the one you found most interesting and explain how you solved it.