Trial test, Physics 1, UNSW

Reading time: 5 minutes

Allowed time: 30 minues

Allowed material: pen, paper,

calculator without alphanumeric keys, eg standard UNSW model.

No books or written material.

Data supplied: g = 9.8 ms-2.

What is this test for?

Although you get feedback from quizzes, the first formal test you do will be at the end of session. This one gives you practice on doing such questions, under conditions that are as realistic as you decide to make them. It will also give you some idea of how tests are marked.

Warning: this test is not based on a typical sample of material.

This test is based on material covered briefly in your first three weeks of lectures. Most of this is revision of high school material, and relatively few new concepts are covered. It may therefore seem easier than one based on material from later sections with which you will be less familiar.

How to mark this test.

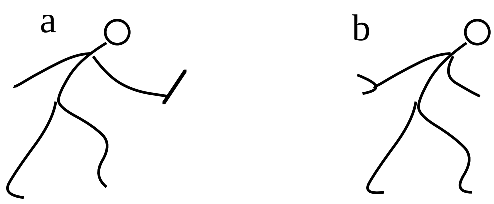
Download the answers and marking scheme *after you have completed the test.*

Don't be over-generous in your marking. Near enough is not necessarily good enough. If your answer is a number when you have been asked for a quantity or if the answer is a vector and you have given a scalar, you will in general lose marks. You should also think about the appropriate number of significant figures in the answer, although this will not usually lose marks in tests of this sort.

Explanation is sometimes required to support an argument, or to justify the use of a physical law or equation in a particular instance. In the model answers, the text *is* required (except for the text in small italics, which is there by way of explanation of the answers).

If you get the first part of a question wrong, and if that answer is then used in further parts, you will not lose further marks for the subsequent parts, provided that your argument and working are correct.

Question 1. (12 marks)



In a relay race, runner a (carrying the baton) is about to finish the first stage. She is travelling at a constant speed v = 8 m.s^{-1}. At time t = 0, the next runner (runner b) accelerates from rest at position s = 0. Both run in the same direction. Runner b has constant acceleration a = 2 ms^{-2}, until she reaches a final speed v = 8 m.s^{-1}, at which her speed remains constant. Because they have practised, runner b knows she must start when runner a is a distance d behind her so that she (runner b) reaches speed v just at the moment when runner a draws level with her.

i) Draw a graph of showing the displacements of the two runners.

Your graph should clearly show the positions of the two runners for $t < 0$ to a time after they have met.

ii) Indicate the distance d on your graph.

iii) Write an expression for s_a, the position of the runner a as a function of time t.

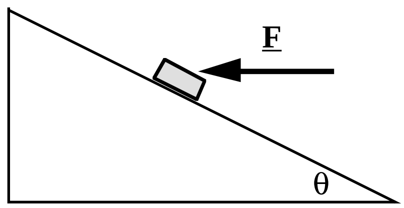
iv) Give an expression for s_b, the position of the runner b as a function of time t, during the initial acceleration phase.

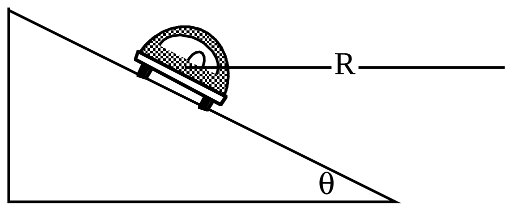
v) Determine the time T at which runner b finishes accelerating.

vi) Using your answers above, or otherwise, derive an expression for the distance d, as a function of v and a.

vii) Determine a numerical value for d in this particular problem.

Question 2 (14 marks)





i) A mass m is on a plane inclined at an angle θ to the horizontal. A **horizontal** force **F** is pushing it up the slope at a steady speed v. The coefficient of kinetic friction between the mass and the plane is μ_k. Determine the magnitude of **F**.

ii) Derive an expression for the power applied by **F** in case (i). (i.e., for the rate at which **F** is doing work.)

iii) In the lower sketch, a roadway is banked at angle θ for a curve of radius R. Derive an expression for the angle θ at which the road must be banked if a car goes round the bend at speed v and exerts no frictional force either up or down the plane (i.e. no frictional forces in the plane of the diagram).