PRINCETON UNIVERSITY PHYSICS COMPETITION

Onsite Test — Sample Problems

Below are examples of three sample problems which will give you a sense about the difficulty of the problems on the Onsite Test.

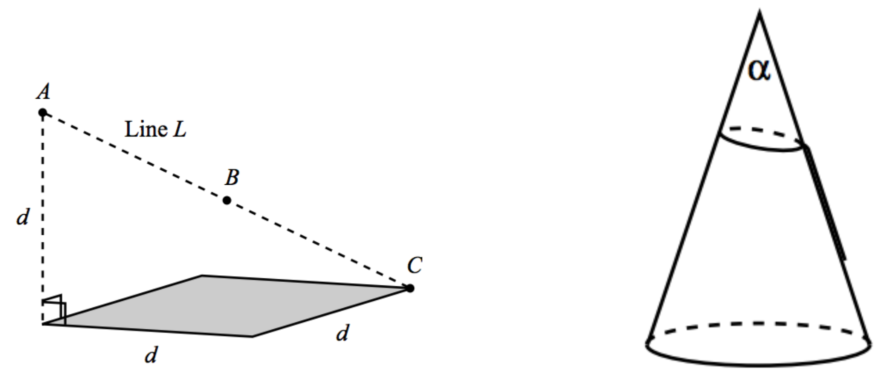
The test consists of **three** problems and you will be given **2** hours to complete these problems. Calculators are allowed. **No collaboration** is allowed and partial credit will be given for incomplete solutions.

Some useful test-taking hints:

1. You may not be able to complete every problem. Keep moving; do what you know first.
2. Make your answer clear by circling it.
3. Use symbols rather than numbers wherever possible and check units.
4. Whenever possible, check whether an answer or intermediate result makes sense before moving on.
5. If you get stuck on an early part of a problem, check the later parts some may be independent and doable.
6. If you get stuck on an early part of a problem, and a later part depends on it, clearly define a symbol for the unknown answer and use it in later parts. However, keep in mind that we often give multiple parts to guide you through a problem.

To get full credit you need to show your work!

Good luck!



(a) Question 2 (b) Question 3

Figure 1: Drawings corresponding to the questions below

Question 1 (Renowned Pop Question)**.** *Consider that you have two identical balls, that are thermally isolated from their environment, the first is stuck to the ground and the second is stuck to the ceiling. You now start raising the temperature of the room in which the two balls are in. If the two balls absorb the same amount of heat, will there be any difference between the two balls in the end?*

Question 2 (Adapted from BAUPC 2004)**.** *A flat square plate with side length d serves as a detector for the radiation emitted by a particle. The particle emits the radiation uniformly in all directions. Consider the line, L, joining points A and C, as shown. C is one corner of the square, and A is the point directly above the opposite corner, a distance d above the square.*

What fraction of the total radiation emitted by the particle is detected by the detector if the particle is placed on the line L:

(a) at point A,

(b) at point B (halfway between A and C),

(c) at a point infinitesimally close to point C.

Question 3 (Harvard Problem of the Week — Week 7)**.** *A mountain climber wishes to climb up a frictionless conical mountain. He wants to do this by throwing a lasso (a rope with a loop) over the top and climbing up along the rope. Assume that the mountain climber is of negligible height, so that the rope lies along the mountain, as shown.*

His lasso is made of a segment of rope tied to loop of rope of fixed length.

When viewed from the side, this conical mountain has an angle at its peak. For what angles α can the climber climb up along the mountain?