Trigonometry

There are ten questions in all – please try as many as you have time for. Remember to draw a diagram for each to help you visualize the problem. As always, any mistakes are my fault.

Problems

1. A helicopter has to fly rom its base, grid reference 107 843, to rescue a dinghy in difficulties at grid reference 438 951. Visibility is poor; on what bearing should the pilot fly, and how far should he go before looking out for the dinghy?

2. Safety regulations limit the height of a children's slide to 3 m, and the angle of slope to 35°. What length of metal is required for the highest, steepest side allowed?

3. An outcrop of ore 2.8 m from top to bottom is discovered in the face of a vertical cliff. If the ore dips directly into the cliff at 22° below the horizontal, find its true thickness. The ore is to be mined from above, but it is not safe to dig less than 50 m from the cliff edge. If the outcrop was observed 23 m below the top of the cliff, how deep will the shortest safe shaft have to be?

4. In a pot-holing rescue, a casualty is strapped to a stretcher 2.1 m long. It is planned to haul this up a shaft 1.9 m wide, but for medical reasons the stretcher must not be tilted at more than 30° to the horizontal. Is this plan acceptable?

5. Calculate the polar coordinates (r, t°) of these points, whose cartesian points are given:

   a) (5,2)
   b) (3,8)
   c) (19,27)
   d) (5,–3)

6. A strip of land 2.5 m wide is available for the construction of a boat shed. If it is hoped to sling a 4.9 m mast diagonally across the ceiling, for winter storage, how long will the shed have to be?

7. The sloping sides of a bivouac tent are 1.5 m long, and, to ensure good run-off of rainwater, they slope in each side down to the ground at 50° below the horizontal. How wide will the floor space be?

8. A range-finder is constructed by mounting the two halves of a pair of binoculars on a fixed base 1 m apart. The right-hand one is fixed at 90° to the board, and the left-hand one is swivelled until it, too, is pointing straight at the object whose distance is to be measured. If the left-hand one is at an angle of 88.9° to the board, what is the range? If this angle is measured incorrectly as 89.0°, what is the error in the range?

9. A navigator on a ship sailing at 20 km h^{-1} knows that his course will take him to a closest approach of 8 km to a lighthouse. If his radar now gives his distance from the lighthouse as 28 km, how long will it be until the ship is at its closest to the lighthouse?

10. The diameter of the Earth's orbit around the Sun is about 3.0×10^8 km. Light travels at 3.0×10^5 km s^{-1}, and takes about 4.3 years to reach us from the nearest star. Over a period of six months, the change in the Earth's position makes this starlight reach us from a slightly different angle, which can be measured against the virtually constant direction of light from distant galaxies. Calculate this change in angle, known as the *parallax* of the star.