

Physics 100: Homework Solutions #7

Chapter 15 and 19: *due Nov 6*

1) Desert sand is very hot during the day and very cool at night. What does this tell you about the specific heat of sand and that of water?

Sand has a low specific heat, as evidenced by its relatively large temperature changes (for small changes in internal energy), i.e. a small thermal inertia. A substance with a high specific heat such as water, on the other hand, must absorb or give off large amounts of internal energy for comparable temperature changes.

2) It would be much safer if we could use water in thermometers rather than mercury. Explain why this wouldn't work by considering the behavior of such a water-thermometer at 4°C if the temperature increased compared to if it decreased.

Water has the greatest density at 4°C; therefore, either cooling or heating at this temperature will result in an expansion of the water. A small rise in water level would be ambiguous, as it could mean that either the temperature has increased or decreased, and so this makes a water thermometer impractical in this temperature region.

3) Galaxies are observed to have a "red-shift". What can we deduce about their motion, and give the name of the phenomena you are using to make this deduction?

This means that they are moving away from us – red shift means that the frequencies of light that they are emitting are received by us at lower frequencies. This is the Doppler effect; if there is relative motion between source and receiver, the received frequency is less than what is emitted if they are moving further apart, and greater if moving closer together.

4) A weight suspended from a spring is seen to bob up and down over a distance of 20 cm every three seconds. What is its frequency? Its period? Its amplitude?

Every three seconds \rightarrow frequency = $1/3$ Hz and period = $1/\text{frequency} = 3$ s (i.e. time to complete one cycle is three seconds).

Distance 20cm for whole up and down distance \rightarrow amplitude = 10cm

5) Your clicker question