

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

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

- 5) Your clicker question