

**Physics 173, Physics of Sustainable Energy**  
**Homework 5**  
**Due: 1pm Tues Oct 1st, 2024**

Please upload your answers at the Canvas website as a PDF file. Please ensure that the PDF presents the text in the correct orientation.

**Short report**

**{20 points}**

Write a short critical summary (about 300 words) of a recent published article which is related to one of the topics covered in recent lectures: power, heat, kinetic energy, temperature, thermal expansion etc. You can choose the article but first read the instructions for writing the report which are on the course web page in the “Materials” tab. For the report, text-based PDF (produced by “Export as PDF” in most apps) is preferred over an image since it is easier to annotate.

**Using AI tools such as ChatGPT:** You are allowed to use an AI tool to help you with your short report; if you do that, please provide additional information as described in the instructions.

**Piazza:** If you are unsure about your choice of article or use of AI tools or have other questions, you can post on the Piazza page, <https://piazza.com/class/lvy8oqrzxjr1ln>

**Multiple choice questions**

**{2 points each}**

Each question has one correct answer, unless the question specifies otherwise. You do not have to show your working, but it may help the grader. You may look up online any quantities that are needed but not supplied in the question or in lecture materials. If you hand-write your answers please use capital letters.

1. A heater can heat a cup of water from room temperature (20 C) to boiling in 1 minute. What is the power of the heater?  
(A) 3500 W      (B) 1500 W      (C) 6 kW      (D) 80 kW
2. Based on the energy density table that we studied earlier in the course, estimate how fast the internal parts of an energy-storage flywheel are travelling.  
(A) 500 mi/hr      (B) 20 mi/hr      (C) 100 mi/hr      (D) 5 mi/hr
3. A baseball pitcher throws a ball at 80 mi/hr. The ball’s kinetic energy is measured as 90 J. What is the mass of the ball?  
(A) 5 kg      (B) 150 g      (C) 70 g      (D) 2500 g
4. Gasoline consists of molecules that typically contain about 8 carbon atoms and 18 hydrogen atoms. Estimate how many such molecules there are in a gallon of gasoline.  
(A)  $10^{19}$       (B)  $10^{28}$       (C)  $10^{16}$       (D)  $10^{25}$
5. Different isotopes of the same element have  
(A) different numbers of protons in the nucleus  
(B) the same number of neutrons in the nucleus  
(C) the same total number of neutrons plus protons  
(D) similar chemical properties

6. Absolute zero is the temperature at which
- (A) water freezes
  - (B) molecules fall apart into atoms
  - (C) an object contains no heat energy
  - (D) air becomes a liquid
7. When you heat water from just above its freezing point to just below its boiling point, the kinetic energy per molecule
- (A) increases by about 20%
  - (B) increases by about 40%
  - (C) doubles
  - (D) stays about the same
8. Which contains a larger amount of heat energy: one kilogram of boiling water, or two kilograms of ice at  $-100\text{ C}$ ?
- (A) there is significantly more heat energy in the one kilogram of water
  - (B) there is significantly more heat energy in the two kilograms of ice
  - (C) they have the same amount of heat energy to within 10%
  - (D) it is impossible to say from just this information
9. A nylon rod is 12 cm long at room temperature. When dropped in boiling water, how much does its length increase by?  
(Nylon has a linear thermal expansion coefficient  $\alpha = 10^{-4}\text{ C}^{-1}$ .)
- (A) 0.1 mm
  - (B) 0.3 cm
  - (C) 3 mm
  - (D) 1 mm
10. The linear expansion coefficient of water is  $5 \times 10^{-5}$  per C. If we take 1 liter of water in the ocean and heat it by  $2.5\text{ C}$  (a reasonable estimate of the change due to global warming in a hundred years or so) by how much does the volume increase?
- (A) 0.05 ml
  - (B) 2 ml
  - (C) 0.12 ml
  - (D) 0.4 ml