

PHYS 1200 Physics of Everyday Experience

Review questions and exercises for Lecture 16 (T-1)

1. Explain how Hero's engine converts heat energy into work.
2. What is meant by the internal energy of a system?
3. What mechanical property of a system does a thermometer measure?
4. What is heat energy?
5. On which temperature scale is 0 degrees the lowest possible temperature?
6. Use the temperature conversion formulas to fill in the following table:

T_F	T_C	T_K
-31		
140		
	-5	
		0
77		
5		
	-5	
		73
-40		

7. What property of an ideal gas can be used to determine absolute zero?
8. (Challenge problem) On the Merlino temperature scale, water freezes at -50 M and boils at $+150\text{ M}$. Find the conversion formula from T_M to T_C . Hint: Assume that the formula can be written as $T_C = a(T_M + b)$, and use the two pairs of temperatures on the M and C scales to find a and b.

Solutions:

1. In Hero's engine water is boiled to produce steam. The steam comes out of the cylinder in two streams in opposite directions which makes the pivoted cylinder spin.
2. The internal energy of a system is the sum of the kinetic energy of all the molecules in it.
3. A thermometer measures temperature which is an indication of the average kinetic energy of the molecules.
4. Heat is the energy that flows from one system to another system when their temperatures are different.
5. The absolute temperature scale is the Kelvin scale on which 0 K is the lowest possible value.
- 6.

T_F	T_C	T_K
-31	-35	238
140	60	333
23	-5	268
-459	-273	0
77	25	298
5	-15	258
23	-5	268
-328	-200	73
-40	-40	233

7. For an ideal gas the pressure is proportional to the temperature. Absolute zero is found by measurement of the pressure as a function of temperature in C and then finding the temperature that is the extrapolation of the line to $p = 0$.
8. $T_C = a(T_M + b) \rightarrow 0 = a(-50 + b)$, and $100 = a(150 + b) \rightarrow b = 50, a = \frac{1}{2} \rightarrow T_C = \frac{1}{2} (T_M + 50)$
You should check that this formula works for both the points: $T_C = \frac{1}{2} [-50 + 50] = 0$ C, and $T_C = \frac{1}{2} [150 + 50] = \frac{1}{2} [200] = 100$ C. OK!