1. See homework 4, problems 4-6 for calculation process.

    a. $E_{heat} = P_{heat} * t_{discharge} = 10{,}000\ W * 5\ s = 50\ kJ$

    b. $specific\ heat = specific\ heat\ capacity * mass = 2\ [kJ/(kg*K)] * 5\ kg = 10\ kJ/K$

    $T_{rise} = E_{heat} / specific\ heat = 50\ kJ / 10\ kJ/K = 5\ K$ or $5\ ^{o}\ C$

    $T_{final} = T_{initial} + T_{rise} = 25\ ^{o}\ C + 5\ ^{o}\ C = 30\ ^{o}\ C$

2. For the statements below, circle each correct statement and provide a justification for each circled or non-circled statement. Note that an erroneous choice can still receive credit if the rationalization you state is fact based.

    a. Battery hazards and safety

        i. Batteries are passive energy storage devices, just like fuel tanks.

            False (Lecture 6a, s. 3) – batteries are active unlike a passive fuel tank

        ii. Consider an *LFP/C* battery cell whose operational range is [2,5] V and its nominal discharge resistance is 1 $m\Omega$. The cell is used to supply a load at its max-power voltage under the usual assumptions. The cell power output delivered this load is 7.5 kW. To get full credit for your answer, you must provide your calculations.

            False (See Lecture 6b, s. 6 for the calculations): as $V_{max} = 5\ V$, we assume that at $P_{\max}$ the cell voltage is $V_{max}/2 = 5/2 = 2.5\ V$ and that the load voltage $V_{load} = 2.5\ V$. The current is $(V_{max} - V_{load})/10^{-3} = 2{,}500\ A$ and so the delivered power to the load at V_{load} = 2.5 X 2.5 kVA = 6.25 kW.

iii. Metal-oxide cathode decomposition can occur earliest at a temperature of 115° *C*.

True (Lecture 6a, s. 23)

iv. The highest EUCAR hazard level is 7: explosion.

True (Lecture 6a, s. 7)

b. Energy Issues

i. Energy can be created or destroyed in addition to being able to be transformed from one form to another.

False (Lecture 5, s. 2)

ii. The energy within a hydroelectric plant usually goes through the following sequence of transformations: potential energy → kinetic energy → electric energy.

True (Lecture 5, s. 17)

iii. It is possible to have an efficiency above 100%.

False since energy can neither be created or destroyed

iv. Consider a system S that consists of a sequence of N subsystems connected in series. Each subsystem s has its own efficiency η_s. The overall system S has an effective efficiency of $\Pi[(\eta_s)^{-1}]$ for $1 \leq s \leq N$.

False (Lecture 5, s. 27) the correct answer is $\Pi[(\eta_s)]$ for $1 \leq s \leq N$