**Unit 5 Free Response & Practicum Review**

*Paraffin wax (C25H52), a hydrocarbon, is the main component of candle wax. Cindy takes a small tea candle and burns it on a piece of aluminum foil for about four minuntes in an effort to determine the amount of heat released when paraffin wax combusts.*

*Use the data to answer the questions that follow:*

|  |  |
| --- | --- |
| Initial mass of candle and Al foil | 42.0 g |
| Final mass of candle and Al foil (after burning) | 39.2 g |
| Mass of paraffin wax used in reaction | \_\_\_\_\_\_\_\_\_g (you can calculate this) |

1. Given that the formula for paraffin wax is *C25H52* , calculate the molar mass of this compound.
2. Calculate the number of moles of paraffin wax that were used in the reaction (use the mass of paraffin used in the reaction and convert to moles)
3. The balanced chemical equation for the combustion of paraffin is as follows:

*C25H52* (s) + 38O2 (s) 🡪 26H2O (g) + 25 CO2 (g)

Using average bond energies, calculate the heat of reaction for **one mole** of paraffin wax. *(Hint: Pariffin wax, C25H52 , contains 24 C-C bonds and 52 C-H bonds)*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bond | H-H | C-H | C-C | C=C | O-H | C-O | C=O | O=O | O-O |
| Bond energy (kJ/mol) | 452 | 413 | 347 | 614 | 467 | 358 | 799\* | 495 | 146 |

\*C=O in CO2: 799, in organic molecules: 745

1. Calculate the amount of heat Cindy’s candle released in the reaction (based on the answer for number 3 and the amount of paraffin wax burned in the experiment).
2. Consider the composition and decomposition of water. When water is formed, ΔHreaction=-242kJ/mol and when water decomposes, ΔHreaction=+242kJ/mol.
   1. Write the balanced equations (including heat of reaction as a reactant or product) for the composition and decomosition of water.
   2. Draw an energy diagram for the composition and decomposition of water. Label the transition states, activation energy, products, reactants, and heat of reaction in each.
   3. Which reaction is endothermic? Which is exothermic?
3. From the following substances, choose which would make the best fuel and explain why.

Alcohol Noble gas Ionic Compound Alkane Covalent Compond

1. Write the balanced chemical equation for the combustion of the following:
   1. Butonol, C4H10O
   2. Hexanol, C6H14O
2. List all the ways you can speed up a chemical reaction.
3. The two half-cell reactions below can be combined to form an electrochemical cell.

Al3+ + 3e- 🡪 Al -1.71 volts

Pb2+ + 2e- 🡪 Pb -0.13 volts

1. Which metal will be oxidized?
2. What is the voltage of the cell?
3. Write a balanced chemical equation for the overall reaction in the cell.
4. The two half-cell reactions below can be combined to form an electrochemical cell.

Mg2+ + 2e- 🡪 Mg -2.38 volts

F33+ + 3e- 🡪 Fe -0.04 volts

1. Which metal will be oxidized?
2. What is the voltage of the cell?
3. Write a balanced chemical equation for the overall reaction in the cell.
4. Why does a red object appear red to our eyes when white light is shining on it?
5. Calculate the frequency of purple light that has a wavelength of 4.20 x 10-7m. The speed of light is 3.00 x 108 m/s.
6. Calculate the wavelength of light that has a frequency of 2.30 x 106 Hz. The speed of light is 3.00 x 108 m/s.
7. Calculate the energy of radiation that has a wavelength of 3.21 x 10-10 m. The speed of light is 3.00 x 108 m/s, and Planck’s constant is 6.626 x 10-34 J•s.
8. Calculate the energy of radiation that has a wavelength of 2.5 x 10-12m. The speed of light is 3.00 x 108 m/s, and Planck’s constant is 6.626 x 10-34 J•s.