

College of the Holy Cross, Fall Semester 2017
MONT 100N – Modeling the Environment
Midterm Exam, October 27

Your Name: _____

Instructions Please write your answers in the spaces provided on the following pages, and show work on the test itself. **For possible partial credit, you must show work.** Use the back of the preceding page if you need more space for scratch work.

Please do not write in the space below

Problem	Points/Poss
I	/ 25
II	/ 20
III	/ 15
IV	/ 10
Essay	/ 30
Total	/100

I. The following table gives estimates of the amounts of carbon (in units of 10^{15} kilograms) contained in the major “reservoirs” of this element on planet Earth:

Reservoir	Carbon Content
Atmosphere	.59
Crust (as fossil fuels)	3.7
Vegetation	2.3
Shallow Ocean	.9
Deep Ocean	37.3

A. (10) What percent of the total carbon present on Earth is contained in each of these reservoirs?

Reservoir	Percent of Total Carbon
Atmosphere	_____
Crust (as fossil fuels)	_____
Vegetation	_____
Shallow Ocean	_____
Deep Ocean	_____

B. (15) Construct and draw a chart (your choice of type) showing how the total carbon breaks down into these categories.

II. Burning coal provides between 9500 and 14000 BTUs of heat energy per pound. Using the information below, answer questions A and B:

- $1 \text{ lb} \doteq .454 \text{ kg}$
- $1 \text{ BTU} \doteq .252 \text{ Kilocalorie}$

A. (8) Express the heat energy from burning one pound of coal as a range of values in Kilocalories. Give the endpoints of your range in scientific notation.

B. (8) What is the range of heat energy values provided by burning 1 kilogram of coal, expressed in BTUs?

C. (4) If the 9500 BTU figure comes from bituminous coal and the 14000 BTU comes from anthracite coal, what is the percentage difference in heat energy between anthracite and bituminous?

III. The Honda Civic comes in a standard (gasoline engine) version and a hybrid (gasoline-electric) version. The standard version has a fuel efficiency of about 34 miles per gallon, while the hybrid version gets about 44 miles per gallon. The hybrid version has a price about \$4000 more than the standard. You drive about 10000 miles per year. Assume that gasoline will average \$3.00 per gallon over the life of your vehicle.

A. (5) How many gallons of gasoline would you use to drive the 10000 miles with each version?

B. (5) What is the difference between your costs for gasoline with the two versions?

C. (5) If you bought the hybrid version, about how many years would it take for your savings in gasoline costs to make up for the difference in price?

IV. Consider the Excel scatter plot below.

Place a check next to the best responses to the questions below.

A. (5) The least squares regression line for this data set would have a slope m about:

$m = -.1$ _____

$m = .3$ _____

$m = 1$ _____

B. (5) Based on the scatter plot, the R^2 statistic is probably:

between .8 and 1 _____

between .4 and .6 _____

between .2 and .4 _____

between .0 and .2 _____

Essay (30)

In §193 of the *Laudato Si'* encyclical letter, Pope Francis seems to suggest that economic growth should be contained or reversed in order to achieve “sustainable development.” But economic growth in the developing world has lifted millions into the “global middle class” in recent decades and there is strong sentiment in countries like India that they *deserve* to experience the benefits of economic development like the development that has occurred in North America and Europe. Do more developed countries have the right to say “no” to those desires? Francis suggests redefining what we mean by “progress” to address these questions (§194), but is that realistic or desirable?