Grading Key

Question #	A	B	C	D	E
1	2	0	0	4	–
2	0	0	4	0	–
3	0	0	1	4	–
4	2	4	1	0	–
5	4	0	1	0	–
6	0	0	0	4	0
7	4	0	0	0	0
8	0	0	3	4	0
9	4	0	0	0	–
10	0	0	4	0	–
11	4	2	0	0	–
12	4	1	0	0	–
13	0	0	4	0	–
14	0	4	0	0	–
15	0	4	0	0	0
16	2	2	2	4	–
17	2	2	4	0	–
18	0	0	2	4	–
19	0	0	4	1	–
20	4	0	0	1	–
21	0	0	4	0	–
22	4	0	0	0	–

Short answer 1

- 2 points: A graph that looks like the titration of a base
- 2 points: Correct equivalence point at 100 mL
- 2 points: Starting pH ~ 8.2 and at the half-equivalence point pH ~ 3.4

Short answer 2

- 2 points: Explanation as to why the concentration decreases
- 2 points: Recognition that 0.060 M is too high, so the solution is not at equilibrium

Short answer 3

- 2 points: The gas pressure has increased.
- 2 points: This increases the solution concentration to reach equilibrium.

Short answer 4

- 2 points: As seen on the graph, as the ocean acidity increases, the concentration of CO_3^{2-} decreases.
- 2 points: The shells will be thinner because: (1) there is less CO_3^{2-} (aq) or (2) the shells will be more soluble.

Short answer 5

- 2 points: Recognition that the A^- form binds to the column.
- 2 points: Phenolphthalein is in the HA form, whereas methyl red and methyl orange are in the A^- form.