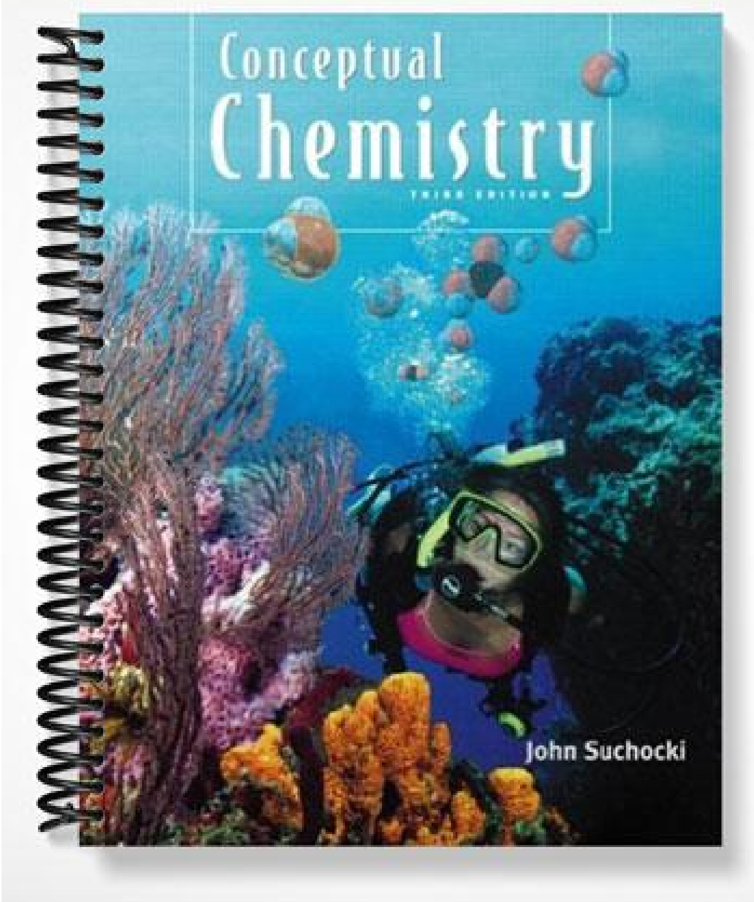
SOLUTIONS MANUAL



Solutions to Concept Builders and Supporting Calculations

• Beginner •• Intermediate ••• Expert

Chapter 1

•

31. Why is it important to work through the Chapter Highlight questions before attempting the Concept Building questions?

31. The Chapter Highlight questions are a simple review of the chapter. They are not designed to be challenging, but they set the stage for the more rigorous Concept Building questions. If you have not already studied the chapter and worked through the Chapter Highlight questions, you will have a more difficult time with the Concept Building questions, which are the types of questions found on exams. To benefit most from the Concept Building questions you should try writing out your answers or, better yet, explain your answers verbally to a friend.

•

32. In what sense is a color computer monitor or television screen similar to our view of matter? Place a drop (and only a drop) of water on your computer monitor or television screen for a closer look.

32. When looked at macroscopically, matter appears continuous. On the submicroscopic level, however, we find that matter is made of extremely small particles, such as atoms or molecules. Similarly, a TV screen looked at from a distance appears as a smooth continuous flow of images. Up close, however, we see this is an illusion. What really exists are a series of tiny dots (pixels) that change color in a coordinated way to produce the series of images.

••

33. Of the three sciences physics, chemistry, and biology, which is the most complex?

33. Biology is based upon the principles of chemistry as applied to living organisms, while chemistry is based upon the principles of physics as applied to atoms and molecules. Physics is the study of the fundamental rules of nature, which more often than not are rather simple in their design and readily described by mathematical formula. Because biology sits at the top of these three sciences, it can be considered to be the most complex of them all.

••

34. Is chemistry the study of the submicroscopic, the microscopic, the macroscopic, or all three? Defend your answer.

34. Chemistry is the careful study of matter and can take place at a number of different levels including the submicroscopic, microscopic, or macroscopic levels.

•

35. What do members of the Chemical manufacturers Association pledge in the Responsible Care program?

The members of the Chemical Manufacturers Association pledge to manufacture without causing environmental damage through a program called Responsible Care.

••

36. Why is the process of science not restricted to any one particular method?

36. Science would not progress as rapidly if it were restricted to one particular method. The scientist needs to be open to all possibilities and different ways of doing science in order to gain as much knowledge as possible from his or her research.

••

37. Some politicians take pride in maintaining a particular point of view. They think a change of mind would be seen as a sign of weakness. How is a change of mind viewed differently in science?

37. A good scientist must change his or her mind when faced with evidence to the contrary. Holding to hypotheses and theories that are either not testable or have been shown to be wrong is contrary to the spirit of science.

••

38. How might the demand for reproducibility in science have the long-run effect of compelling honesty?
38. Any false claims are eventually uncovered. Scientists, therefore, stand to gain most from reporting their results truthfully.

••

39. Distinguish between a scientific hypothesis and a theory.
39. A hypothesis is a testable assumption often used to explain an observed phenomenon. A theory, however, is a single, but comprehensive, idea that can be used to explain a broad range of phenomena.

•

40. Why were McClintock and Baker exploring the oceans off Antarctica?
40. Professors McClintock and Baker were studying the toxic chemicals that Antarctic marine organisms secrete to defend themselves from predators.

•

41. McClintock and Baker worked together on scientific research projects involving marine organisms of the Antarctic seas, yet they have different scientific backgrounds—McClintock in biology and Baker in chemistry. Is this unusual? Explain.
41. This is not unusual at all. As discussed in the answer to question 33, there is much overlap between the different sciences. While Baker is interested in how the chemicals produced by the sea butterfly may be used for some human purpose, McClintock is interested in how the sea butterfly uses this chemical in its own self-defense. Here we see two different approaches to the same phenomenon. Aside from learning from each other, studying the same system together allows these researchers to pool their research resources together.

•

42. What evidence supported McClintock and Baker's hypothesis that amphipods abducted sea butterflies for chemical defense against predators?
42. McClintock and Baker made two sets of pellets to feed to the predatory fish. One set of pellets contained sea butterfly extract and the other did not. They fed the pellets to the predatory fish but the fish would not eat the pellets with the sea butterfly extract.

••

43. Why is it wrong to assume that you are only "doing science" while you are doing experiments?
43. Experimentation is a very important aspect of science, but it is hardly the only aspect. So long as you are engaging in activities that help to further your knowledge or understanding about the natural environment you are practicing science. There is, however, a reason science instructors like to have you perform lab experiments. Such experiments allow you to see for yourself the science concepts in action. This is a much better than having some one simply tell you what was suppose to occur.

•

44. There are no libraries in Antarctica. How then are scientists in Antarctica able to research that which is already known about a subject?
44. Most scientific journals are now available on CD-rom, which the scientist can access on their portable computers. Furthermore, through a satellite link, the scientist has access to technical libraries through the internet. Their colleagues are also experts in their fields and are a good source of information.

••

45. Can a person claim themselves to be a scientist if they no longer do experiments?
45. There are many university science professors who only rarely perform experiments. Instead, they oversee undergraduate, graduate, and post-doctoral students who perform the actual experiments. The professor, however, is still very much engaged in the many other aspects of the scientific process and is by all measures a professional scientist.

••

46. Of the scientific activities listed in Figure 1.6, which do you think would be the top two activities undertaken by an older, well-seasoned scientists? How about a younger, less-seasoned scientist?

46. The older, well-seasoned scientist tends to spend more time pondering broad questions and communicating with others. The younger, less-seasoned scientist tends to spend more time on the nitty gritty work, which includes a lot of time in the library learning about what is already known and working late nights in the lab trying to perform successful experiments.

••

47. Of the scientific activities listed in Figure 1.6, which is likely the most time consuming?

47. The performing of experiments is typically the most involved and time-consuming, as well as money consuming, activity. That said, it's quite possible that the scientist might instead end up devoting hoards of time to other scientific activities.

••

48. At what point in the scientific process does the scientist make observations?

48. The scientist is always making observations.

•••

49. During which of the scientific activities listed in Figure 1.6, does the scientist come up with a hypothesis?

49. A hypothesis can come at any time to a scientist no matter what she may be doing. She could be cooking at a barbeque when suddenly the idea pops into her head. Again, for emphasis, there is no one prescribe method for doing science. In fact, there are as many ways of doing science as there are people interested in doing science.

••

50. Which of the following are scientific hypotheses?

a. Stars are made of the lost teeth of children.
b. Albert Einstein was the greatest scientist ever to have lived.
c. The planet Mars is reddish because it is coated with cotton candy.
d. Aliens from outer space have transplanted themselves into the minds of government workers.
. *e. Tides are caused by the moon.*
. *f. You were Abraham Lincoln in a past life.*
. *g. A human remains self-aware while sleeping.*
. *h. A human remains self-aware after death.*

50. A hypothesis must be testable, at least in principle, in order to be deemed scientific. The tests may suggest that the hypothesis is correct or incorrect. Either way, so long as some definitive tests can be designed, then the hypothesis is scientific: a, c, e, g, h

••

51. In answer to the question "When a plant grows, where does the material come from?" the ancient Greek philosopher Aristotle (384–322 B.C.) hypothesized that all material came from the soil. Do you consider his hypothesis to be correct, incorrect, or partially correct? What experimental tests do you propose to support your choice?

51. If it all came from the soil, then one might expect a large hole to develop around the tree if it were grown in a pot. Also the weight of the soil in the pot should be greater when the tree is young than when the tree is older.

•

52. The great philosopher and mathematician Bertrand Russell (1872–1970) wrote, "I think we must retain the belief that scientific knowledge is one of the glories of man. I will not maintain that knowledge can never do harm. I think such general propositions can almost always be refuted by well-chosen examples. What I will maintain—and maintain vigorously—is that knowledge is very much more often useful than harmful and that fear of knowledge is very much more often harmful than useful." Think of examples to support this statement.

52. The examples are endless. Knowledge of electricity, for example, has proven to be extremely useful. Harm is typically brought to those—typically children—who understand the least about electricity The number of people who have been harmed by electricity who understood it is far fewer than the number of people who are harmed by it that don't understand it.