4.9 Exercises

E 4–1
In a spectrum with just one line, the dispersion mode lineshape might be acceptable – in fact we can think of reasons why it might even be desirable (what might these be?). However, in a spectrum with many lines the dispersion mode lineshape is very undesirable – why?

E 4–2
Suppose that we record a spectrum with the simple pulse-acquire sequence using a 90° pulse applied along the x axis. The resulting FID is Fourier transformed and the spectrum is phased to give an absorption mode lineshape.

We then change the phase of the pulse from x to y, acquire an FID in the same way and phase the spectrum using the *same* phase correction as above. What lineshape would you expect to see in the spectrum; give the reasons for your answer.

How would the spectrum be affected by: (a) applying the pulse about $-x$; (b) changing the pulse flip angle to 270° about x?

E 4–3
The gyromagnetic ratio of phosphorus-31 is 1.08×10^8 rad s^{-1} T^{-1}. This nucleus shows a wide range of shifts, covering some 700 ppm.

Suppose that the transmitter is placed in the middle of the shift range and that a 90° pulse of width 20 μs is used to excite the spectrum. Estimate the size of the phase correction which will be needed at the edges of the spectrum. (Assume that the spectrometer has a B_0 field strength of 9.4 T).

E 4–4
Why is it undesirable to continue to acquire the FID after the signal has decayed away?

How can weighting functions be used to improve the SNR of a spectrum? In your answer described how the parameters of a suitable weighting function can be chosen to optimize the SNR. Are there any disadvantages to the use of such weighting functions?

E 4–5
Describe how weighting functions can be used to improve the resolution in a spectrum. What sets the limit on the improvement that can be obtained in practice? Is zero filling likely to improve the situation?

E 4–6
Explain why use of a sine bell weighting function shifted by 45° may enhance the resolution but use of a sine bell shifted by 90° does not.

E 4–7
In a proton NMR spectrum the peak from TMS was found to show "wig-

gles" characteristic of truncation of the FID. However, the other peaks in the spectrum showed no such artefacts. Explain.

How can truncation artefacts be suppressed? Mention any difficulties with your solution to the problem.