

Probability I

Quantifying a likelihood

30

Answers to additional problems

30.1 From eqn. (30.1), the probability of choosing a defective voltmeter is $1/7$, or 14 per cent. Next, using the equation for a sequence of related events in eqn. (30.3), we say the overall probability $P = (P_{\text{First choice}}) \times (P_{\text{Second choice}}) \times (P_{\text{Third choice}}) = (1/7)^3$.

The probability of choosing a defective voltmeter three times in a row is $1/343$ or $0.0029 = 0.29$ per cent.

30.2 One in every eleven molecules of alcohol is *i*-decanol. The chance of reacting with that molecule is therefore $1/11$, or 9.1 per cent.

30.3 Using eqn. (30.4), $P = (1/6)^4 = 1/1296 = 0.077\%$.

30.4 • The probability P of obtaining a bottle of **technical grade** KClO_4 is $1/6$.

• The probability P of obtaining a bottle of **ACS grade** KClO_4 is $3/6$.

• The probability P of obtaining a bottle of **Analar® grade** KClO_4 is $2/6$.

so the overall probability $P = \frac{1}{6} \times \frac{3}{6} \times \frac{2}{6} = \frac{6}{216} = \frac{1}{36}$ or about 2.8 per cent.

- 30.5**
1. The **first** electron can enter whichever orbital it likes— p_x , p_y , or p_z —because all are equivalent and all are empty. Whatever we do, adding one electron will fill an empty orbital. The probability of the electron filling an empty orbital is $1/3$.
 2. The **second** electron will enter one of two empty orbitals (the p_x is already partially full). So there are 2 vacancies for which the probability of filling is $1/2$.
 3. The **third** electron has no choice because there is only one empty orbital (call it p_z). The probability = 1.
 4. The **fourth** electron can enter whichever half-filled orbital it likes—again, p_x , p_y , or p_z —because all are equivalent and are half-full. Whatever we do, we fill a half-full orbital, so again the probability of the electron filling an empty orbital is $1/3$.

So the overall probability is $\frac{1}{3} \times \frac{1}{2} \times \frac{1}{1} \times \frac{1}{3} = \frac{1}{18}$ or about 5.6%.