

**Mark scheme for Extension Worksheet – Option F,
Worksheet 2**

- 1 a** A continuous signal varying between two extreme values. [1]
- b** The fifth sample has a voltage of 6.75 so it corresponds to PAM voltage of 6 V; and hence it can be expressed as the binary number
 $6 = 4 + 2 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 110$ [2]
- c** An advantage would be that with a higher sampling frequency there would be a better reconstruction of the original signal from its samples; because the sampling frequency must be higher than twice the highest frequency in the signal; a disadvantage would be that there would be many more samples; and these would have to be stored somewhere. [4]
- 2 a** The time between samples is 0.20 ms; and the sampling frequency is
 $f_c = \frac{1}{0.20 \times 10^{-3}} = 5.0 \text{ kHz}$ [2]
- b** Connecting the sample voltages with a smooth curve does not reproduce the original signal; this is because the sampling frequency is not high enough. [2]
- c** There is variation of the signal from 0.20 ms to 0.35 ms i.e. over a time interval of 0.15 ms; so a more appropriate sampling frequency would be
 $\frac{1}{0.15 \times 10^{-3}} = 6.7 \text{ kHz}$ [2]
- d** The signal strength varies by as little as 4.5 V so to see this variation the quantisation level must be smaller than this; i.e. $\frac{30 - 0}{4.5} = 6.7 \approx 7$; we can have this many quantisation levels with 3 bits since $2^3 > 7$. [3]