1. **[AJC 18 MYE]**
Four double-decker beds are arranged in a row. Eight boys, three of whom are Andrew, Ben and Perry, have been allocated to these beds.

   (a) Find the number of ways of allocating the beds to the eight boys. [1]

   (b) If Perry does not want to share the same double decker bed as Andrew, find the number of ways of allocating the beds to the eight boys. [2]

   (c) Besides not sharing the same double decker bed as Andrew, Perry who is afraid of heights, has also requested to be allocated on the lower deck. Ben, who is Perry's best friend, has requested to be allocated on a lower deck bed next to Perry. Find the number of ways of allocating the beds to the eight boys based on these requests. [2]

   The eight boys decide to hold a meeting at a round table with eight seats.

   (d) Find the number of ways of arranging the boys at the round table if Perry is to be seated next to Andrew or Ben but not between them. [3]

2. **[CJC 18 MYE]**
A curve C has parametric equations

$$x = t + \sin t, \qquad y = 1 - \cos t,$$

where $-\frac{\pi}{4} \leq t \leq \pi$.

   (a) Find the exact equation of the normal to the curve C at $t = \frac{\pi}{3}$. [4]

   (b) Find the area of the region bounded by C, the x-axis and the normal to C at $t = \frac{\pi}{3}$. [4]

3. **[CJC 18 MYE]**

   (a) Find $x \sin kx \, \mathrm{d}x$, where k is a positive constant. [2]

   (b) Find the constants A, B and C such that $\cos 5x \sin 3x = A(\sin Bx + \sin Cx)$. [2]

   (c) Hence find $\int 3x \cos 5x \sin 3x \, \mathrm{d}x$. [3]

Answers

1. (a) 40 320.
   (b) 34 560.
   (c) 3 600.
   (d) 2 400.

2. (a) $y = -\sqrt{3}x + \frac{\sqrt{3}}{3}\pi + 2$.
   (b) $\frac{\pi}{6} - \frac{1}{4\sqrt{3}}$ (or 0.451).

3. (a) $\frac{\sin kx}{k^2} - \frac{x\cos kx}{k} + C$.
   (b) $\frac{1}{2}(\sin 8x - \sin 2x)$.
   (c) $\frac{3}{16}(\frac{\sin 8x}{8} - x\cos 8x) - \frac{3}{4}(\frac{\sin 2x}{2} - x\cos 2x) + C$.