## Algorithms 1F

**1 a** $\frac{600}{300} = 2$

$0.14 \times 2^3 = 1.12$ seconds

It would take approximately 1.12 seconds to multiply $600 \times 600$ matrices.

**b** $\frac{1000}{300} = 3\frac{1}{3}$

$0.14 \times 3\frac{1}{3}^3 = 5.19$ seconds

It would take approximately 5.19 seconds to multiply $1000 \times 1000$ matrices.

**2 a** To pack the $k^{\text{th}}$ item requires at most $k-1$ comparisons, if every item placed so far is in a separate bin. Hence the total number of comparisons for $n$ items is $\sum_{k=1}^{n}(k-1) = \frac{1}{2}n(n-1)$ which is a quadratic expression.

**b** $\frac{6200}{400} = 15.5$

$0.72 \times (15.5)^2 = 173$ seconds (3 s.f.)

**c** The exact run-time will depend on the specific lengths of pipe.

**3 a** If the size of the problem is multiplied by $k$, then the algorithm will take approximately $k^2$ times as long to run.

**b** $\frac{500}{50} = 10$

$0.028 \times (10)^2 = 2.8$ seconds

**4** If the runtime of bubble sort is $an^2 + bn + c$ and the runtime of first-fit bin-packing is $pn^2 + qn + r$ then the combined runtime will be $(an^2 + bn + c) + (pn^2 + qn + r) = (a+p)n^2 + (b+p)n + (c+r)$ which is a quadratic expression, so the combined process has quadratic $(n^2)$ order, not $(n^4)$

**5** The bubble sort $(n^2)$ is applied to a list of $n^2$ items which gives the order of the algorithm as $n^4$