## Algorithms Mixed exercise

**1** Bubbling left to right

| | | | | | | |
|---|---|---|---|---|---|---|
| Initial list | 27 | 15 | 2 | 38 | 16 | 1 |
| 1st pass | 15 | 2 | 27 | 16 | 1 | 38 |
| 2nd pass | 2 | 15 | 16 | 1 | 27 | 38 |
| 3rd pass | 2 | 15 | 1 | 16 | 27 | 38 |
| 4th pass | 2 | 1 | 15 | 16 | 27 | 38 |
| 5th pass | 1 | 2 | 15 | 16 | 27 | 38 |

No further changes ∴ sorted

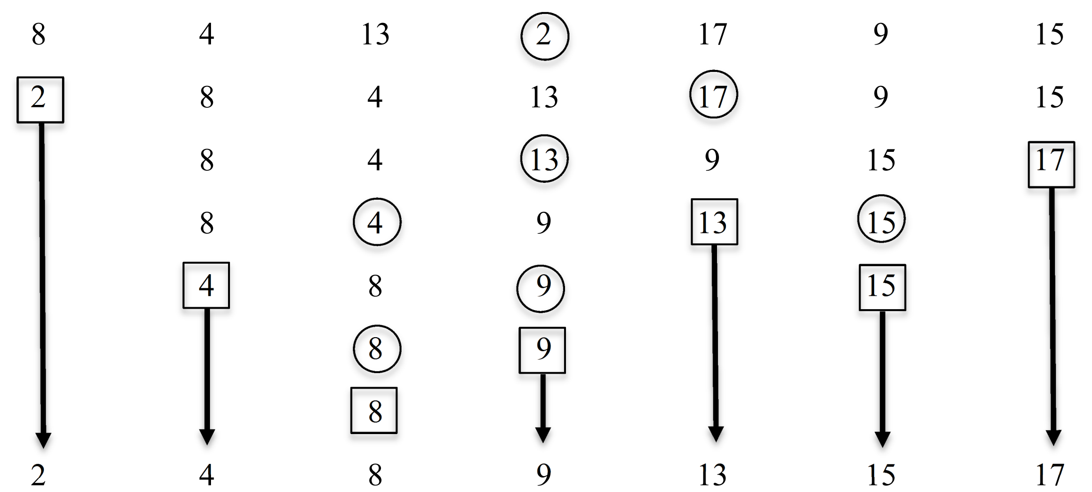
**2 a** Bubbling left to right

| | | | | | | |
|---|---|---|---|---|---|---|
| Initial list | 25 | 42 | 31 | 22 | 26 | 41 |
| 1st pass | 42 | 31 | 25 | 26 | 41 | 22 |
| 2nd pass | 42 | 31 | 26 | 41 | 25 | 22 |
| 3rd pass | 42 | 31 | 41 | 26 | 25 | 22 |
| 4th pass | 42 | 41 | 31 | 26 | 25 | 22 |

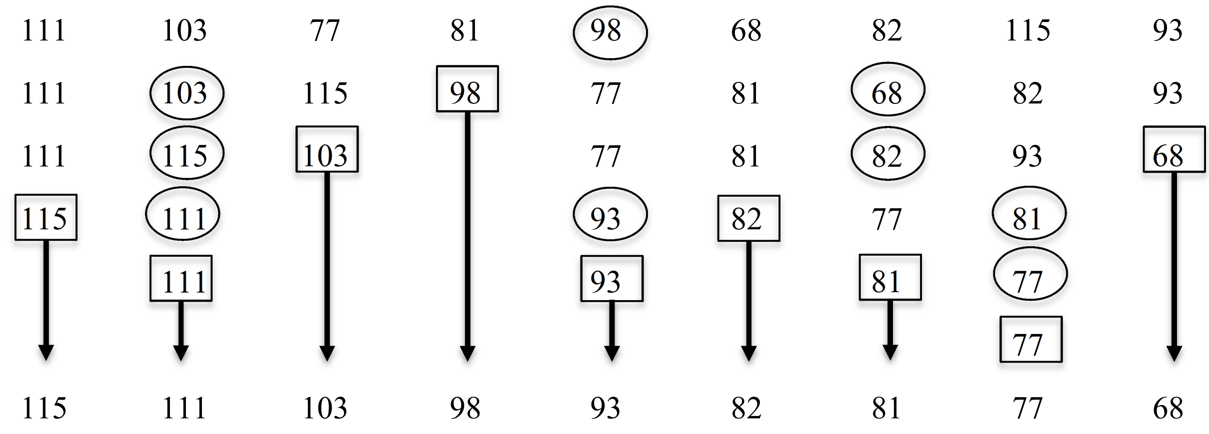
No further changes ∴ sorted

**b** 15

**3**



**4 a**




**b i** Bin 1: $115+82$
Bin 2: $111+81$

Bin 3: $103+93$

Bin 4: $98+77$

Bin 5: 68

**ii** No room in bin 1 (3 left) or bin 2 (8 left) or bin 3 (4 left) but room in bin 4.

**5 a** Rank the times in descending order and use them in this order. Number the bins starting at 1. Place each recording time into the first available bin, starting with bin 1 each time.

100 92 84 75 60 52 42 30

Bin 1: 100

Bin 2: 92

Bin 3: $84+30$

Bin 4: $75+42$

Bin 5: $60+52$

$$\text{unused DVDs} = 5\times 120-\left(100+92+84+75+60+52+42+30\right)$$
$$= 600-535$$
$$= 65 \text{ minutes}$$

**b** There is room on DVD 2 for one of the 25-minute programmes but no room on any tape for the second programme.

**c** There is room on tape 2 for 28-minutes; one of the 25-minute programmes can be recorded on tape 2. But there is no room on any tape for the second programme.

**6 a** For example, the length total is 12m so no wastage is permitted. We are therefore seeking a full bin solution.
The two 1.2m lengths cannot be 'made up' to 2m bins since these are only $2\times 0.4\,\text{m}$ length. Two of these can be used to make a full bin, $1.2+0.4+0.4$, but the second 1.2m cannot be made up to 2m since there is only 1 remaining 0.4 m length.

**6 b** Bin 1: $1.6 + 0.6$
Bin 2: $1.4 + 1$
Bin 3: $1.2 + 1.2$
Bin 4: $1 + 1 + 0.4$
Bin 5: $0.6 + 0.6 + 0.6 + 0.4$
Bin 6: $0.4$

**c** For example;
Bin 1: $1.6 + 0.4 + 0.4$
Bin 2: $1.4 + 1$
Bin 3: $1.2 + 1.2$
Bin 4: $1 + 1 + 0.4$
Bin 5: $0.6 + 0.6 + 0.6 + 0.6$

**7 a**

| | *I* | *M* | Box 4 | *A* | Temp | Box 6 |
|---|---|---|---|---|---|---|
| **Initial conditions** | 1 | - | | 6.1 | 1.1 | |
| **1st pass** | 2 | 1.9 | No | 6.1 | 1.1 | Yes |
| **2nd pass** | 3 | 0.7 | Yes | 5.7 | 0.7 | Yes |
| **3rd pass** | 4 | 0.2 | Yes | 4.8 | 0.2 | Yes |
| **4th pass** | 5 | 0.3 | No | | | No |

output = 4.8

**b** It selects the number nearest to 5.

**c** It would select the number furthest from 5.

**8 a** Bubbling left to right
After 1st pass: 2.0 1.3 1.6 0.3 1.3 0.3 0.2 2.0 0.5 0.1
After 2nd pass: 2.0 1.6 1.3 1.3 0.3 0.3 2.0 0.5 0.2 0.1
After 3rd pass: 2.0 1.6 1.3 1.3 0.3 2.0 0.5 0.3 0.2 0.1
After 4th pass: 2.0 1.6 1.3 1.3 2.0 0.5 0.3 0.3 0.2 0.1
After 5th pass: 2.0 1.6 1.3 2.0 1.3 0.5 0.3 0.3 0.2 0.1
After 6th pass: 2.0 1.6 2.0 1.3 1.3 0.5 0.3 0.3 0.2 0.1
After 7th pass: 2.0 2.0 1.6 1.3 1.3 0.5 0.3 0.3 0.2 0.1
After 8th pass: 2.0 2.0 1.6 1.3 1.3 0.5 0.3 0.3 0.2 0.1
No swap in 8th pass, so the list is in descending order.

**b** Sorting into descending order, 2.0, 2.0, 1.6, 1.3, 1.3, 0.5, 0.3, 0.3, 0.2, 0.1
Bin 1: 2.0
Bin 2: 2.0
Bin 3: $1.6 + 0.3 + 0.1$
Bin 4: $1.3 + 0.5 + 0.2$
Bin 5: $1.3 + 0.3$
5 lengths of pipe needed

**c** Yes: The lower bound is given by $\frac{2.0 + 2.0 + 1.6 + 1.3 + 1.3 + 0.5 + 0.3 + 0.3 + 0.2 + 0.1}{2} = \frac{9.6}{2} = 4.8$ rounded up to 5 lengths of pipe.

**9 a**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| M | V | C | A | D | B | K | S |
| C | A | B | D | M | V | K | S |
| A | C | B | D | K | M | V | S |
| A | B | C | D | K | M | S | V |
| A | B | C | D | K | M | S | V |

There are 8 names in the list, so the pivot should be the name to the right of the middle (Daisy). Starting at the beginning of the list, each name is compared with Daisy and placed on the left side if it comes before D or the right side if it comes after D to produce two sub lists. The process is repeated for each sub-list with pivot of A on the left and K on the right. Select further pivots from within each sub-list and repeat the process until the names are in alphabetical order.

**b** $\dfrac{1000\log 1000}{100\log 100} = 15$

$0.3 \times 15 = 4.5$ seconds

**Challenge**

**a i** $\dfrac{1.1^{10}}{1.1^{7}} \times 0.734 = 0.977$ seconds

**ii** $\dfrac{1.1^{100}}{1.1^{7}} \times 0.734 = 5191$ seconds

**b** $60 \times 60 \times 24 \times 365 = 31\ 536\ 000$ seconds

$31\ 536\ 000 = \dfrac{1.1^{n}}{1.1^{7}} \times 0.734$

$1.1^{n} = \dfrac{31\ 536\ 000 \times 1.1^{7}}{0.734} = 83725807.17$

$\log 1.1^{n} = \log 83725807.17$

$n = \dfrac{\log 83725807.17}{\log 1.1} = 192$

**c** If it checks small potential factors first, all even numbers will be factorised very quickly compared to a number which is a product of two large prime factors.