Algorithms 1C

1 i a Bubbling left to right

23 16 15 34 18 25 11 19 — 23 > 16 so swap
16 23 15 34 18 25 11 19 — 23 > 15 so swap
16 15 23 34 18 25 11 19 — 23 < 34 so leave
16 15 23 34 18 25 11 19 — 34 > 18 so swap
16 15 23 18 34 25 11 19 — 34 > 25 so swap
16 15 23 18 25 34 11 19 — 34 > 11 so swap
16 15 23 18 25 11 34 19 — 34 > 19 so swap
16 15 23 18 25 11 19 34

After 1st pass: 16 15 23 18 25 11 19 34
After 2nd pass: 15 16 18 23 11 19 25 34
After 3rd pass: 15 16 18 11 19 23 25 34
After 4th pass: 15 16 11 18 19 23 25 34
After 5th pass: 15 11 16 18 19 23 25 34
After 6th pass: 11 15 16 18 19 23 25 34
After 7th pass: 11 15 16 18 19 23 25 34
No swap in 7th pass, so the list is in order.

b Bubbling left to right

23 16 15 34 18 25 11 19 — 23 > 16 so leave
23 16 15 34 18 25 11 19 — 16 > 15 so leave
23 16 15 34 18 25 11 19 — 15 < 34 so swap
23 16 34 15 18 25 11 19 — 15 < 18 so swap
23 16 34 18 15 25 11 19 — 15 < 25 so swap
23 16 34 18 25 15 11 19 — 15 > 11 so leave
23 16 34 18 25 15 11 19 — 11 < 19 so swap
23 16 34 18 25 15 19 11

After 1st pass: 23 16 34 18 25 15 19 11
After 2nd pass: 23 34 18 25 16 19 15 11
After 3rd pass: 34 23 25 18 19 16 15 11
After 4th pass: 34 25 23 19 18 16 15 11
After 5th pass: 34 25 23 19 18 16 15 11
No swap in 5th pass, so the list is in order.

ii a After 1st pass: E N T O R K S W
After 2nd pass: E N O R K S T W
After 3rd pass: E N O K R S T W
After 4th pass: E N K O R S T W
After 5th pass: E K N O R S T W
After 6th pass: E K N O R S T W
No swap in 6th pass, so the list is in order.

b After 1st pass: N T W O R K S E
After 2nd pass: T W O R N S K E
After 3rd pass: W T R O S N K E
After 4th pass: W T R S O N K E
After 5th pass: W T S R O N K E
After 6th pass: W T S R O N K E
No swap in 6th pass, so the list is in order.

1 iii a After 1st pass: A5 D2 A1 B4 C7 C2 B3 D3
After 2nd pass: A5 A1 B4 C7 C2 B3 D2 D3
After 3rd pass: A1 A5 B4 C2 B3 C7 D2 D3
After 4th pass: A1 A5 B4 B3 C2 C7 D2 D3
After 5th pass: A1 A5 B3 B4 C2 C7 D2 D3
After 6th pass: A1 A5 B3 B4 C2 C7 D2 D3
No swap in 6th pass, so the list is in order.

b After 1st pass: D3 D2 A5 B4 C7 C2 B3 A1
After 2nd pass: D3 D2 B4 C7 C2 B3 A5 A1
After 3rd pass: D3 D2 C7 C2 B4 B3 A5 A1
After 4th pass: D3 D2 C7 C2 B4 B3 A5 A1
No swap in 4th pass, so the list is in order.

2 Bubbling left to right
After 1st pass: Ch St Br Bu Cr Ev Yo
After 2nd pass: Ch Br Bu Cr Ev St Yo
After 3rd pass: Br Bu Ch Cr Ev St Yo
After 4th pass: Br Bu Ch Cr Ev St Yo
No swap in 4th pass, so the list is in order.
Bridlington, Burton, Chester, Cranleigh, Evesham, Stafford, York

3 a If there are n items, then there are $n-1$ pairs of items that need to be compared.
For a pair, the minimum number of passes needed is 1.

b One pass is sufficient if the items are already in ascending order.

c The maximum number of passes needed is n.

d n passes are needed if the smallest item is at the end of the list.

4 a Bubble left to right of the list comparing each pair of numbers. If the first number of a pair is greater than or equal to the second, make no change. If the first number of a pair is less than the second, swap them. This is the first pass.

b After 1st pass: 63 57 55 48 48 72 49 61 39 32
After 2nd pass: 63 57 55 48 72 49 61 48 39 32
After 3rd pass: 63 57 55 72 49 61 48 48 39 32
After 4th pass: 63 57 72 55 61 49 48 48 39 32
After 5th pass: 63 72 57 61 55 49 48 48 39 32
After 6th pass: 72 63 61 57 55 49 48 48 39 32
After 7th pass: 72 63 61 57 55 49 48 48 39 32
No swap in 7th pass, so the scores are in order.