Q1.

Stable: Relative order of dupes is preserved.

$2, 3_a, 1, 3_b, 0 \Rightarrow 0, 1, 2, 3_a, 3_b$ = stable

$\Rightarrow 0, 1, 2, 3_b, 3_a$ = not stable

Adaptive: An algo. capable of reacting differently to different inputs (eg. sorted arrays)

Bubble sort is a common example

Comparison-based: Uses comparisons to sort elements

(Non-assessable.)

Q4. Selection Sort:

Iteration	Array	Comparisons
0	4, 3, 6, 8, 2	—
1	2, 3, 6, 8, 4	(4,3), (3,6), (3,8), (3,2)
2	2, 3, 6, 8, 4	(3,6), (3,8), (3,4)
3	2, 3, 4, 8, 6	(6,8), (6,4)
4	2, 3, 4, 6, 8	(8,6)

#. comparisons: 10

Bubble Sort (bubble-up):

Iteration	Array	Comparisons
0	4, 3, 6, 8, 2	—
1	3, 4, 6, 2, 8	(3,4), (4,6), (6,8), (8,2)
2	3, 4, 2, 6, 8	(3,4), (4,6), (6,2)
3	3, 2, 4, 6, 8	(3,4), (4,2)
4	2, 3, 4, 6, 8	(3,2)

#. comparisons: 10

Insertion sort:

Iteration	Array	Comparisons
0	4, 3, 6, 8, 2	—
1	3, 4, 6, 8, 2	(4, 3)
2	3, 4, 6, 8, 2	(4, 6)
3	3, 4, 6, 8, 2	(6, 8)
4	2, 3, 4, 6, 8	(8, 2), (6, 2), (4, 2), (3, 2)

#. comparisons: 7

Insertion sort commonly the most used of these 3 $O(n^2)$ sorts.

Q5.

lo mid hi

Array: 1 4 5 6 7 2 3 4 7 9, lo=0, mid=4, hi=9

Step 1: Initialisation → i = 0, j = 5, k = 0

Step 2: Merge while there are items in both halves

i j

A: 1, 4, 5, 6, 7, 2, 3, 4, 7, 9

After this step the first half is exhausted

tmp: 1, 2, 3, 4, 4, 5, 6, 7

Step 3: Copy remaining items in the arrays

A: 1, 4, 5, 6, 7, 2, 3, 4, 7, 9

tmp: 1, 2, 3, 4, 4, 5, 6, 7, 7, 9

This works because what is left is sorted and greater than everything in tmp

Step 4: copy back tmp's contents to A. ⇒ Done!

Q6. A: 5, 3, 9, 6, 4, 2, 9, 8, 1, 7 (lo = 5, hi = 7)

Step 1: Initialisation → $l = 1$, $r = 9$, pivot = 5

Step 2: Rearrange

A: 5, 3, 1, 2, 4, 6, 9, 8, 9, 7 (l, r = 6)

Step 3: Swap pivot index if necessary

A: 4, 3, 1, 2, 5, 6, 9, 8, 9, 7 (m = 5)

4, 3, 1, 2 ≤ 5 ; 6, 9, 8, 9, 7 ≥ 5

Step 4: Return pivot index. → 4.

Without even simulating it step-by-step, how would partitioning change these two arrays?

0, 1, 2, 3, 4, 5, 6, 7, 8, 9 → Same

9, 8, 7, 6, 5, 4, 3, 2, 1, 0 → pretty much same

Both end up with a really uneven split ⇒ $O(n^2)$ worst case is usually caused by this.