1. Why are user-defined types needed? Select **all** that apply.

   ☐ they group values of different types that describe one thing

   ☐ the declaration says what the variable is, not just how it is stored

   ☐ they make the program run faster

   ☐ they restrict a field to its legal values, so the compiler catches more mistakes

   Tick every correct option.

2. A serial file stores records:

   ☐ in the order they were added, with no sorting

   ☐ in random memory addresses

   ☐ sorted by a key field

   ☐ at positions computed from a key

3. A hash function:

   ☐ turns a record's key into a storage address

   ☐ encrypts each record's key

   ☐ compresses the record's data

   ☐ sorts the file into key order

4. A floating-point number is stored as:

   ☐ a string of decimal digit characters

   ☐ a mantissa multiplied by 2 raised to an exponent

   ☐ a denary fraction over a power of ten

   ☐ a single integer with an implied point

5. An enumerated type holds:

   ☐ a memory address

   ☐ a value from a fixed list of named constants

   ☐ a group of different fields

   ☐ any string at all

6. A random (direct-access) file places each record:

   ☐ in alphabetical order of a name field only

   ☐ always at the end of the file, after the last record

   ☐ in the order the records arrive, one after another

7. What makes a hash function a good one? Select **all** that apply.

   ☐ the same key always gives the same address

   ☐ it never produces a collision

   ☐ it is fast to compute

   ☐ it spreads keys evenly over the slots

   Tick every correct option.

8. Written as a normalised fraction times a power of two, $2.5 = 0.101 \times 2^{n}$ (the fraction in binary). The exponent n is _____.

   _____

9. A pointer stores the memory address of another variable, and dereferencing it (e.g. ‘p^‘) reaches the variable it points to.

   ☐ True ☐ False

10. A sequential file can be read by sequential access and also by direct access.

    ☐ True ☐ False

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1. **they group values of different types that describe one thing; the declaration says what the variable is, not just how it is stored; they restrict a field to its legal values, so the compiler catches more mistakes**

   Restriction, grouping and self-documentation. Speed is not the reason; correctness and clarity are.

2. **in the order they were added, with no sorting**

   Serial files keep records in arrival order – fast to append, slow to search. Sequential files are sorted by key.

3. **turns a record's key into a storage address**

   A hash function maps a key to an address, enabling near-instant direct lookup.

4. **a mantissa multiplied by 2 raised to an exponent**

   value = mantissa × 2^exponent – binary scientific notation, with both parts stored in two's complement.

5. **a value from a fixed list of named constants**

   An enumerated type restricts a variable to one of a fixed set of named values (e.g. days of the week).

6. **at a position computed from its key, giving very fast direct lookup**

   A key is converted (often by a hash) to a position, so a single-key lookup is very fast.

7. **the same key always gives the same address; it is fast to compute; it spreads keys evenly over the slots**

   Fast, deterministic and evenly spread. No realistic hash avoids collisions entirely, which is why every design includes a resolution strategy.

8. **2**

   2.5 is 10.1 in binary; sliding the point two places left gives 0.101, so the exponent is 2 and the mantissa is '01010000'.

9. **True**

   Pointers (with NULL marking "points to nothing") are how dynamic structures like linked lists and trees are built.

10. **True**

    Sequential access serves serial and sequential files; direct access serves sequential and random files. Only a serial file is limited to one method.

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