**Question 25 — The Software Developer's View of the Hardware** (20 marks)

(a) (i) Explain how a fraction is represented in single precision floating point binary representation. **3**

(ii) Convert the decimal number 45 (ie 45_{10}) to a hexadecimal number. **2**

(iii) Using four-bit binary representation and two's complement, perform the following subtraction: $1110-0111$. **2**

(b) (i) Describe the function of a flip-flop, and briefly explain how it achieves its purpose. You may use a diagram to illustrate your answer. **3**

(ii) **4**
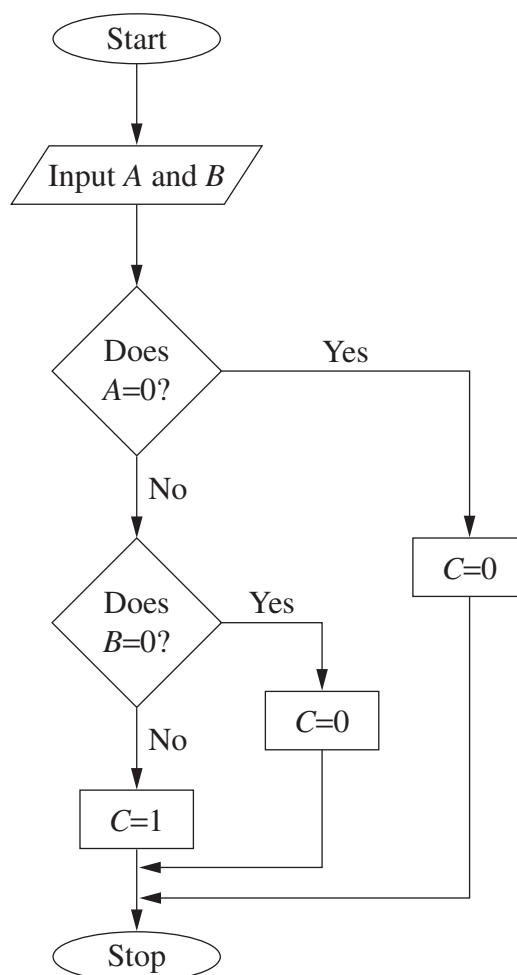
The flowchart above describes the logic of an AND gate where the values of *A* and *B* are binary digits.

Use the flowchart to draw a truth table for an AND gate. Also draw a flowchart that describes the logic of an OR gate.

Question 25 (continued)

(c) A fingerprint scanner is used by a software development company to maintain **6**
a high level of security at its premises. The fingerprint scanner operates in black
and white mode only.

Ridges in the fingerprint are
recorded and processed as black.

Valleys (indentations) in the fingerprint
are recorded and processed as white.

When employees arrive at the workplace they must:

• place their index finger on an imaging pad located at the door; and

• wait for a scan of their fingerprint to be taken.

The image produced by the scan of the fingerprint is then sent to a central
computer as a data stream. It is compared to the stored set of fingerprint data
records for all employees. If a match is found, the door is opened.

In each of the data packets sent from the fingerprint scanner to the central
computer there is header information, data characters and trailer information.

Compare and contrast the data stream that would be sent from the scanner to the
central computer with the data stream that would be sent from the central
computer to the door. Make specific reference to header information, data
characters and trailer information for both data streams.

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