Cambridge IGCSE™ Computer Science (0478/12)

Mark Scheme — February / March 2026

General Marking Principles

- **Calculators must not be used** where mathematical steps or raw binary calculations are requested.
- **Equivalence:** Accept alternative wording provided that the fundamental technical accuracy and computer science terminology remain unchanged.

Question 1

(a) Data Storage Statement [1]

- **Correct Option: C** – One exbibyte (EiB) equals 1024×1024 tebibytes (TiB).
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(b) File Size Calculation [3]

- **Working Steps (2 marks):**
  1. Total pixels = 1024×1024=1,048,576 pixels
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  2. Total bits/bytes = 1024×1024×2 bytes (colour depth)=2,097,152 bytes
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  3. Conversion to MiB: Divide by 1024 to get KiB, then divide by 1024 again to get MiB.
     1024×10241024×1024×2 =2 MiB
- **Final Answer (1 mark): 2** MiB
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Question 2

(a) Functions of a web browser [3]

Any three from:

- Renders/translates HTML/CSS into a viewable webpage.
- Provides navigation tools (Back, Forward, Refresh, Home buttons).
- Manages/stores browsing history and bookmarks.
- Handles protocols such as HTTP and HTTPS.
- Manages plugins / extensions.

(b) (i) Purpose of an IP address [2]

- It uniquely identifies a device connected to a network/the internet.
- It provides a destination/routing address so that data packets can be sent and received correctly.

(b) (ii) How a URL is converted to an IP address [3]

1. The user enters the URL into the browser; the browser requests the IP address from a **Domain Name System (DNS) server**.
2. The DNS server looks up the domain name in its database to find its matching IP address.
3. If found, the IP address is sent back to the browser; if not found, the query is passed up to a higher-level DNS server.

(c) (i) What is meant by a cookie? [1]

- A small text file sent by a web server and stored on the user's local computer/hard drive by the web browser.
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(c) (ii) Examples of session vs persistent cookies [2]

- **Session Cookie:** Temporarily holds items in an online shopping cart / keeps a user securely logged into a banking portal during a single visit. (Deleted when the browser closes).
- **Persistent Cookie:** Remembers user login credentials (e.g., "Remember Me" checkboxes) / saves user theme preferences or tracks user browsing behavior for targeted ads across multiple sessions. (Stored long-term).

Question 3

(a) Drone characteristics identifying it as a robot [2]

- **Sensing:** It uses sensors to capture environmental data independently.
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- **Processing / Autonomous Action:** It contains a microprocessor to interpret sensor inputs and make operational control decisions without continuous human input.
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(b) (i) Sensor selection [1]

- Ultrasonic sensor / Infrared sensor / LiDAR sensor / Radar sensor.

(b) (ii) Definition of a microprocessor [1]

- An integrated circuit (IC) that contains the functions of a central processing unit (CPU) on a single chip, designed to execute control instructions in embedded systems.

(b) (iii) Sensor and microprocessor interaction loop [4]

1. The **sensor** continuously measures proximity/distance and outputs analogue readings.
2. This data is passed through an **Analogue-to-Digital Converter (ADC)** to become digital signals.
3. The **microprocessor** receives this digital data and compares it to a pre-set threshold value (e.g., safe distance).
4. If the distance is below the threshold, the microprocessor sends a signal to actuators to change direction, slow down, or apply brakes to avoid a crash.
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(c) (i) What is meant by a USB interface? [1]

- Universal Serial Bus; an industry-standard interface used for short-distance digital data communication and power supply connections between computer peripherals.
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(c) (ii) How USB transmits data [2]

- It uses **serial transmission** where data bits are sent sequentially, one bit at a time, along a single wire.
- It uses **asynchronous transmission**, meaning data is accompanied by start and stop bits to synchronize sender and receiver rather than a shared clock signal.

Question 4: Packet Structure & Transmission Diagram [4]

Marks are awarded for accurate structural layout labels matching text requirements:

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- **Packet Contents Structure (2 marks):** Diagram showing a packet split into three distinct zones:
    - **Header:** Containing Sender IP, Receiver IP, Packet Size, and Packet Sequence Number.
    - **Payload:** Containing the actual raw data slice.
    - **Trailer / Footer:** Containing error-checking structures (e.g., Checksum) and an End-of-packet marker.
- **Transmission Scheme (2 marks):** Diagram or notes showing:
    - A continuous data file split up into distinct, numbered individual packets.
    - Packets traveling across a dynamic network mesh via independent, varied routes.
    - Packets arriving at the receiver out of sequence and being reassembled into the original file using their sequence numbers.

Question 5

(a) Two characteristics of secondary storage [2]

- Non-volatile (retains data when power is disconnected).
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- Not directly accessible by the CPU (must be loaded into RAM first).
- Typically offers high capacity storage at lower cost relative to primary storage.

(b) Storage Fill-in-the-Blanks [5]

- "A hard disk has several platters. Each platter is split into tracks and **sectors**."
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- "To read data, the read/write head moves over the platters to the position where data starts. The **electromagnetic field** indicates if the data is a 1 or a 0."
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- "A solid-state drive uses NAND gates or **NOR gates**."
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- "It is made of transistors that work as floating gates and **control** gates."
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- "The gates control the **flow** of electrons to memory cells."
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(c) (i) Meaning of cloud storage [1]

- Storing data off-site on remote servers accessed securely over the Internet, managed and maintained by a third-party service provider.
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(c) (ii) Advantages of cloud storage over local computer storage [2]

- Access files from any geographical location using any internet-connected device.
- Easy file sharing and collaborative editing features with other users.
- Scalable storage capacity on-demand without purchasing new physical hardware units.
- Automatic backup and disaster recovery handled by the provider.

(c) (iii) Advantages of local computer storage over cloud storage [2]

- Data access does not require an active internet connection.
- Zero recurring subscription/bandwidth fees to host or download files.
- Faster read/write access speeds when handling large files directly over physical internal system buses.
- Enhanced privacy/security control since files are not exposed to third-party servers.

Question 6

(a) Denary 150 to 8-bit Binary [1]

- **Answer: 10010110**
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- *Check:* 128+16+4+2=150

(b) Hexadecimal F08 to 12-bit Binary [1]

- Convert each hex character to a 4-bit nibble (F=1111, 0=0000, 8=1000).
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- **Answer: 111100001000**

(c) Logical Shift Left of 2 Places on 00110101 [1]

- Move all bits left by two positions, discarding the leftmost bits and padding the right with zeros.
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- **Answer: 11010100**

(d) Two's Complement Binary 01110101 to Denary [1]

- MSB is 0, so it is a positive value. Sum values: 64+32+16+4+1.
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- **Answer: 117**

(e) Binary Addition [3]

```
 1111          (Carries)
  00011010(26)
+01101110(110)
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  10001000(136)
```

- **MarkingCriteria:** 1 mark for correct column addition alignment, 1 mark for showing logic carriescorrectly, 1 mark for precise final binary value: **10001000**.
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Question 7

(a) Transmission Method: Serial or Parallel for Printer [2]

- **Method: Serial**
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- **Justification:** Data is sent over a single wire, eliminating **bit skewing** issues over distance. It is cheaper to manufacture cabling and experiences less electromagnetic interference compared to parallel wiring paths.

(b) Duplex Mode: Simplex, Half-Duplex, or Full-Duplex [2]

- **Method: Half-Duplex** or **Full-Duplex**
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- **Justification:** Data must travel in both directions; the computer sends raw print payloads down, while the printer returns feedback status updates and service interrupts back up.
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  - *(Note: Simplex is incorrect as it restricts data flow to one direction only).*

(c) (i) Data transmission error causes [1]

- Electromagnetic interference (EMI) / Power surges along copper lines / Attenuation / Network cross-talk.
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(c) (ii) How ARQ works with Negative Acknowledgement (NAK) [3]

1. The sender transmits a data block and starts a timeout clock.
2. The receiving device runs an error check (e.g., Checksum). If an error is caught, the receiver automatically sends a **Negative Acknowledgement (NAK)** packet back to the sender.

3. Upon receiving the NAK (or if the internal timeout clock runs out before any confirmation arrives), the sender automatically retransmits that exact same data block. This cycle repeats until the block passes cleanly.

Question 8

(a) System Software vs Application Software [2]

- **System Software:** Controls, manages, and maintains the computer hardware architecture and operational infrastructure (e.g., OS, utility programs).
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- **Application Software:** End-user programs designed to execute specific productive tasks or solve concrete problems independent of platform controls (e.g., word processors, web browsers, games).
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(b) Managing Peripherals Function [2]

- Communicates directly with external hardware items using software files called **device drivers**.
- Allocates data streams, input priorities, and output signals cleanly to external components without conflict.
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(c) Software Security Solutions Table [2]

Security Solution PDF	Explanation PDF
Firewall	Monitors incoming and outgoing network traffic based on configurable security rules to block unauthorized external access.
Anti-malware / Anti-virus	Scans system files and memory against known signature databases to quarantine or delete worms, trojans, and viruses.

(d) Define Firmware and Operating System [2]

- **Firmware:** Flash memory software embedded directly into hardware chips (typically ROM) containing permanent, low-level execution instructions necessary for basic device initialization.
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- **Operating System:** Core platform system software that orchestrates hardware assets, executes user programs, manages files, and provides the user interface.
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Question 9

(a) How check digits evaluate barcode scan accuracy [3]

1. A calculation algorithm is run locally on the initial digits of the scanned barcode during data entry.
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2. The numerical result generated by this calculation is compared directly to the barcode's final trailing digit (the **check digit**).
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3. If the numbers match, the entry is accepted as error-free; if they do not match, the scanner flags a read error, prompting a retry.
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(b) (i) High-Level Language [2]

- A programmer-friendly development language written using English-like syntax and abstract logic. It is portable across different CPU architectures and requires translation into machine code before execution.
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(b) (ii) Benefits of a compiler during program development [3]

- Translates the entire source code program into a single, optimized **executable machine code file (.exe)** that runs standalone without needing the original development tools.
- Protects the programmer's intellectual property, as the final distributed machine code file is difficult for end-users to reverse-engineer.
- Compiled code executes faster than interpreted code because translation is completed fully beforehand.
- Generates a comprehensive summary report highlighting all syntax errors found across the entire code file at the end of compilation.
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