

Comprehensive Question Bank & Model Solutions (120 Questions with Technical Rationale)

Subject: Programming and Artificial Intelligence — Grade 11 (First Term)

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Curriculum Reference: Official Ministry of Education Curriculum (Experimental & Language Schools Edition)

Introduction & Test Specifications

This standardized Question Bank is engineered as a definitive pedagogical assessment reference designed for **Distinguished Teachers** in crafting formative and summative assessments, and for **Honors Students** seeking mastery over official exam traps, critical engineering paradigms, and rigorous problem-solving.

Question Distribution Matrix (120 Questions):

Curriculum Unit	Multiple Choice (MCQ)	True / False with Correction	Scientific Terms	Applied Problems & Scenarios	Total Questions
Unit 1: Information Technology and Society	12	6	6	6	30 Questions
Unit 2: Cybersecurity	12	6	6	6	30 Questions
Unit 3: Web Applications	12	6	6	6	30 Questions
Unit 4: Web and Media Design	12	6	6	6	30 Questions
Total Cumulative Volume	48 Questions	24 Questions	24 Questions	24 Questions	120 Questions

Architectural Note:

- Document Architecture:** This volume is organized into two distinct sections:
- Section I: Questions Booklet (1 - 120):** Grouped by curriculum unit, enabling self-paced practice and mock testing without revealing answers.
 - Section II: Comprehensive Model Answer Key & Engineering Rationale (1 - 120):** Providing complete solutions, step-by-step calculations, comparative rubrics, and in-depth scientific rationales.



Section I: Questions Booklet (1 - 120)



Unit 1: Information Technology and Society (Questions 1 - 30)

Part I: Multiple Choice Questions (MCQ) — (12 Questions)

- Classical Moore's Law in semiconductor manufacturing states that the number of transistors on a silicon microchip doubles approximately every:**
 - 6 months
 - 2 years (18 to 24 months)
 - 5 years
 - 10 years
- The quantum mechanical phenomenon where electrons exhibit wave-particle duality and penetrate the insulating gate barrier of a closed transistor below 3 nm is called:**
 - Quantum Entanglement
 - Quantum Tunneling
 - Quantum Superposition
 - Photoelectric Conduction
- Undesired parasitic electrical currents that continuously bleed through a transistor's gate even when it is in an "OFF" state, causing static power waste and heat, are termed:**
 - Leakage Currents
 - Alternating Currents (AC)
 - Eddy Currents
 - Induction Currents
- To overcome the physical limitation known as the "Thermal Wall" and frequency stagnation, major chipmakers shifted processor design towards:**
 - Shrinking chip surface area and using vacuum tubes
 - Multi-core Processors and parallel computing architectures
 - Increasing operating voltage to maximum limits
 - Replacing silicon chips with mechanical magnetic relays
- The fundamental unit of information processing and storage in quantum computing, capable of representing both 0 and 1 simultaneously, is the:**

- (A) Bit
- (B) Byte
- (C) Qubit
- (D) FLOPS

6. If a quantum computer possesses a register of 4 qubits in full superposition, how many states can it represent and evaluate simultaneously in a single instant?

- (A) 4 states
- (B) 8 states
- (C) 16 states
- (D) 32 states

7. The paradigm of Machine Learning that relies on training models using pre-labeled datasets containing explicit feature-target pairs is:

- (A) Unsupervised Learning
- (B) Supervised Learning
- (C) Reinforcement Learning
- (D) Heuristic Search

8. The phenomenon wherein a Large Language Model (LLM) fabricates incorrect or non-existent facts and presents them with high confidence is known as:

- (A) Algorithmic Bias
- (B) Model Overfitting
- (C) AI Hallucination
- (D) Gradient Vanishing

9. The industrial maintenance strategy that uses IoT vibration and thermal sensor streams combined with AI anomaly detection to forecast failures before they happen is:

- (A) Reactive / Breakdown Maintenance
- (B) Scheduled Preventive Maintenance
- (C) Predictive Maintenance (PdM)
- (D) Manual Visual Inspection

10. The ethical and regulatory design principle requiring a qualified human expert to review and authorize critical algorithmic decisions (e.g., in healthcare and defense) is:

- (A) Unrestricted Full Automation
- (B) Human-in-the-Loop (HITL)
- (C) Open-Source Architecture
- (D) Algorithmic Delegation

11. **Deep neural networks are frequently referred to as "Black Box" models primarily because:**
- (A) User interfaces are rendered with dark mode backgrounds
 - (B) Billions of non-linear weights make internal decision logic opaque and difficult to trace
 - (C) Database storage files are encrypted and inaccessible
 - (D) Server rooms operate without physical lighting
12. **The computer science subfield dedicated to developing tools, saliency maps, and methods to make AI reasoning transparent, auditable, and interpretable to humans is:**
- (A) Natural Language Processing (NLP)
 - (B) Explainable AI (XAI)
 - (C) Generative Adversarial Networks (GAN)
 - (D) Distributed Cloud Computing

Part II: True or False with Justification / Correction (6 Questions)

13. () **Quantum computing is a universal replacement that will completely obsolete classical microprocessors in smartphones and personal laptops.**
14. () **When shrinking transistors below 3 nanometers, quantum tunneling ceases to exist, making processors significantly cooler and more stable.**
15. () **In Unsupervised Learning, algorithms discover hidden structural patterns and clusters within unlabeled data without explicit ground-truth guidance.**
16. () **Predictive Maintenance strictly replaces machinery components at pre-determined fixed calendar intervals regardless of actual mechanical health.**
17. () **Artificial Intelligence algorithms are intrinsically objective and immune to reflecting societal or historical demographic biases.**
18. () **The simultaneous state representation capacity of quantum registers scales exponentially (2^n), whereas classical registers scale linearly.**

Part III: Scientific & Technical Terminology (6 Terms)

19. [.....] : The historical observation that the density of transistors on integrated circuits doubles roughly every two years with decreasing manufacturing costs.
20. [.....] : A quantum phenomenon where subatomic particles penetrate through an impassable classical physical energy barrier.
21. [.....] : The generation of statistically plausible but factually incorrect or nonsensical outputs by generative AI language models.

22. [.....] : An advanced maintenance paradigm leveraging live IoT sensor telemetries and AI machine learning to predict mechanical degradation.
23. [.....] : A system architecture ensuring that human judgment remains the ultimate authoritative gatekeeper for high-consequence AI outcomes.
24. [.....] : A suite of technical frameworks and feature-attribution methods designed to demystify and interpret opaque deep learning decisions.

Part IV: Applied Problems, Calculations & Case Studies (6 Questions)

25. **Engineering Rationale:** Explain why classical Moore's Law encountered a physical breakdown around 2016, and why chip manufacturers pivoted away from raw clock speed scaling (GHz) toward multi-core parallelism.
26. **Structured Comparison:** Create a comprehensive comparative table between **Supervised Learning** and **Unsupervised Learning** covering: (Dataset Nature, Primary Objective, and Real-World Industry Application).
27. **Mathematical Calculation:** Consider a classical computer register containing 6 bits, compared to a quantum register containing 6 qubits in a state of coherent superposition:
- How many distinct states can the classical register evaluate **at any single instant**?
 - How many distinct states can the quantum register evaluate **simultaneously at that exact instant**?
28. **Industrial IoT Scenario:** A high-speed bottling facility relies on preventive maintenance by replacing conveyor drive motors every 90 days at immense expense. Despite this, an unexpected rotor bearing seizure halted production, causing severe financial losses.
- Propose an AI-driven Predictive Maintenance (PdM) architecture utilizing IoT sensors.
 - Explain how this solution optimizes operational expenditure (OpEx) while preventing downtime.
29. **Ethical AI Analysis:** A multinational corporation deployed an automated deep-learning resume screener for software engineering candidates. An internal audit revealed systemic bias against female applicants.
- Identify the root technical and data-engineering cause of this bias.
 - Propose two algorithmic and data remediation strategies to enforce fairness.
30. **High-Stakes Case Study:** An autonomous vehicle navigation system relies 100% on an end-to-end "Black Box" deep neural network without Explainable AI (XAI) instrumentation or driver override capabilities. Discuss the legal liability, safety risks, and catastrophic failure modes of this architecture.

Unit 2: Cybersecurity (Questions 31 - 60)

Part I: Multiple Choice Questions (MCQ) — (12 Questions)

31. **The cryptographic technology that uses a single, identical shared secret key for both data encryption and decryption is:**