Explanation of QE Assessment Criteria

[Note: Only selected items that may be potentially confusing (shown in blue text) are explained — Assoc. Prof. Dr. Wattana Watanapa, March 2025.]

[Translated by ChatGPT; corrected and verified by Dr. Thaksaon Kittipassorn, April 2026.]

1. Up-to-date scientific knowledge

Factual knowledge refers to knowledge that is widely accepted within the field as established and validated, such as most content found in textbooks. This primarily relies on memory.

Understanding scientific / physiological principles refers to demonstrating understanding of scientific or physiological principles. While the principles themselves are factual knowledge, this sub-criterion assesses true understanding—i.e., the ability to apply principles to reason through answers or provide explanations, showing genuine comprehension rather than mere memorization.

Holistic / systems perspective refers to the ability to consider the impact of a change on the system as a whole. Emphasis is placed on relationships and interactions among components rather than isolated properties. It includes understanding how a change in one component may affect other components and the overall behavior of the system.

2. Critical thinking skills refers to the ability to analyze, evaluate, and interpret data in order to reach unbiased conclusions. It involves neither immediately accepting nor rejecting information, but instead assessing whether it is likely to be true based on available evidence and reasoning. It also includes seeking additional supporting or conflicting evidence from the data or other reliable sources.

Logical reasoning without bias refers to providing explanations that are logically sound, free from logical fallacies (further information is available on various websites), and unbiased. For example, stating that standing up decreases venous return, which reduces stroke volume and cardiac output, and therefore increases heart rate, is not logically correct. Although these physiological changes occur, the increase in heart rate is mediated by reflex mechanisms, not directly caused by decreased stroke volume. Thus, even if key facts are correct, incorrect causal reasoning should not be awarded marks in written exams. Bias may occur when students consider only a single possibility without ruling out alternatives, or when they selectively interpret evidence to support their own hypothesis (even if the reasoning is logically sound) while ignoring conflicting evidence or alternative explanations.

Clarity of thinking (clear thinking) refers to clarity and precision in thought. For example, being able to distinguish that certain things which appear similar are not the same, or that some things

which are different may share certain characteristics yet remain distinct. It involves avoiding overgeneralization—i.e., not treating superficially similar concepts as interchangeable. For instance, using effectiveness and efficiency interchangeably without clearly understanding their meanings, or failing to distinguish between the Valsalva maneuver and breath-holding, and assuming they are the same. It also includes the ability to explain ideas clearly without confusion and to ask precise questions when something is not understood.

Depth of thinking (deep thinking) refers to thoughtful, reflective thinking that connects with prior knowledge and considers that data may be more complex than it appears at first glance. It involves considering multiple relevant factors and is expressed through explanations or by posing questions about aspects not immediately apparent in the data, including deep and thought-provoking questions. [This should be distinguished from overthinking, which involves repetitive or anxious thinking. Deep thinking leads to insight.]

Differentiating facts vs. possibilities vs. opinions refers to the ability to distinguish factual information from possibilities or personal opinions.

Systematic thinking refers to structured, stepwise thinking that ensures comprehensive and balanced consideration of all relevant factors. It involves using a framework to guide reasoning, which is particularly useful in problem-solving, identifying missing elements, and generating multiple hypotheses. Systematic thinking should precede "thinking outside the box." Only after systematically considering all components/factors should alternative or creative approaches be explored. This leads to more efficient, complete, and genuinely creative problem-solving (not perceiving it as something new when, in fact, it is already well established). A common mistake is responding based on the first idea that comes to mind or guessing randomly without structure—this reflects a lack of systematic thinking.

Note: Three related terms that may be confused but have distinct meanings:

- Systematic thinking: structured, comprehensive, stepwise thinking
- Systems thinking: considering the effects on the system as a whole or on other components within the same system; adopting a holistic perspective rather than viewing individual components in isolation.
- Systemic (adj.): affecting the entire system (opposite of local)

3. Scientific thinking skills

Rationale of the research; relevance

Identifying research questions; asking questions

Making educated predictions refers to the ability to predict outcomes or answer questions based on available data, principles, and current knowledge. The prediction may ultimately be correct or incorrect, but it must be logically reasoned, grounded in valid principles, and plausible.

Designing experiments / testing ideas

Principle of a method

Rationale for choosing a method

4. **Data interpretation skills**

Correct data interpretation

Drawing conclusions correctly