

1.5 Evaluate a scientific contribution with measured benefits and decision limits

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS risk 风险 • evidence 证据 • uncertainty 不确定度

Objective

Evaluate a scientific contribution with measured benefits and decision limits. This is original GAC013-aligned practice, not an official assessment. All supplied case data and review records are fictional; explicitly cited historical context is factual. The case data are invented for learning; they are not findings about a real school, country or population. Use the supplied evidence and do not invent missing observations.

1 Key knowledge and worked examples

■ Key knowledge: a measured benefit informs a choice without deciding every value or risk

Scientific **evidence** 证据 can inform a decision about technology by estimating effects under stated conditions. A **risk** 风险 concerns the chance and seriousness of harm; “possible” and “frequent” are different claims. **Uncertainty** 不确定度 describes limits on a value or estimate, not a licence to invent a confidence range. Costs, accessibility, reliability and acceptable trade-offs also matter. A power comparison alone does not decide whether a real installation is suitable.

■ Source A: text or task brief

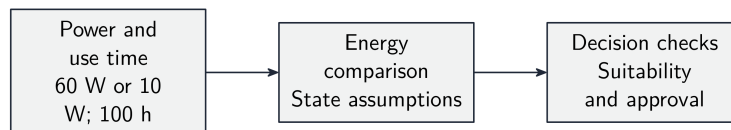
Fictional classroom task: the school compares an existing 60 W lamp with a proposed 10 W lamp for a space needing suitable lighting. For this numerical estimate only, assume each lamp uses its stated constant power for 5 hours daily across 20 days. Use energy $E = P \times t$, with power in kW and time in hours for kWh. These are supplied classroom assumptions, not measured yearly usage.

No measurements of brightness, flicker, lifetime or installation suitability are provided. The new lamp’s purchase cost and any tariff are absent. The school has not approved a replacement. Actual electrical installation must be handled through the school’s authorised personnel, not by students.

■ Source B: response or review record

A poster says: “The new lamp uses no energy and saves exactly 100 RMB every month. Lower power proves it is equally bright and has no risks. Every room should be changed tomorrow without permission. Because some uncertainty remains, science has nothing useful to contribute.” The facilities team proposes checking lighting requirements, purchase and installation costs, compatibility and an approved comparison before deciding.

■ Worked example: calculate an assumption-based energy estimate



Known: power 60 W and usage $5 \times 20 = 100$ hours. Why convert power to kW? The requested energy unit is kWh.

$$E = Pt$$

$$E_{old} = (60/1000) \text{ kW} \times 100 \text{ h} = 6.0 \text{ kWh}$$

This is a calculation under stated assumptions, not a direct measurement of future use. It cannot give a monetary saving without a tariff.

2 Practice

2.1 State the energy equation and convert 10 W to kW. [2]

2.2 Calculate the assumed total operating time. [2]

2.3 Calculate the new lamp's energy use and the reduction from the old lamp. [3]

2.4 Identify THREE missing checks needed before claiming equal suitability or a financial saving. [3]

3 Exam-style questions

3.1 Evaluate the poster with six distinct corrections or limits. [6]

[8]

Solutions

2.1

: $E = P \times t$: $10 \text{ W} = 0.010 \text{ kW}$.

2.2

: total time equals daily hours times days.: $t = 5 \times 20 = 100 \text{ h}$.

2.3

: $E = Pt$: $E_{\text{new}} = 0.010 \times 100 = 1.0 \text{ kWh}$: reduction = $E_{\text{old}} - E_{\text{new}} = 6.0 - 1.0 = 5.0 \text{ kWh}$ under the supplied assumptions.

2.4

each: required brightness/lighting performance; installation compatibility or authorised safety review; tariff; purchase/installation cost; lifetime or reliability. Credit distinct relevant checks, with at least one suitability check and one financial input.

3.1

each: new lamp still uses estimated 1.0 kWh; no tariff supports the claimed RMB saving; power alone does not prove equal brightness; no-risk claim is unsupported; replacement needs school approval and authorised personnel; remaining uncertainty does not erase the bounded evidence of lower estimated energy use.

3.2

Local analytic rubric, 8 ×: state supplied time; give old energy; give new energy; give bounded reduction; reject monetary amount without tariff; require lighting/suitability checks; require cost checks; preserve approval and authorised installation; coherent truthful 80–110 word response. Example: “Using the classroom assumptions, both lamps operate for one hundred hours. The existing lamp uses an estimated 6.0 kilowatt-hours and the proposed lamp 1.0 kilowatt-hour, a reduction of 5.0 kilowatt-hours. This supports a bounded energy comparison, not a claim of zero use or a guaranteed monetary saving. A tariff and purchase and installation costs are needed for the financial assessment. The school should also check required brightness, compatibility and reliability before deciding whether the replacement is suitable. Any installation requires approval and authorised personnel. Uncertainty limits the conclusion but does not erase the useful estimate.”