4.1 The design project

Name: _____ Class: _____ Date: _____ **Total: 30 marks**

KEY WORDS design project • primary research • secondary research • success criterion • weighted decision matrix • Gantt chart • risk assessment

Objective

Build the skills to plan, carry out and evaluate a **design project**: choosing and researching a problem, the design brief, measurable **success criteria**, generating and choosing ideas with a weighted decision matrix, developing with models, planning and working safely, testing against the specification and evaluating honestly.

You must be able to:

- choose a manageable, testable problem with real users
- plan primary and secondary research, and analyse existing products
- write a design brief and success criteria with a test method for each
- generate ideas and choose one with a weighted decision matrix
- develop the idea with models, changing one variable at a time
- plan with a Gantt chart and a risk assessment
- test against every criterion and evaluate with evidence-based improvements

1 Key knowledge and worked examples

■ Problem and research

A good problem has **real users**, a clear **context**, is **manageable** with your time and tools, can be **tested**, and is **safe** in school.

- **Primary research**: data you collect: observation, questionnaires, interviews, measurements, testing existing products.
- **Secondary research**: data others collected: books, websites, standards, anthropometric tables.
- **Product analysis** (e.g. ACCESS FM: aesthetics, cost, customer, environment, safety, size, function, materials): say what each product teaches you, not only what it looks like.

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Brief, specification and success criteria

The **design brief** states the problem, the users, the context and what the solution must achieve. Each **success criterion** is measurable, comes from research and has a **test method** decided before anything is made. A useful criterion **can fail**: "users like it" cannot fail; "at least 8 of 10 users rate it 4 or 5 out of 5" can.

requirement	measurable criterion	test
strength	holds 200 N for 1 minute without permanent bending	hang weights, measure bend before and after
ease of use	fitted without tools in under 30 s	time 10 users

Ideas and development

- Generate many ideas first (sketches with notes, brainstorming, SCAMPER, morphological chart, biomimicry).
- **Weighted decision matrix** : score each idea against criteria; multiply by each criterion's weight; add up.
- Develop with models of rising fidelity; say what each model tests and what it leaves out. Change **one variable at a time** and record each change and result in a development log.

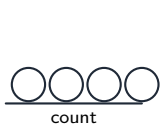
Making, testing and evaluating

- **Gantt chart** : tasks as bars against time, showing overlaps and deadlines. A **risk assessment** lists each hazard, who could be harmed, how likely and serious it is, and the control measures.
- Test the final prototype against **every** criterion; add user trials in the real place.
- **Evaluate** honestly: met, partly met or not met, with the evidence; limitations of the tests; improvements each linked to evidence.

Worked example. Weights: strength 3, fitting 2, cost 2, appearance 1; scores out of 5. Clamp hook: $5 \times 3 + 3 \times 2 + 4 \times 2 + 3 \times 1 = 32$ out of 40. Adhesive hook: $2 \times 3 + 5 \times 2 + 5 \times 2 + 3 \times 1 = 29$. The clamp hook wins because strength carries the most weight.

2 Practice

2.1 Distinguish between **primary** and **secondary** research, with an example of each for a project on bicycle storage at a school. [2]





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2.2 A student's specification says: "The hook must be strong." Rewrite this as a measurable success criterion and state a test method. [3]



2.3 Two ideas for a phone stand are scored from 1 to 5.

Calculate the weighted total for each idea and state which should be chosen. [3]

idea	stability (×3)	cost (×2)	looks (×1)
X	4	3	5
Y	3	5	2

2.4 Explain why a success criterion must be able to **fail**. [2]

pass fail

2.5 Outline how a **Gantt chart** helps a student plan a design project. [2]



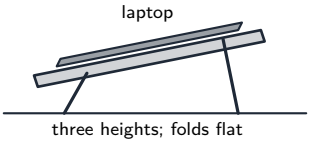
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3 Exam-style questions

3.1 Ana designed a folding laptop stand for students. Her success criteria and test results are shown.

success criterion	result	met?
holds 50 N for 1 minute with no lasting bend	held; 2 mm bend, fully recovered	yes
three heights from 80 to 150 mm	80, 115 and 150 mm	yes
folds flat to 25 mm or less	32 mm	no
mass under 600 g	540 g	yes
costs under ¥40 to make	¥36 (materials only)	partly verified
at least 8 of 10 users rate comfort 4 or 5 out of 5	6 of 10	no

(a) Identify **two** criteria that were **not** met. [2]



(b) The cost criterion is marked "partly verified". Explain why. [2]

(c) Explain **one** limitation of Ana's comfort test. [3]

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(d) Suggest **two** improvements to the stand, each linked to the evidence. [4]

(e) Evaluate how successful the stand is against its specification. [7]

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Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

primary: data you collect yourself, e.g. counting bikes at the gate / interviewing cyclists; secondary: data others collected, e.g. a bike-rack standard or a website on bike sizes

2.2

a load with a number and unit, e.g. holds 150 N; a condition, e.g. for 1 minute without breaking or permanent bending; test: hang weights, measure the bend before and after

2.3

X: $4 \times 3 + 3 \times 2 + 5 \times 1 = 23$; Y: $3 \times 3 + 5 \times 2 + 2 \times 1 = 21$; choose X, the higher weighted total

2.4

a criterion that cannot fail does not test anything / gives no evidence; a measurable criterion shows whether the product works and what to improve

2.5

shows each task as a bar against time, so the order, overlaps and deadlines are clear; the student can see early if they are falling behind and change the plan

3.1

(a) folds flat to 25 mm or less (32 mm); comfort, 8 of 10 users (only 6 of 10)

(b) the ¥36 covers materials only; labour, energy and finishing were not counted, so the full cost may be over ¥40

(c) only 10 users, so the result may not represent all students; a short test, so it does not show comfort over a long study session; users may be friends who rate it kindly, or tested in one setting

(d) any two, linked to evidence: thinner legs or a hinge that folds the legs inside the top, because it folded to 32 mm, not 25 mm; a slightly angled top or a lip to stop the laptop sliding, because only 6 of 10 users were comfortable; cost every part including labour to check the ¥40 target

(e) award up to [7]: strength met: held 50 N with full recovery; the three heights 80 to 150 mm met; mass met at 540 g, so it is easy to carry; but it did not fold flat enough to fit in a bag, which is a key need for students; comfort below target (6 of 10), so the main user need is only partly met; cost not fully verified; judgement: partly successful: strong and adjustable, but needs redesign of the folding and the top, then retesting with more users

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