

ISE 307 — In-Class Activity 06 (Group Assignment)

The Critical-Mineral Development Fund

Team members (name, initials):

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|----------|----------|
| 1. _____ | 4. _____ |
| 2. _____ | 5. _____ |
| 3. _____ | 6. _____ |

Problem. The Kingdom has created a **1,000,000,000 SAR (1 billion SAR) fund** to build out its **critical-mineral supply chain** (copper, lithium, phosphate, and rare earths) for Vision 2030 and sustainable energy transition and resilience efforts. Three strategies are proposed to spend the fund. Your group is hired as subject matter experts to assess which strategy is the most valuable at $i = 8\%$ compounded annually. *Divide the tasks among your members.*

Group Decision (After the three strategies are valued)— Which strategy would you recommend, and why? (40 pts)

1. Compare the three strategies' present worth values (P). Which is largest? Are any close enough that the decision should not rest on the number alone?

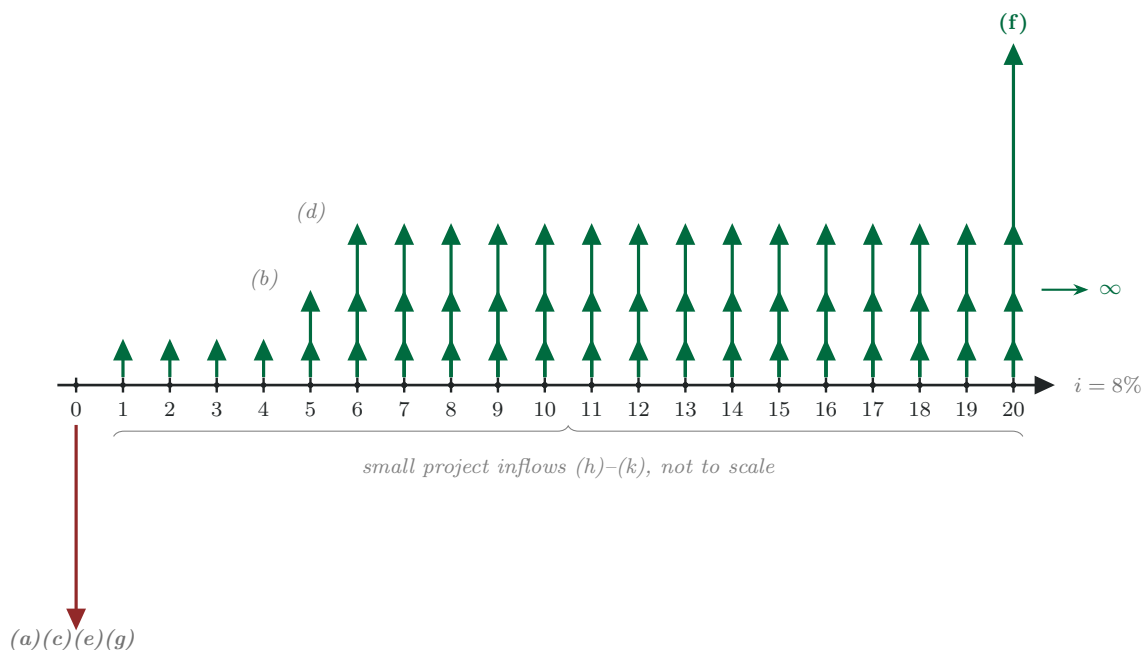
2. For the chosen strategy, calculate the equivalent annual worth (A) of each strategy to perpetuity. What does this tell you about the strategy's value?

3. **Recommendation.** Money is not everything. Beyond P , which strategy best serves a **secure, self-reliant** critical-mineral supply chain? State your team's choice and give your reasoning.

Strategy 1: Human-Centered Capacity Building (Research, Human Capital, and Public Awareness) (20 pts)

Initials: _____

- (a) Spend **350 million SAR** at **year 0** on research labs and top faculty/students at the top 10 Saudi universities.
- (b) *Effect of (a)*: extraction cost drops **50 million SAR per year from year 5 onward, forever** (a **perpetuity** of savings beginning at year 5).
- (c) Spend **250 million SAR** at **year 0** on a public green-energy awareness program.
- (d) *Effect of (c)*: processed-mineral demand rises, adding **+70 million SAR per year at years 6–20** (deferred annuity).
- (e) Spend **300 million SAR** at **year 0** on a strategic stockpile of refined lithium and phosphate.
- (f) *Effect of (e)*: the stockpile is sold once for **+1500 million SAR at year 20**.
- (g) **Project allocations, –1.9M total at year 0**: Coffee Shop 500k, Padel Club 500k, Kids Club 300k, Campus Delivery Robot 600k.
- (h) **Coffee Shop**: net cafe surplus **45k SAR/yr forever** (from year 1); and ideas traded between leaders, firms, and students over coffee turn into process tweaks and licensing leads worth **25k SAR/yr forever** (from year 2). Two perpetuities.
- (i) **Padel Club**: cuts turnover (**95k SAR/yr**) and lowers sick-leave/HR cost (**30k SAR/yr**), both for years 1–10.
- (j) **Kids Club**: faculty childcare. Deposit the **40k SAR/yr** retention saving into a reserve for 15 years; find the year-15 balance with (F/A) , grow it to year 20 with (F/P) , then bring home with (P/F) .
- (k) **Campus Delivery Robot**: sample-runner between labs saves **95k SAR/yr at years 2–9** (deferred).



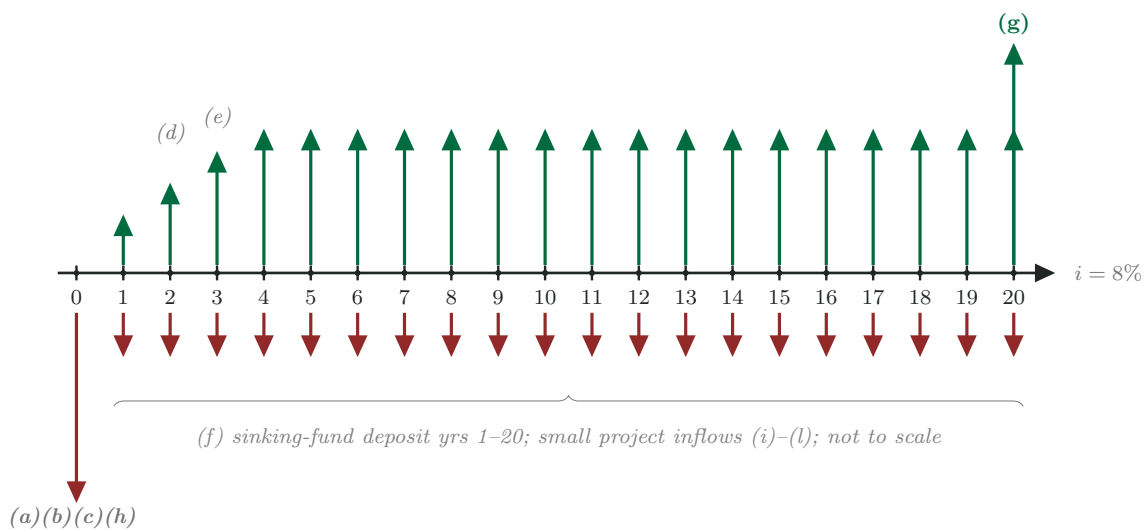
Task: Break down the strategy into its components and value each component today. Calculate what is the total present worth of the strategy today!

Initials: _____

Strategy 2: Earth Stewardship (Focusing on Saudi's Own Exploration & Processing Companies) (20 pts)

Initials: _____

- (a) Spend **600 million SAR** at year 0 to build two state-owned exploration and processing companies.
- (b) Spend **250 million SAR** at year 0 as working capital to ramp operations.
- (c) Spend **148.1 million SAR** at year 0 on a haul-truck fleet and logistics.
- (d) *Ramp revenue (uneven)*: **+40 million SAR at year 1, +75 million SAR at year 2, +110 million SAR at year 3** as output climbs — value as a sum of single (P/F) 's.
- (e) *Steady revenue*: net profit **+120 million SAR per year at years 4–20** (deferred annuity).
- (f) **Sinking fund**: the main refinery must be replaced at year 20 for **500 million SAR**. Size the equal annual deposit with $(A/F, 8\%, 20)$; this deposit is a **cost** every year 1–20.
- (g) *End of horizon*: plants, trucks, and equipment salvage for **+400 million SAR at year 20**.
- (h) **Project allocations, –1.95M total at year 0**: Smart Vehicle Fleet 800k, Intelligent Warehouse Robots 700k, Smart Vertical Parking 450k.
- (i) **Smart Vehicle Fleet**: telematics. Report the annual ownership cost with $(A/P, 8\%, 6)$ on 800k; weigh it against the **140k SAR/yr** of accidents and idle fuel it prevents (years 1–6).
- (j) **Intelligent Warehouse Robots**: deposit a **50k SAR/yr** maintenance reserve for 10 years; find the year-10 balance with (F/A) , then bring home with (P/F) .
- (k) *Also*: the robot cell saves **120k SAR/yr at years 3–12** (deferred), and fewer pick errors add value too.
- (l) **Smart Vertical Parking**: the stacked design frees plant land and speeds throughput, saving **70k SAR/yr at years 1–10**.



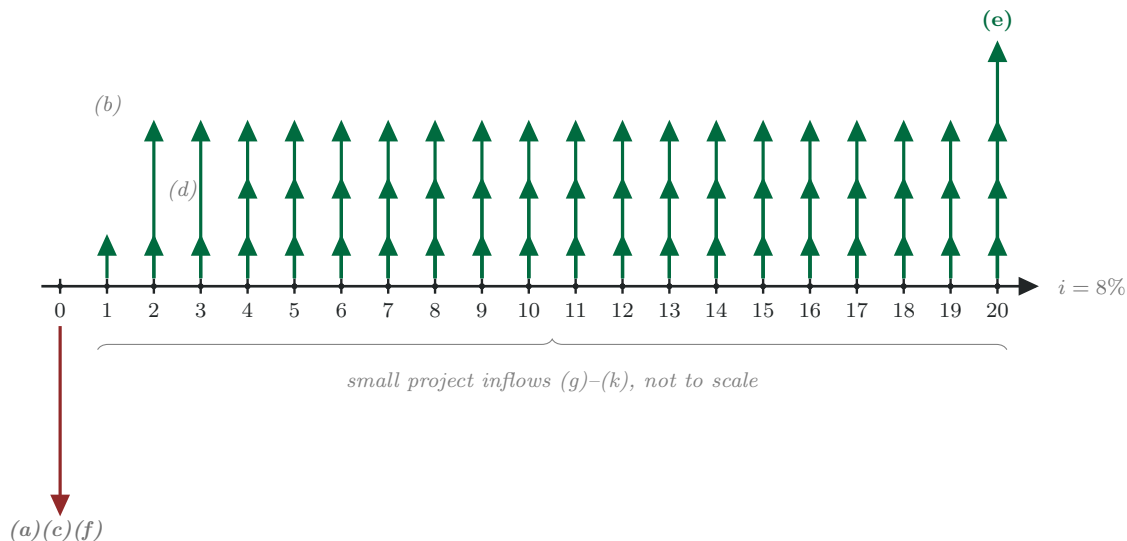
Task: Break down the strategy into its components and value each component today. Calculate what is the total present worth of the strategy today!

Initials: _____

Strategy 3: Global Partnerships with Local Leaders (Overseas Offtake Equity + Domestic Recycling JV) (20 pts)

Initials: _____

- (a) Spend **500 million SAR** at year 0 for an equity stake in an overseas lithium mine with long-term offtake rights.
- (b) *Return on (a)*: dividends **+80 million SAR per year at years 2–20** (deferred annuity).
- (c) Spend **496.5 million SAR** at year 0 on a domestic battery-recycling JV.
- (d) *Return on (c)*: net revenue **+60 million SAR per year at years 4–20** (deferred annuity).
- (e) *End of horizon*: sell the JV stake for **+650 million SAR at year 20**.
- (f) **Project allocations, –3.05M total at year 0**: EV Charging 900k, Coffee Subscription 400k, Jewelry Store 250k, Red Sea Hotel 1,000k, plus a 500k EV seed grant.
- (g) **EV Charging Stations**: the depot pays **140k/yr for 12 years**; off-peak charging earns a grid credit of **30k/yr for 12 years**.
- (h) **Coffee Subscription & Delivery**: a perpetual logistics credit of **36k/yr forever** (from year 1).
- (i) **Premium Jewelry Store**: an assay-grade recycled-gold showcase pays **50k/yr at years 1–7**.
- (j) **Premium Red Sea Hotel**: a green-stay showcase wing pays **130k/yr at years 2–20** (deferred).
- (k) **EV seed grant**: 500k placed at year 0 grows at 8% to its year-20 value with (F/P) (a forward single).



Task: Break down the strategy into its components and value each component today. Calculate what is the total present worth of the strategy today!

Initials: _____