A roof and its energy budget

Climate and energy | constructed energy budget

Name _____ Date _____

At equal incoming sunlight of 800 W/m², Roof A reflects 200 W/m² and Roof B reflects 480 W/m². Treat all unreflected sunlight as absorbed in this simplified comparison. Actual urban temperatures also depend on heat transfer, storage and surrounding surfaces.

1. Calculate reflected fractions and absorbed solar energy per square meter.

2. Explain a mechanism by which the roof choice could affect local heating.

3. Explain a limitation on using this model to predict a city-wide temperature change.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

The afternoon shore breeze

Weather and circulation | constructed temperature transect

Name _____ Date _____

On a sunny afternoon, a shoreline station records land surface at 32°C and adjacent water at 20°C. The initial air over the warmer surface heats, becomes less dense relative to surrounding air, and rises. Use the same initial air pressure at the start of the model.

1. Draw a circulation model with surface and upper-level arrows.

2. Explain how unequal heating contributes to the modeled surface flow.

3. Identify an observation that would challenge the proposed circulation.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A moving plate, a time pattern

Plate tectonics | constructed island-age model

Name _____ Date _____

A simplified chain of volcanic islands lies on a plate moving over a relatively fixed hot spot. Island X is active at position 0 km. Y is 200 km away and 2 million years old. Z is 500 km away and 5 million years old.

1. Estimate the modeled plate speed in centimeters per year.

2. Explain the relationship among distance, age and active volcanism.

3. State an assumption and identify evidence that could weaken the model.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Water through a sediment column

Water and Earth materials | constructed investigation design

Name _____ Date _____

Two sediment columns have equal height and diameter. A contains coarse sand and B fine sediment. Each receives 100 mL of water at the top. After ten minutes, A has released 80 mL and B 30 mL from the bottom. Assume no evaporation and no water remaining above the sediment.

1. Design a repeated comparison to test the effect of grain size.

2. Use the supplied evidence to compare drainage and retained water.

3. Explain a water-material mechanism and name an additional property that should be measured.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

A repeated dimming

Orbital evidence | constructed light-curve data

Name _____ Date _____

A star's relative brightness dips at days 2, 8 and 14, each with similar depth and duration. A simple model attributes each dip to the same orbiting object passing in front of the star from the observer's viewpoint.

1. Infer the modeled orbital period.

2. Explain what the repeat pattern supports and what a single dip could not establish.

3. Identify an alternative explanation or additional observation needed before a stronger conclusion.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.

Recycling under constraints

Resources and decisions | constructed resource comparison

Name _____ Date _____

A town compares two metal-recycling systems over the same project term using constructed estimates. Plan A costs $2 million and recovers 1200 tonnes. Plan B costs $3 million and recovers 1600 tonnes. The budget is $2.5 million. Estimates include total project cost and metal recovered over that term. Ecological effects remain unmeasured.

1. Compare cost per recovered tonne and budget feasibility.

2. Recommend a plan or revision with a limitation.

3. Identify additional resource and environmental evidence required for a robust decision.

Use evidence and show the relationships in your reasoning. Additional paper is permitted.