

## 2023 USGC Nationals Written Examination - Key and Marking Scheme

### Section 1 – Desert Landforms [25 marks]

#### Expected answers:

1. [5 marks] hoodoo - tall, thin spire of rock formed by erosion. Hoodoos typically consist of relatively soft rock topped by harder, less easily eroded stone that protects each column from the elements. Hoodoos typically form in areas where a thick layer of a relatively soft rock, such as mudstone, poorly cemented sandstone, or tuff (consolidated volcanic ash), is covered by a thin layer of hard rock, such as well-cemented sandstone, limestone, or basalt. In glaciated mountainous valleys the soft eroded material may be glacial till with the protective capstones being large boulders in the till. Over time, cracks in the resistant layer allow the much softer rock beneath to be eroded and washed away. Hoodoos form where a small cap of the resistant layer remains, and protects a cone of the underlying softer layer from erosion. [other reasonable answers accepted]
2. [5 marks] mesa - an isolated, flat-topped elevation, ridge or hill, which is bounded from all sides by steep escarpments and stands distinctly above a surrounding plain. Mesas characteristically consist of flat-lying soft sedimentary rocks capped by a more resistant layer or layers of harder rock, e.g. shales overlain by sandstones. Mesas form by weathering and erosion of horizontally layered rocks that have been uplifted by tectonic activity. Variations in the ability of different types of rock to resist weathering and erosion cause the weaker types of rocks to be eroded away, leaving the more resistant types of rocks topographically higher than their surroundings. This process is called differential erosion. [other reasonable answers accepted]
3. [5 marks] butte - isolated hill with steep, often vertical sides and a small, relatively flat top; buttes are smaller landforms than mesas, plateaus, and tablelands. Buttes form by weathering and erosion when hard caprock overlies a layer of less resistant rock that is eventually worn away. The harder rock on top of the butte resists erosion. The caprock provides protection for the less resistant rock below from wind abrasion which leaves it standing isolated. As the top is further eroded by abrasion and weathering, the excess material that falls off adds to the scree or talus slope around the base. On a much smaller scale, the same process forms hoodoos. [other reasonable answers accepted]
4. [1 mark per answer] hoodoo – 3; mesa – 1; butte – 2
5. [2 marks] erosion
6. [2 marks] wadi - a wet (ephemeral) riverbed that contains water only when heavy rain occurs; wadis are located on gently sloping, nearly flat parts of deserts; commonly they begin on the distal portions of alluvial fans and extend to inland sabkhas or dry lakes [other reasonable answers accepted]
7. [3 marks] they have braided stream patterns because of the deficiency of water and the abundance of sediments. Water percolates down into the stream bed, causing an abrupt loss of energy and resulting in vast deposition. Wadis may develop dams of sediment that change the stream patterns in the next flash flood. [other reasonable answers accepted]

### Section 2 - Historical Geography [25 marks]

#### Expected answers:

1. [25 marks] answers may vary but should discuss the decline in population in Rust Belt cities like Detroit and movement to Sun Belt cities like Houston; discussion of demographic changes in New Orleans should mention Hurricane Katrina and changes caused in its aftermath; both Houston and New Orleans have drastically changed since 1960 due to immigration, as has Detroit to a lesser extent. Accept any reasonable answers based on historical, economic, or geographic knowledge. Award partial credit for correct information about each city.

### Section 3 – Hawaiian Landforms [25 marks]

#### Expected answers:

1. [10 marks] Wave action, wind and water erosion have carved once cone shaped volcanoes into the shapes seen in the image; powerful low pressure weather systems in the north pacific generate large high interval swells which bombard the Na Pali coastline shaping majestic cliff lines from the oceans edge. The Hawaiian chain also sits in the center of the strongest trade wind belt in the northern hemisphere producing fairly consistent wind direction and speed throughout the year. As warm, moist trade winds reach land they produce rainfall, which overtime has carved out the volcanic rock [other reasonable answers accepted]
2. [10 marks] A coral ring six miles across encloses a lagoon several meters deep at Kure Atoll; Kure lies close to what is called the Darwin Point, the latitude north of which the rate of natural reef subsidence and destruction surpasses the rate of reef growth. At approximately 30 million years old, it is the oldest in the Hawaiian Island chain. As Kure continues to be slowly carried along to the northwest by the motion of the Pacific Plate, it will move into waters too cool for coral and coralline algae growth to keep up with isostatic subsidence of the mountain [other reasonable answers accepted]
3. [5 marks] Coral bleaching is the process when corals become white due to various stressors, such as changes in temperature, light, or nutrients. Bleaching occurs when coral polyps expel the zooxanthellae (dinoflagellates that are commonly referred to as algae) that live inside their tissue, causing the coral to turn white. Bleached corals continue to live, but they are more vulnerable to disease and starvation. Zooxanthellae provide up to 90 percent of the coral's energy, so corals are deprived of nutrients when zooxanthellae are expelled. Some corals recover if conditions return to normal, and some corals can feed themselves. However, the majority of coral without zooxanthellae starve. [other reasonable answers accepted]

### Section 4 – Development and Population [25 marks]

#### Expected answers:

1. [3 marks] Japan
2. [5 marks] shrink; pyramids show birth rate is far below replacement level and that the population is rapidly ageing [other reasonable answers accepted]
3. [5 marks] 2.1 children; below; lines on the pyramid representing number of children are smaller than those representing people of child-bearing age; pyramids with a smaller base than middle represent a shrinking population [other reasonable answers accepted]
3. [2 marks per reason / explanation] ageing population means a shrinking workforce, higher healthcare costs and other issues associated with a geriatric population; economic productivity will decline over time unless workers are replaced in some way [accept other reasonable answers]
4. [2 marks per policy / explanation] tax incentives or other economic policies to incentivize childbirth; loosening immigration laws to encourage an influx of immigrants; increasing paid family leave for both parents [accept other reasonable answers]