

2021 USGC Nationals Cartographic Exam – Key and Marking Scheme

Section 1 [25 marks]

Please refer to the maps in section 1 of the Resource Booklet.

1. In a well-developed paragraph, briefly discuss the social, political and economic reasons for the 'Great Migrations' of African Americans shown on these maps. Be as specific as possible. [13 marks]
2. In a well-developed paragraph, briefly discuss the causes for the population changes in the 'Sunbelt' states since 1950 as shown on the map. Be as specific as possible. [12 marks]

Grading notes: Both questions are level marked; answers must be in the form of a well-organized paragraph with specific examples to receive full marks

Expected answers:

1. [13 marks] a wide variety of acceptable answers are possible but should include things that would fall into the categories of push and pull factors for migration, including fleeing violence and persecution and the pursuit of economic gain; specific details are necessary, including types of jobs sought and specific destination cities / states in order to receive full marks.
2. [12 marks] a wide variety of acceptable answers are possible, but should include things that would fall into the categories of push and pull factors for migration, including the availability of jobs and cheap land, as well as factors like favorable climates; specific details are necessary for full marks.

Section 2 [25 marks]

Please refer to the map in section 2 of the Resource Booklet. This map shows the decline in kelp populations in various sites in California.

3. In a paragraph, explain the role of kelp in carbon sequestration. Be as specific as possible. [10 marks]
4. Identify and explain two reasons that kelp forests more effective in carbon sequestration than terrestrial forests. [4 marks]
5. Roughly how much more carbon does kelp sequester than an equivalent area of trees? (twice as much, 5 times as much, 10 times as much, 20 times as much) [1 mark]
6. Identify three human threats that would account for the decline in kelp population in California during the period shown. [3 marks]
7. Identify three natural threats that would account for the decline in kelp population in California during the period shown. [3 marks]
8. Identify and explain two ways that local governments, universities or environmental organizations could help to restore the kelp populations in California. [4 marks]

Grading notes: Questions 3, 4, 6 and 7 are level marked, question 5 is point marked.

Expected answers:

3. [10 marks] In addition to leaf-like structures and roots that we are generally familiar with, macroalgae have gas-filled bladders that help them float towards the surface where they receive more sunlight for photosynthesis. These gas-filled bladders allow bits of macroalgae to float for long distances and be carried far away from where the macroalgae is grown. Because they contain unpalatable compounds, macroalgae remain mostly uneaten as they travel across the ocean. Eventually, the air bladders burst and the macroalgae sink down towards the deep-sea floor, where the carbon is thought to be sequestered away from the atmosphere for centuries (and potentially up to millions of years). [accept reasonable equivalents]
4. [4 marks] Although trees store carbon, this storage is vulnerable since deforestation or forest degradation release this carbon back into the atmosphere, undoing the benefits whereas kelp sequestration is basically permanent; kelp and other microalgae also grow much faster than terrestrial trees [accept reasonable equivalents]
5. [1 mark] 20 times
6. [1 mark per answer] pollution / sewer discharge into sensitive areas; sediment discharge from waterways worsened by industry and construction; overfishing resulting in imbalanced ecosystems; climate change [accept reasonable equivalents]
7. [1 mark per answer] die-off of sea stars / takeover of sea urchins that eat kelp; toxic algae infestations; warmer waters / more severe storms due to climate change [accept reasonable equivalents]
8. [2 marks per answer / explanation] answers may vary and a wide range of reasonable conservation measures would be accepted

Section 3 [25 marks]

Please refer to the map in section 3 of the Resource Booklet. This map shows predicted landslide hazard on Nov. 5, 2020 immediately following the landfall of Hurricane Eta in this area.

9. Identify five natural causes of landslides. [5 marks]

10. Identify five human activities that can increase risk of landslides. [5 marks]

11. Given the information on the map, explain why the areas shown in purple are considered to be at the highest risk from devastating landslides. [5 marks]

12. In addition to population data, what other information would scientists need to consider to assess the risk of and hazard from landslides in this region. Provide at least four other types of information that would help in this assessment. [4 marks]

13. Identify and explain three methods that can be used to mitigate landslides. [6 marks]

Grading notes: All questions are level marked.

Expected answers:

9. [1 mark per correct answer] saturation by rain water infiltration, snow melting, or glaciers melting; rising of groundwater or increase of pore water pressure; increase of hydrostatic pressure in cracks and fractures; loss or absence of vertical vegetative structure, soil nutrients, and soil structure; erosion of the toe of a slope by rivers or sea waves; physical and chemical weathering; ground shaking caused by earthquakes, which can destabilize the slope directly; volcanic eruptions [accept reasonable equivalents]

10. [1 mark per correct answer] deforestation, cultivation and construction; vibrations from machinery or traffic; blasting and mining; earthwork; in shallow soils, the removal of deep-rooted vegetation that binds colluvium to bedrock; agricultural or forestry activities (logging), and urbanization, which change the amount of water infiltrating the soil; temporal variation in land use and land cover (LULC); land degradation and extreme rainfall can increase the frequency of erosion and landslide phenomena [accept reasonable equivalents]

11. [5 marks] this map combines layers of GIS data including population data, weather data and natural risk factors to come up with a color-coded scale for landslide risk; the darkest purple areas are the most densely populated areas that also have the highest natural risk factors – less densely populated areas or those with lower natural risk are shaded lighter colors [accept reasonable equivalents]

12. [1 mark per correct answer] quantitative information on if roads have been built, trees have been cut down or burned, a major tectonic fault is nearby, the local bedrock is weak, and/or the hillsides are steep; also basic information about weather and climate is also of predictive value [accept reasonable answers outside of those listed]

13. [1 mark per correct answer] these mitigation methods fall into 3 categories - geometric methods, in which the geometry of the hillside is changed (in general the slope); hydrogeological methods, in which an attempt is made to lower the groundwater level or to reduce the water content of the material; chemical and mechanical methods, in which attempts are made to increase the shear strength of the unstable mass or to introduce active external forces (e.g. anchors, rock or ground nailing) or passive (e.g. structural wells, piles or reinforced ground) to counteract the destabilizing forces [accept more specific methods that fall into these broad categories]

Section 4 [25 marks]

Please refer to the maps in section 4 of the Resource Booklet. These maps show information on Orleans Parish, Louisiana used by the CDC to calculate its Social Vulnerability Index for 2018. The CDC defines social vulnerability as factors that 'may weaken a community's ability to prevent human suffering and financial loss in a disaster'.

14. Define the term geographic information science. [3 marks]

15. What is the relationship between geographic information science and geographic information systems? [2 marks]

16. How was Dr. John Snow able to use spatial analysis to track the 1854 London Soho cholera outbreak? What specific information did Snow include in his map that allowed him to find the source of the outbreak? [6 marks]

17. In a paragraph, explain how the four sets of factors shown in the second set of maps might make a community or county vulnerable to the effects of a disaster or disease outbreak. [8 marks]

18. Give three specific ways that municipal, county or state governments might use the SVI data to inform their disaster response planning. [3 marks]

19. Give three specific ways that municipal, county or state governments might use the SVI data to make systemic or long-term changes for vulnerable communities like those shown on the map. [3 marks]

Grading notes: All questions are level marked.

Expected answers:

14. [3 marks] the scientific discipline that studies the techniques to capture, represent, process, and analyze geographic information [accept reasonable equivalents]

15. [2 marks] geographic information systems are the frameworks used to visualize, analyze and capture spatial and geographic data, including the software commonly referred to as 'GIS' [accept reasonable equivalents]

16. [6 marks] Snow achieved this through plotting the residence of each casualty on a map of the area, as well as the nearby water sources. Once these points were marked, he was able to identify the water source within the cluster that was responsible for the outbreak. This was one of the earliest successful uses of a geographic methodology in pinpointing the source of an outbreak in epidemiology. Snow's map was unique due to his use of cartographic methods, not only to depict, but also to analyze clusters of geographically dependent phenomena [accept reasonable formulations of this information]

17. [8 marks] answers scoring full marks will draw connections between the four sets of data shown and the specific vulnerabilities these criteria would cause during a disaster or disease outbreak (like Covid); a wide variety of answers would be acceptable

18. [1 mark per correct response] answers may vary and a wide range of reasonable public policy options would earn credit.