

3. Increasing global urbanization causes associated problems such as the formation of urban heat islands.

(a) **Describe** how urbanization leads to the formation of urban heat islands.

(b) Urban heat islands have been linked to a variety of environmental problems.

(i) **Propose** a reasonable solution that could help lower the temperature increases caused by urban heat islands.

(ii) **Justify** the solution proposed in part (b)(i) by providing one additional benefit other than reducing temperatures in urban heat islands.

(c) Urban areas are increasingly using solar energy to generate electricity for residences and businesses.

(i) As a result of improved technology, the efficiency of solar panels has changed over time. In 1992 a solar cell had a maximum efficiency of 15.9%. In 2017 a solar cell prototype capable of 44.5% efficiency was produced. **Calculate** the percent change in efficiency from the 1992 cell to the 2017 cell. **Show** your work.

(ii) The average home in the United States uses 12,900 kWh of electricity per year. The local power company is raising the cost of purchasing electricity from \$0.11 per kWh to \$0.13 per kWh. Assuming a home uses the average kWh of electricity in one year, **calculate** the change in electricity cost for one year for the homeowner. **Show** your work.

(iii) The roof of a typical house in the United States receives a total of four hours of sunlight per day that can be converted by solar panels into electricity. A house has 30 solar panels on its roof, and each panel generates a maximum output of 300 watts. **Calculate** how many kWh can be produced by the system at maximum output in one calendar year. **Show** your work.

(d) **Explain** why the Northern Hemisphere receives more solar energy from the Sun between June and August than the Southern Hemisphere receives between June and August.

Begin your response to this question at the top of a new page in the separate Free Response booklet and fill in the appropriate circle at the top of each page to indicate the question number.

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