**2009 AP\* COMPUTER SCIENCE A FREE-RESPONSE QUESTIONS**

**3. An electric car that runs on batteries must be periodically recharged for a certain number of hours. The battery technology in the car requires that the charge time not be interrupted.**

**The cost for charging is based on the hour(s) during which the charging occurs. A rate table lists the 24 one-hour periods, numbered from 0 to 23, and the corresponding hourly cost for each period. The same rate table is used for each day. Each hourly cost is a positive integer. A sample rate table is given below.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Hour** | **Cost** |  | **Hour** | **Cost** |  | **Hour** | **Cost** |
| **0** | **50** |  | **8** | **150** |  | **16** | **200** |
| **1** | **60** | **9** | **150** | **17** | **200** |
| **2** | **160** | **10** | **150** | **18** | **180** |
| **3** | **60** | **11** | **200** | **19** | **180** |
| **4** | **80** | **12** | **40** | **20** | **140** |
| **5** | **100** | **13** | **240** | **21** | **100** |
| **6** | **100** | **14** | **220** | **22** | **80** |
| **7** | **120** | **15** | **220** | **23** | **60** |

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The class BatteryCharger below uses a rate table to determine the most economic time lo charge the battery. You will write two of the methods for the BatteryCharger class.

public class BatteryCharger {

/\*\* rateTable has 24 entries representing the charging costs for hours 0 through 23. \*/ private int[] rateTable;

/\*\* Determines the total cost to charge the battery starting at the beginning of startHour.

\* @param startHour the hour at which the charge period begins

\* Precondition: 0 < startHour ^23

\* @param chargeTime the number of hours the battery needs to be charged

\* **Precondition:** chargeTime > 0

\* ©return the total cost to charge the battery

\*/ \_\_^\_\_™\_ \_^\_^^\_\_\_

private int getChargingCost(int startHour, int chargeTime)

{ / \* to be implemented in part (a) \* / }

/ \* \* Deiermines start time to charge the battery at the lowest cost for the given charge time.

\* @param chargeTime the number of hours the battery needs to be charged

\* **Precondition:** chargeTime > 0

\* @return an optimal start time, with 0 S returned value < 23

\*/ ,^\_n\_\_a

public int getChargeStartTime(int chargeTime)

{ / \* to be implemented in part (b) \* / }

)

/ / There may be instance variables, constructors, and methods that are not shown.

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**2009 AP\* COMPUTER SCIENCE A FREE-RESPONSE QUESTIONS**

(a) Write the BatteryCharger method getChargingCost that returns the total cost to charge a battery given the hour at which the charging process will start and the number of hours the battery needs to be charged.

For example, using the rate table given at the beginning of the question, the following table shows the resulting costs of several possible charges.

|  |  |  |  |
| --- | --- | --- | --- |
| **Start Hour of Charge** | **Hours of Charge Time** | **Last Hour of Charge** | **Total Cost** |
| **12** | **1** | **12** | **40** |
| **0** | **2** | **1** | **110** |
| **22** | **7** | **4 (the next day)** | **550** |
| **22** | **30** | **3 (two days later)** | **3,710** |

Note that a charge period consists of consecutive hours that may extend over more than one day. Complete method getChargingCost below.

/ \*\* Determines the total cost to charge the battery starting at the beginning of startHour.

\* @param startHour the hour at which the charge period begins

\* **Precondition:** 0 5 startHour 5 23

\* @param chargeTime the number of hours the battery needs to be charged

\* Precondition: chargeTime > 0  
©return the total cost to charge the battery

**\*/**

private int getChargingCost(int startHour, int chargeTime)

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**2009 AP\* COMPUTER SCIENCE A FREE-RESPONSE QUESTIONS**

(b) Write the BatteryCharger method getChargeStartTime that returns the start time that will allow the battery to be charged at mimmal cost If there is more than one possible start time that produces the minimal cost, any of those start times can be returned.

For example, using the rate table given at the beginning of the question, the following table shows the resulting minimal costs and optimal starting hour of several possible charges.

|  |  |  |  |
| --- | --- | --- | --- |
| **Hours of Charge Time** | **Minimum Cost** | **Start Hour of Charge** | **Last Hour of Charge** |
| **1** | **40** | **12** | **12** |
| **2** | **110** | **0 1 or**  **23 0 (the next day)** | |
| **7** | **550** | **22** | **4 (the next day)** |
| **30** | **3,710** | **22** | **3 (two days later)** |

Assume that getChargingCost works as specified, regardless of what you wrote in part (a). Complete method getChargeStartTime below.

/ \* \* Determines start time to charge the battery at the lowest cost for the given charge time.

\* @param chargeTime the number of hours the battery needs to be charged

\* Precondition: chargeTime > 0

\* ©return an optimal start time, with 0 £ returned value £ 23  
**\*/**

public int getChargeStartTime(int chargeTime)

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