

## Solutions to 7.012 Cell Cycle

### Part A

a) In the figure, what does the increase in the amount of incorporated [<sup>3</sup>H]-thymidine into DNA starting at 10 hours represent?

**The beginning of the first S phase after release from nocodazole arrest.**

b) Assuming that the mitotic division period, M, equals 1 hour, determine the following cell-cycle parameters based on the figure above.

- |  |                 |
|--|-----------------|
| i) The length of the total cell cycle period | <b>25 hours</b> |
| ii) The length of the G <sub>1</sub> phase   | <b>9 hours</b>  |
| iii) The length of the S phase               | <b>5 hours</b>  |
| iv) The length of the G <sub>2</sub> phase   | <b>10 hours</b> |

### Part B

1) Incubate *cdcX*<sup>-</sup> yeast at 20°C with hydroxyurea present until all the cells are synchronized in S phase; you then shift the cells to 37°C and remove the hydroxyurea. You then monitor the cells to determine if they complete mitosis during the second incubation.

2) Incubate *cdcX*<sup>-</sup> yeast at 37°C; you then add hydroxyurea and shift the cells to 20°C. You then monitor the cells to determine if they complete mitosis during the second incubation.

|                      |   |                    |
|----------------------|---|--------------------|
|                      | <b>Completion of mitosis during second incubation</b> |                    |
| <b>Block point?</b>  | <b>Condition 1</b>                                    | <b>Condition 2</b> |
| <b>G<sub>1</sub></b> | yes   | no                 |
| <b>S</b>             | no  | no                 |
| <b>G<sub>2</sub></b> | no  | yes                |

b) If you were to screen temperature-sensitive yeast mutants using the following reciprocal shift experiments, what observed block point would you predict for the following?

Cells with a mutation in the gene encoding the G<sub>2</sub> cyclin.      **G<sub>2</sub>**

Cells with a mutation in the gene encoding the G<sub>1</sub> cyclin.      **G<sub>1</sub>**

Cells with a mutation in the gene encoding the cdk2 kinase subunit.

**In yeast, the cdK2 subunit is required to enter both S phase and M phase. These mutant cells would block in both G<sub>1</sub> and G<sub>2</sub>. Therefore, it would depend upon where the cells were when they were shifted to restrictive temperature.**

Cells with two mutations, in the genes encoding both the G<sub>1</sub> cyclin and the G<sub>2</sub> cyclin.

**These cells would block in both G<sub>1</sub> and G<sub>2</sub>. Therefore, it would depend upon where the cells were when they were shifted to restrictive temperature.**