Problem 1

(a) LRU Replacement Policy

Instruction:	1*	2*	3*	1	4*	5*	3	4	1	6	7	8*	9*	5	10
Frame 1	**1**	**1**	**1**	1	1	1	1	1	1	1	1	1	1	1	10
Frame 2		**2**	**2**	2	2	**2**	**2**	**2**	2	2	2	**2**	2	2	2
Frame 3			**3**	3	3	**3**	3	3	3	3	3	**8**	**8**	8	8
Frame 4					**4**	**4**	4	**4**	4	4	4	4	**9**	**9**	9
Frame 5						**5**	5	5	5	5	5	5	5	5	5
Frame 6										6	6	6	6	6	6
Frame 7											7	7	7	7	7

Note: pages in bold are pinned.

(b) Clock Replacement Policy

Note: a subscrpt "p" indicates that a page is pinned, and a subscript "r" indicates that the reference bit is set to 1.

1*

2*

1_{pr}

□ 2_{pr}

□   □

□   □

3*

1_{pr}

□ 2_{pr}

□ 3_{pr}

□   □

<u>1</u>

1_{r}

□ 2_{pr}

□ 3_{pr}

□   □

4*

1_r

☐ 2_{pr}

☐ 3_{pr}

☐ 4_{pr}

5*

1_r

☐ 2_{pr}

☐ 3_{pr}

5_{pr} 4_{pr}

<u>3</u>

1_r

☐ 2_{pr}

☐ 3_r

5_{pr} 4_{pr}

3

$\underline{4}$

$\boxed{1_r}$

$\square$ $\boxed{2_{pr}}$

$\square$ $\boxed{3_r}$

$\boxed{5_{pr}}$ $\boxed{4_r}$

1

$\boxed{1_r}$

$\square$ $\boxed{2_{pr}}$

$\square$ $\boxed{3_r}$

$\boxed{5_{pr}}$ $\boxed{4_r}$

6

$\boxed{1_r}$

$\square$ $\boxed{2_{pr}}$

$\boxed{6_r}$ $\boxed{3_r}$

$\boxed{5_{pr}}$ $\boxed{4_r}$

4

7

1_r

7_r 2_{pr}

6_r 3_r

5_{pr} 4_r

8*

8_{pr}

7 2_{pr}

6 3

5_{pr} 4

9*

8_{pr}

7 2_{pr}

6 9_{pr}

5_{pr} 4

5

8_{pr}

7 2_{pr}

6 9_{pr}

5_{pr} 4

10

8_{pr}

7 2_{pr}

6 9_{pr}

5_{pr} 10_r