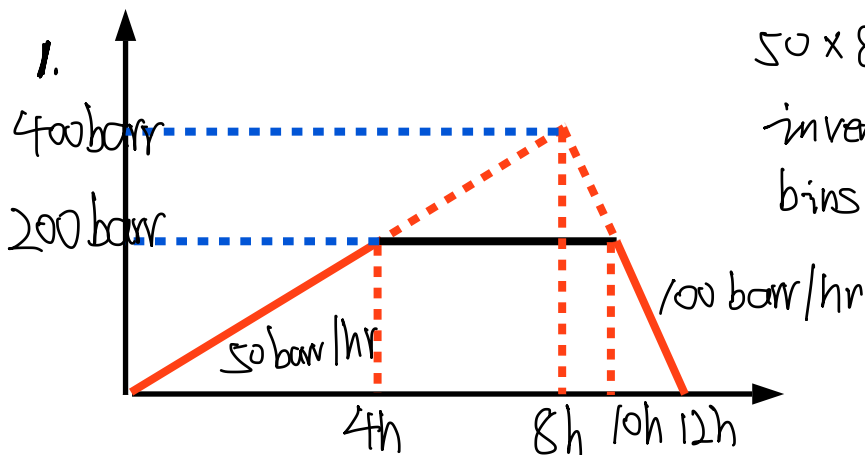


## Homework 3

**Problem 1.** (15 points) International Cranberry Uncooperative (ICU) is a competitor to the National Cranberry Cooperative (NCC). At ICU, barrels of cranberries arrive on trucks at a rate of 150 barrels per hour and are processed continuously at a rate of 100 barrels per hour. Trucks arrive at a uniform rate over eight hours, from 6:00 a.m. until 2:00 p.m. Assume that the trucks are sufficiently small so that the delivery of cranberries can be treated as a continuous inflow. The first truck arrives at 6:00 a.m. and unloads immediately, so processing begins at 6:00 a.m. The bins at ICU can hold up to 200 barrels of cranberries before overflowing. If a truck arrives and the bins are full, the truck must wait until there is room in the bins.

Answer the following questions. *Show your work to receive full credits.*

1. (2 points) What is the maximum amount of cranberries that are waiting on the trucks?
2. (2 points) At what time do the trucks stop waiting?
3. (1 point) For how long does the last in-coming truck, i.e., the truck that arrives at 2 p.m., have to wait?
4. (2 points) For how long does the truck that arrives at 1 p.m. have to wait?
5. (1 point) At what time do the bins become empty?
6. (6 points) ICU is considering using seasonal workers in addition to their regular workforce to help with cranberry processing. When the seasonal workers are working, the processing rate increases to 125 barrels per hour. The seasonal workers would start working at 10:00 a.m. and finish working when the trucks stop waiting. At what time would ICU finish processing the cranberries using these seasonal workers?



$$50 \times 8 = 400 \text{ barrels} \quad (400 - 200) / 100 = 2 \text{ h}$$

inventory builds at  $150 - 100 = 50 \text{ bbl/h}$   
 bins will be filled  $\frac{200}{50} = 4 \text{ h}$ .

8 hrs. there will be 400 berries in inventory ( $50 \times 8$ )  
 and  $400 - 200 = 200$  berries waiting in truck

Maximum amount of cranberries is 200

2:

$$\left. \begin{array}{l} \text{overflow of bins} = 200 \text{ barrels} \\ \text{processed hour} = 200/100 = 2 \text{ hours} \\ 2:00 \text{ pm} + 2 \text{ hrs} = 4:00 \text{ pm} \end{array} \right\} \text{track will stop waiting at 4 p.m.}$$

3.

$$(50 \times 8 - 200) / 100 = 2 \text{ hrs}$$

the track have to wait 2 hours

4. The amount of cranberries waiting for processed at 1:00 pm:

$$(150 \times 7) - (120 \times 7) = 350 \text{ barrels}$$

$\therefore$  There are 200 barrels in bins

$$\therefore 350 - 200 = 150 \text{ barrels}$$

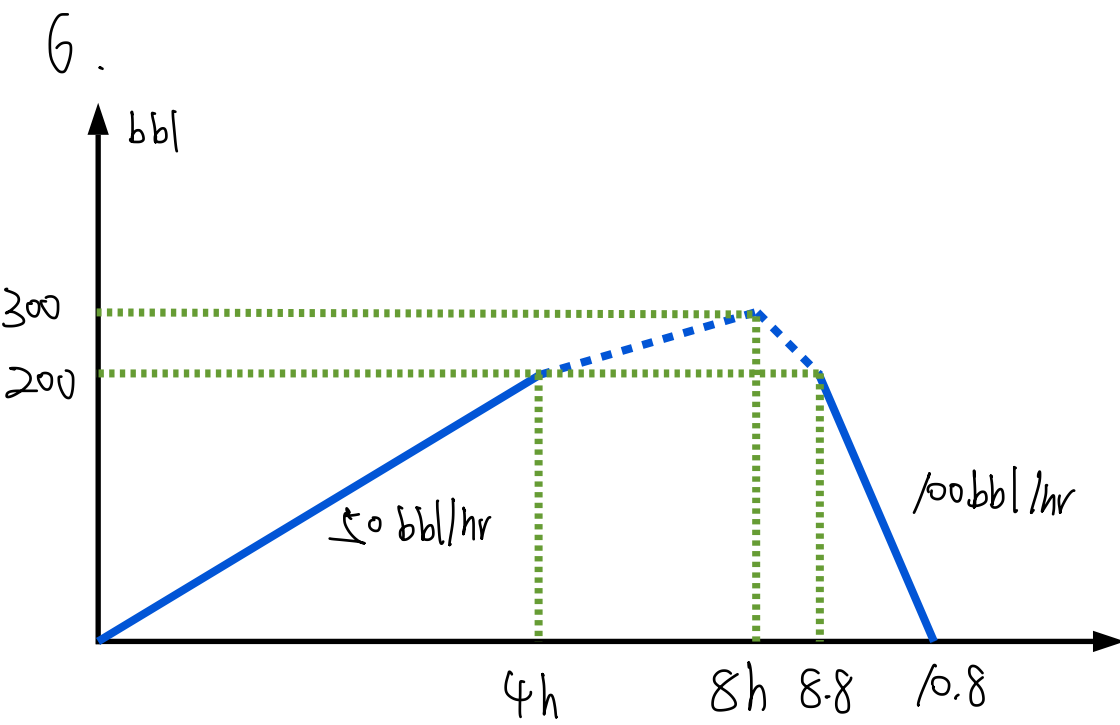
$$\text{processed hour} = 150/100 = 1.5 \text{ hrs}$$

$$1.5 \text{ hrs} + 1:00 \text{ pm} = 2:30 \text{ pm.}$$

Wait 1.5 hrs until 2:30 p.m.

5. After 12 hrs later, the bin will empty

$$200/100 = 2 \quad 2 + 2 + 8 + 6 = 18:00 \sim 6:00 \text{ p.m.}$$



$$150 - 125 = 25 \text{ bbl/hr}$$

$$4 \times 25 = 100 \text{ bbl} \quad 200 + 100 = 300 \text{ bbl}$$

$$(300 - 200) / 125 = 0.8 \text{ h}$$

$$200 / 100 = 2 \text{ h} \quad 0.8 \times 60 = 48 \text{ min.}$$

$$10 \text{ h } 48 \text{ min} + 6 \text{ h} = 16 \text{ h } 48 \text{ min} = 4:48 \text{ p.m.}$$