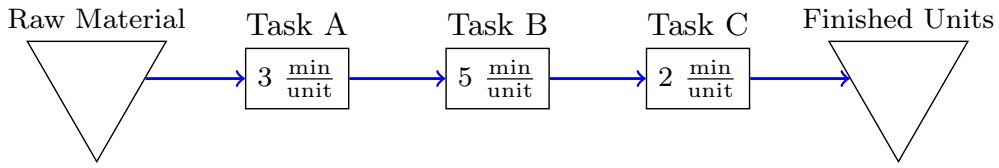
1. Consider the following three-step production process:



The numbers refer to the time necessary to process one unit of the product (run time) at that step. The process is staffed by three operators, with one operator assigned to each of the three steps. Assume no setups are required, that there is no variability in the process, that operators are capable of working at 100% all the time.

(a) What is the hourly capacity of the process?

A. 6 $\frac{\text{units}}{\text{hour}}$
B. 12 $\frac{\text{units}}{\text{hour}}$
C. 18 $\frac{\text{units}}{\text{hour}}$
D. 30 $\frac{\text{units}}{\text{hour}}$

(b) What is the utilization rate of the operator at Task A?

A. 30%
B. 40%
C. 60%
D. 100%

(c) What is the direct labor content of a unit produced by this process?

A. 3.3 $\frac{\text{minutes}}{\text{unit}}$
B. 5 $\frac{\text{minutes}}{\text{unit}}$
C. 10 $\frac{\text{minutes}}{\text{unit}}$
D. 12 $\frac{\text{minutes}}{\text{unit}}$

The operators receive wages of \$12/hour for 8 hours/day, and \$18/hour for any time over 8 hours. Each operator can work no more than 12 hours per day. A finished unit sells for \$10 (with unlimited demand at that price) and total variable cost per unit is \$6 plus the cost of direct labor.

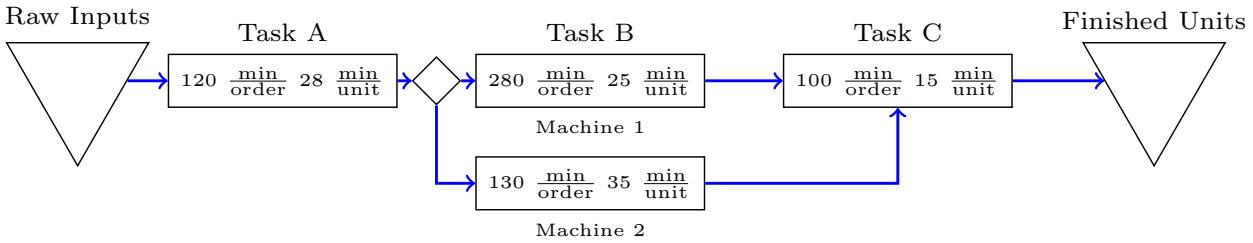
(d) To maximize profits, how many hours a day would you have operators work?

A. 0 $\frac{\text{hours}}{\text{day}}$
B. 6 $\frac{\text{hours}}{\text{day}}$
C. 8 $\frac{\text{hours}}{\text{day}}$
D. 12 $\frac{\text{hours}}{\text{day}}$

(e) Would you hire a skilled operator whose wage rate is \$20/hour (regular time) but could perform Step B at a speed of 4 minutes/unit?

A. Yes, because hourly profits increase.
B. No, because hourly profits decrease.
C. Indifferent, because hourly profits remain the same.
D. None of the above.

2. Consider the following high-setup-time production process below. Note that for the second step in sequence, an order can either be processed with Machine 1 or Machine 2 (but not both). In the process flow diagram below, a diamond indicates you must choose one of the two paths rather than having both occurring in parallel. For each step, the time on the left above the step is the setup time required for each new order; the time on the right is the run time. Assume that each order must be completed in one step before the order is moved to the next step. Each task has one operator who performs the setup and must be present during the run time as well; that is, all the setup and run times require labor content.



(a) Consider the second step in sequence (which features a choice between Machine 1 or Machine 2 for that task). Assuming our objective is to minimize labor content, for what order sizes should we use Machine 1? For what orders sizes should we use Machine 2?

A. Use Machine 1 for all order sizes that are less than or equal to 15 units.

B. Use Machine 1 for all order sizes that are greater than or equal to 15 units.

C. Use Machine 1 for all order sizes that are less than or equal to 10 units.

D. Use Machine 1 for all order sizes that are greater than or equal to 10 units.

E. Indifferent between Machine 1 or Machine 2 for all order sizes.

(b) Suppose now that all orders are for 10 units. What is the daily 10-unit order capacity of this process, assuming an 8-hour day? Continue to assume you want to minimize the labor content.

A. $4.2 \frac{\text{units}}{\text{day}}$

B. $9 \frac{\text{units}}{\text{day}}$

C. $10 \frac{\text{units}}{\text{day}}$

D. $12 \frac{\text{units}}{\text{day}}$

(c) Suppose the production line was going to continue processing orders of a single size (number of units), and we wanted to know what the capacity would be if we processed orders of only 1 unit, only 2 units, etc., through 16 units. Management has suggested that graphing processing times vs. order size may help with this analysis. Which of the options below depicts a graph where the vertical axis is the task processing time, order size is the horizontal axis (for order sizes of up to 20 units), and one line is drawn depicting this relationship for each task (that is 4 lines in total, including one for Machine 1 and one for Machine 2)?

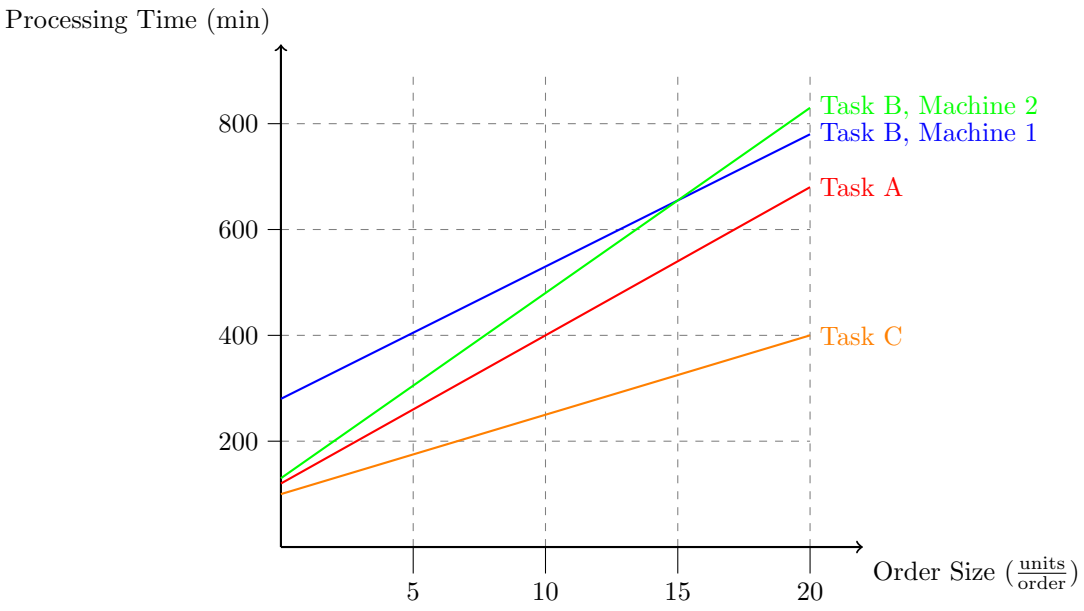
A. Graph A

B. Graph B

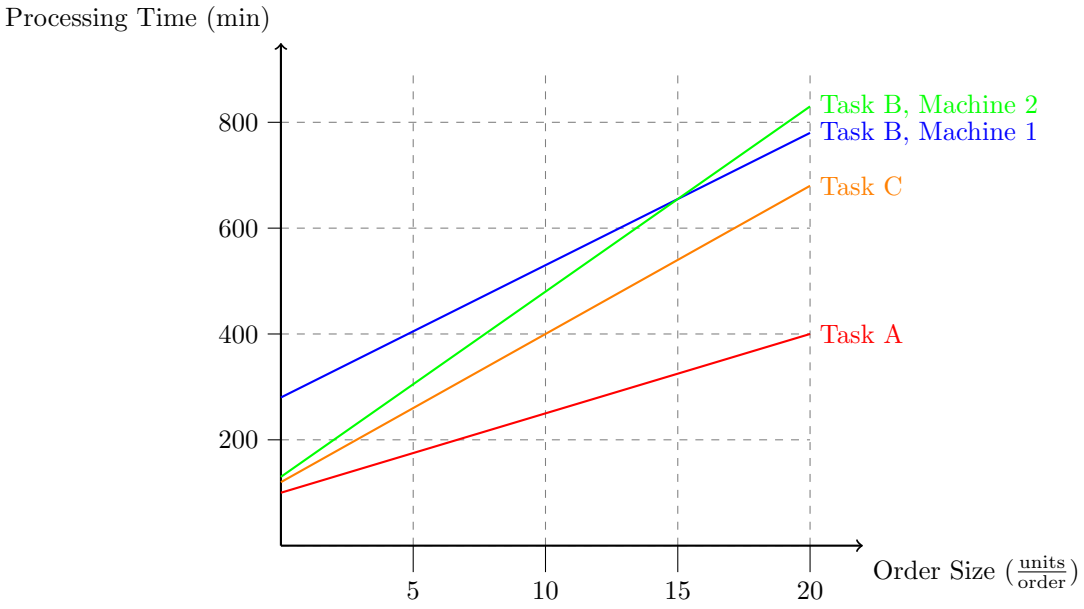
C. Graph C

D. Graph D

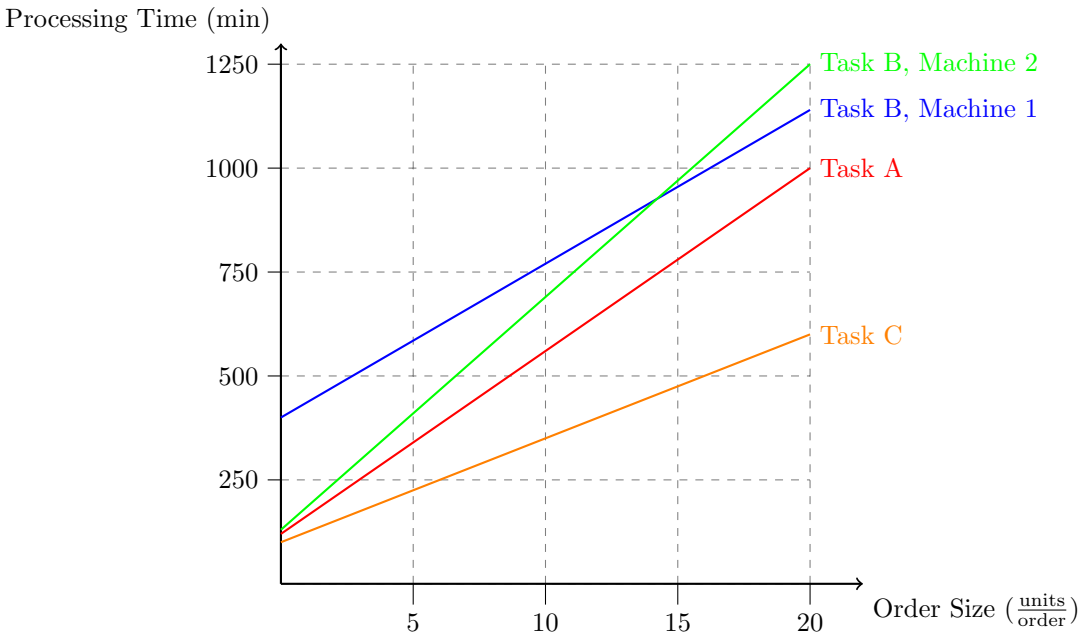
Graph A



Graph B



Graph C



Graph D