1. In the given manufacturing process in the slides, how much time does it take to make one bicycle?

   (a) 1 hr
   (b) 2 hrs
   (c) 4 hrs
   (d) 5 hrs
   (e) depends on the pipeline

   Answer: (d)

2. In the given manufacturing process in the slides, how much time will it take to make 10 bicycles?

   (a) 50 hrs
   (b) 15 hrs
   (c) The answer depends on whether or not we use pipelining

   Answer: (c)

3. How long will it take to make 10 bicycles without pipelining? Give your answer in number of hours.

   Answer: 50 hrs

4. How long will it take to make 10 bicycles, when pipelining is employed? Give your answer in number of hours.

   Answer: 23 hrs

5. What is the y-axis in the pipeline timing diagram in the slides?

   (a) Time
   (b) Units of works
   (c) Insufficient information

   Answer: (b)

6. What is the x-axis in the pipeline timing diagram in the slides?

   (a) Time

(b) Units of works

(c) Insufficient information

Answer: (a)

7. What is the y-axis in this diagram (look at slides)?

   (a) Time

   (b) Units of works

   (c) Insufficient information

   Answer: (a)

8. What other examples of pipelining can you think of from real life?

   Answer: Assembly line of a car factory, water pipelines, etc.

9. One form of parallelism is to use pipelining. Another is to use parallel processing, which in case would translate to 1/8 of the set of students being evaluated by each of the 8 TAs. Which of the following are true regarding the relative merits & demerits of pipelining?

   (a) Pipelining will achieve better speed overall

   (b) Pipelining will achieve more uniform evaluation across students

   (c) Pipelining will have difficulty handling exceptions (TA needs a break)

   (d) With pipelining, each TA needs to focus on only one part of the project

   Answer: (a), (b), (c), (d)

10. What is the time taken (in hours) to manufacture N cycles, without pipelining?

    (a) N

    (b) $2N$

    (c) $3N$

    (d) $5N$

    (e) $5N + 1$

    Answer: (d)

11. What is the time taken (in hours) to manufacture N bicycles, using pipelining?

    (a) N
    (b) $2N$
    (c) $2N + 3$
    (d) $2N + 5$
    (e) $5N$
    (f) $5N + 3$

    Answer: (c)

12. What is the speedup due to pipelining, for large values of N? Give your answer as an irreducible fraction.

    Answer: 5/2

13. If the third stage also took 1 hour, what would be the speedup due to pipelining, for large N?

    Answer: 4

14. What is the speedup due to pipelining, for large values of N, if the pipeline has 5 stages each of 1 hour?

    Answer: 5

15. In the pipeline example of project evaluation, could I have divided the pipeline into 16 stages for a speedup factor of 16 ? What do you think were the factors that prevented me from doing this? Select all that apply.

    (a) The startup delay would have been higher
    (b) This would have required 16 TAs
    (c) This would have required breakup of the project into 16 roughly-equal parts

    Answer: (a), (b)

16. What is the effect of introducing the empty MEM stage for register-register instructions? Select all that apply.

    (a) This will increase the latency for register-register instructions

(b) This will reduce the throughput of instruction completion by a factor of 5/4

(c) This will increase the latency of the program execution by a factor of 5/4

(d) This will NOT affect the throughput of instruction completion in the long run

Answer: (a), (d)