(1) In an observational study, process variables are not manipulated. The process is observed, but there is no intervention. In an experimental study, the investigator manipulates process variables.

(b) In an observational study, uncontrolled or lurking variables can obscure effects of other variables making causality harder to assess. Thus the results from an experiment are more reliable.

(2) control, blocking, randomization

(3) This is like spiked samples of know chemical concentrations that we use to monitor results in a GC lab. We don't tell the lab that these are test cases or what the right answer is before they do the analysis. For the fingerprints, we would send some known test cases to technicians without telling them these are test cases or whose prints they are and see how well the system works. If the system (for example Automated Fingerprint Identification System or AFIS) works off particular data bases (for example a prison database), we would want to send some prints that are in the database and some that are not.

(4) The treatment combinations are

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<tr>
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Run 3 blocks with one of each plane type in each block.

Block 1 = 1st 4 planes flown (Runs 1-4)
Block 2 = 1st 4 planes flown (Runs 5-8)
Block 3 = 1st 4 planes flown (Runs 9-12)

(5) (a) A controlled variable is a variable that is kept constant throughout the experiment.
(b) The other managed variables are the factors in the experiment, for example charge size in the propellant example.

(6) Since I did this example in class as a blocked design, odds are that’s what I am looking for. If we do a complete randomized design, one club can end up by chance with too many of the better balls. The randomization does not eliminate all possible bias. The randomization buys some insurance against bias. If there are observable variables such as the brand and condition of the balls, we provide better insurance by blocking. In class we made blocks of similar balls, hitting one of each ball in a given block with each club. We also blocked the run order so that
one club didn’t have an advantage in which time of the day it was used. This provides uniform environments (based on ball condition and run order) in which to compare the clubs.

(7) (a) Sample mean = 41.88  
      Sample standard deviation = 1.33  
(b) Since all values are below the intended 45°, there is an accuracy issue. The precision is measured by the standard deviation, how similar the values are to each other. Whether these values are considered “precise enough” depends on the engineering application and how close we need to be to 45 degrees.

(8) (a) There is no replication. Bouncing the same ball multiple times does not give us true replicates. For all we know the ball with the hole didn't bounce as far as the other ball even before the hole.  
(b) Bounce all balls several times without a hole. Bouncing the same ball several times doesn't add to the number of replicates, but by taking the average for each ball, we can get amore precise measure of how high that ball bounces. Then poke a whole in each ball and bounce each ball several times again. This gives us replication and also allows us to check the effect of the hole under more uniform conditions, with and without the hole for a fixed ball.

(9) (8) (a) 734 94 5 342 2 75 093 342 291 945 was above 900. The second 342 was a repeat.  
(b) In a file with part numbers and warehouse locations, we can add a column of random numbers, sort by the random numbers, and pick the first five parts corresponding to the parts with the five smallest random numbers.

(10) (a) Randomly select 5 batteries from the 20 batteries for each temperature. Maybe dump them into a box, mix them up, and take the first 6 chosen for temperature 1.  
(b) Some 4-packs may be have weaker batteries maybe form being older or due to brand differences. It would be better to randomly assign 1 battery in each pack to each temperature. That way all temperatures are tested on sets of similar batteries. This would be a randomized complete block design. This was the answer I was looking for. Another good idea would be to test each battery at room temperature before exposing it to the manipulated temperatures. This pairing would allow us to have a baseline value for each separate battery.