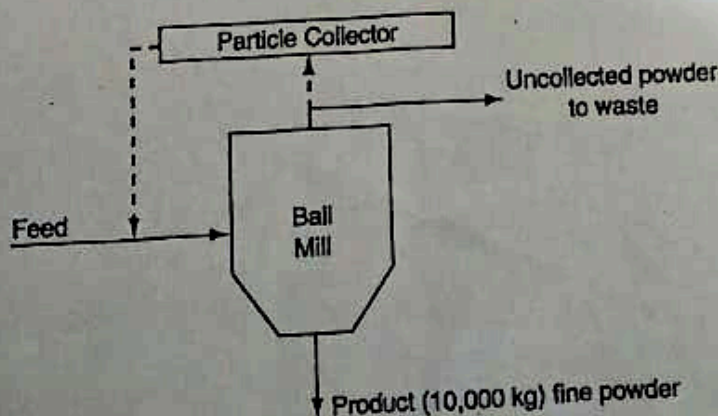1. A ball mill grinds plastic to make a very fine powder as shown in the Figure. Presently 10,000 kg. of powder is produced per day. The process (shown by solid lines) is inefficient because 20 % of the feed is not recovered as powder- it goes to waste. You make a proposal (designated by dashed lines) to recycle 75 % of the uncollected material back to the feed stream so that it can be re-milled. If the feed costs Rs. 1.20 /kg., how much money would you save per day while producing 10,000 kg of powder? 1957
(10)

2. Two mercury manometers, one open-end and the other sealed-end, are attached to an air duct. The reading on the open-end manometer is 25 mm and that on the sealed end manometer is 800 mm. Determine the absolute pressure in the duct, the gauge pressure in the duct and the atmospheric pressure, all in mmHg. 775 15mm (2x3)

3. If C_p of SO_2 is 10 cal/gmol.K, what will be its value in FPS units? 32.335 (2)

4. Air at 100^0F and 20 % relative humidity is forced through a cooling tower. The air leaves at 85^0F and 70 % relative humidity. Atmospheric pressure is 29.48 inches of mercury. Calculate the pounds of water evaporated per pound of dry air. (10)
   Vapor pressure of water at 100^0F = 1.9325 inches of mercury
   Vapor pressure of water at 85^0F = 0.8754 inches of mercury

5. Methane burns in the reactions
   $$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$
   $$CH_4 + (3/2)O_2 \longrightarrow CO + 2H_2O$$
   One hundred mol/h of methane is fed to the reactor.
   a. What is the theoretical oxygen flowrate if complete combustion occurs in the reactor? 200
   b. What is the theoretical oxygen flowrate assuming that only 70 % of the methane reacts? 140
   c. If 100 % excess air is supplied, what is the flowrate of air entering the reactor? (2x3) 1894

6. A gas contains 350 ppm of H_2S in CO_2. If the gas is liquefied, what is the mass fraction of H_2S? 2.7 X 10 (2)

7. Fresh orange juice contains 12 weight % solids and the rest water, and concentrated orange juice contains 42 wt. % solids. Initially a single evaporator process was used for the concentration, but volatile contents of the juice escaped with water, leaving the concentrate with a flat taste. The current process overcomes this problem by bypassing the evaporator with a fraction of the fresh juice. The juice that enters the evaporator is concentrated to 58 wt. % solids and the evaporator product stream is mixed with the bypassed fresh juice to achieve the desired final concentration. Calculate the amount of product (42 % concentrate) produced per 100 kg fresh juice fed to the process and the fraction of the feed that bypasses the evaporator. 2652 (9)
   0.9

Product (10,000 kg) fine powder