A. The average thickness of the first 2 km of a concrete pavement, based on a large number of cores, was 9.8 cm and the standard deviation was 0.2 cm. If the same paving process is used for the remaining 5 km of the project:
 1. How many of the 25 cores that will be taken on the remaining 5 km would you expect to indicate a thickness greater than or equal to 10 cm? (10 points)
 2. If a single, randomly selected core is checked, what is the probability that it will be less than or equal to 9.5 cm? (10 points)

B. The job mix formula for an asphalt concrete mix calls for an asphalt content of 5.5%. The highway agency tolerance from this value is ± 0.5%. The contractor has compiled enough historical data on this mix to know that his mean is 5% and standard deviation is 0.5%. If the contract or gets paid at his full unit bid price for all material that is within the tolerance limits, how many of the 10,000 tons of material on the project will probably be paid at the full unit price? (20 points)

C. One researcher runs the following multiple linear regression analysis that contains 5 independent variables:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$$

She obtains an ANOVA Table as shown below:

Variations	Degree of Freedom	Sum of Square	Mean Square	F
Explained by treatments				
Error or Unexplained		180		
Total	35	210		

 1. Please complete the ANOVA Table as listed above. (12 points)
 2. Please calculate the R^2 value. (4 points)
 3. Please test the null hypothesis $H_0: b_1 = b_2 = b_3 = b_4 = b_5 = 0$ when $F_{0.05} = 2.53$ (4 points)

D. A civil engineer is investigating the effect of adding a new material on Portland cement concrete's strength. He prepares 7 samples, which are to be tested at a material laboratory for compressive strength. The engineer is seeking a material strong enough to meet customer specifications for parts in a building. These require that the mean strength, μ, exceeds 500,000 kPa. Assume the type I error is equal to 0.01. Please answer the following questions:
 1. Please formulate the hypotheses. (5 points)
 2. Please write down the associated degree of freedom and calculate the test statistics when average strength = 557,900 kPa and standard deviation = 34,007 kPa. (10 points)
 3. What should be the decision? Accept or abandon the idea of adding this type of new materials? $t_{0.01} = 3.143$ (5 points)

Related information for calculation:

Cumulative probability distribution function for the standard normal distribution

z	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
$\Phi(z)$	.8413	.8643	.8849	.9032	.9192	.9332	.9452	.9554	.9641	.9713	.9772