1. Short questions:

   a) Chris has the following elementary utility function: $v(c) = \sqrt{c}$, where c is the value of Chris' fortune which consists of a house worth 100. The likelihood of a fire reducing the value of the house to 0 is 10%. Chris has to take a decision on whether to buy fire insurance. The insurance contract on offer specifies a premium $P = 19$ and a deductible $D = 17$. Will Chris buy insurance?

   b) What is a "complete asset market"? State all the conditions that need to be satisfied for an asset market to be complete.

   c) Consider an economy consisting of two risk averse individuals, A and B. There are two states of the world. In the good state the sum of all the economy's resources is larger than in the bad state. It is possible for A and B to trade state-claims. Show how this economy can be represented by an Edgeworth box, with individual A in the lower left corner and individual B in the upper right corner and claims in the bad state measured on the horizontal axis. Indicate both individuals' certainty lines. Will the contract curve lie above or below individual A's certainty line? Will the contract curve lie above or below individual B's certainty line? Illustrate where the contract curve is located in the Edgeworth box (you are not supposed to derive it, just show where it is approximately located). State the condition that has to be satisfied along the contract curve.

   d) The owner of a farm hires a worker to grow crops. The crop yield is random (depending on e.g. weather conditions), either high or low. However, the probability of the crop yield being high π_e also depends on the effort $e \in \{0, 1\}$ that the worker exerts, such that $\pi_0 = \frac{1}{4}$ and $\pi_1 = \frac{1}{2}$. The cost that the worker incurs from exerting effort e is $\Psi(e) = e$. The farm owner, who is the only employer, offers a contract $(\underline{t}, \bar{t})$ that induces the worker to exert high effort. The worker's expected utility is given by $EU_e = \pi_e \bar{t} + (1 - \pi_e)\underline{t} - \Psi(e)$. Unfortunately it is not possible for the farm owner to observe how much effort has been exerted. Moreover, the worker's liability is limited such that no losses from transfers can be incurred. State all the constraints that need to be satisfied for a contract $(\underline{t}, \bar{t})$ offered by the farm owner. Illustrate these constraints graphically in a figure, with $\underline{t}$ on the x-axis and $\bar{t}$ on the y-axis.

2. Consider an entrepreneur (the agent) who needs to borrow money to set up a production facility. A bank (the principal) provides a loan of size k (at cost k). The repayment of the entrepreneur is given by t. The bank's profit is thus given by $V = t - k$. The value of the entrepreneur's output P is determined by the size of the loan and his/her type: $P(k, \Theta) = 3\Theta k^{\frac{1}{3}}$, where $\Theta = \underline{\Theta} = 1$ if the entrepreneur is inefficient and $\Theta = \overline{\Theta} = 4$ if the entrepreneur is efficient (note: a higher Θ implies higher efficiency). The entrepreneur's profit is given by $U_\Theta = P(k, \Theta) - t$.

   a) What is the socially optimal loan size for each type of entrepreneur?

   b) What are the socially optimal output values?

   c) Which repayments will be paid by entrepreneurs if the bank is the only money lender? Which is the first-best menu of contracts?

   Assume now that information regarding entrepreneurs' types is hidden to the bank. However, the bank knows that the share of efficient entrepreneurs is $v = \frac{1}{5}$.

   d) State the bank's optimization problem and all constraints that need to be satisfied. Which constraints are relevant? Explain why the other constraints are not relevant.

   e) Simplify the optimization problem by taking into consideration that the bank is a monopolist. Solve the optimization problem to determine the second-best menu of contracts.

   f) Show that it is not optimal for the bank to shut down inefficient entrepreneurs. Provide a brief intuitive explanation for why the bank chooses not to shut down inefficient entrepreneurs.

3. Consider a market with a monopsonist employer. There are two types of workers. Type 0 has marginal productivity $\Theta_0 = 1$ and an outside opportunity wage of $w_0(\Theta_0) = 1$. Type 1 has marginal productivity $\Theta_1 = 4$ and an outside opportunity wage of $w_0(\Theta_1) = 3$. The cost of education z is given by $C(z, \Theta_0) = \frac{z}{\Theta_0} = z$ for type 0 and $C(z, \Theta_1) = \frac{z}{\Theta_1} = \frac{z}{4}$ for type 1. A worker's utility function is defined by $U(w, z, \Theta) = w - C(z, \Theta)$. The share of type 1 wokers is given by $\frac{1}{5}$. Workers know their own type but the employer cannot tell the high from the low productivity workers.

   a) Will adverse selection occur in the market if there is no educational screening?

   b) Illustrate in a figure, with wage on the y-axis and the amount of education on the x-axis, which contracts will make it possible to separate type 1 from type 0 workers.

   c) What contract will the monopsonist employer offer? For simplicity assume that, if two contracts yield the same level of utility, the worker prefers the one with less education. Illustrate your answer in the same figure as before.

   d) What contract would be offered under the competitive (Nash) equilibrium? Illustrate your answer in the same figure as before.

   Now suppose that the reservation wage of type 1 workers decreases to $\widehat{w}_0(\Theta_1) = 2.5$, while it remains the same for type 0 workers ($w_0(\Theta_0) = 1$).

   e) Illustrate in the same figure as before which contracts will make it possible to separate type 1 from type 0 workers.

   f) What contract will the monopsonist employer offer? Illustrate your answer in the same figure as before.

   g) Compare the outcome in f) with the one in c). What is the effect of a lower reservation wage of type 1 workers on their utility and the profits of the monopsonist employer. Is this outcome more or less efficient than the one in c)? Motivate your answer.