*Discuss the three methods used to reduce the risk of extreme price moves. Please elaborate on why simple delta hedging is inadequate to the task.*

Delta tells us the price sensitivity of the option. Simple delta hedging is inadequate because delta varies with the stock price: As the stock price increases and the option moves more into the money, delta also increases. Thus, the delta will understate the actual change in the value of the option due to a price increase. Similarly, delta will overstate the decline in the value of the option due to a stock price decrease. Gamma measures the change in delta when the stock price changes. The ultimate change in the option price is a result of the average delta during the stock price change, not just the delta at the initial stock price. We can use gamma in addition to delta to better approximate the effect on the value of the option of a change in the stock price.

Three methods to reduce the risks of extreme price moves are:

Gamma Neutral position: Just as market-makers can adopt a delta-neutral position, they can also adopt a gamma-neutral position. This position cannot be achieved with the stock alone since the gamma of the stock is zero. Thus, to be gamma-neutral the market-maker must buy or sell options to offset the gamma of the existing position.

Static option replication is a strategy in which options are used to hedge options. The market-maker might not be able to buy an exactly offsetting call option to hedge a written call, but by selectively setting the bid and ask prices for related options, might be able to acquire an option position requiring only infrequent rebalancing. To take a simple example, if the market-maker were able to buy a put with the same strike price and maturity as the written call (e.g., by setting the bid price to attract any seller of that option), then by buying 100 shares to offset the risk of the position, the market-maker would have used put-call parity to create a hedge that is both gamma- and delta-neutral for the life of the options.

Out of money options: S market-maker can buy out-of-the-money options as insurance. In delta-neutral hedging of a written option, the market-maker could buy a deep-out-of-the-money put and a deep-out-of-the-money call. The two options would be relatively inexpensive and would protect against large moves in the stock. One problem with this solution is that, since option positions in the aggregate sum to zero, the market-making community can buy protective options only if investors in the aggregate are willing to sell them. Investors, however, are usually thought to be insurance buyers rather than insurance sellers.