Finance

SECTION A

Question 1

(a) Consider the following series of stock prices for Abertawe plc. The stock did not pay dividends.

The arithmetic return formula shows the percentage change in the value of a stock from an initial value. It is given by getting the difference between the beginning price and the ending price (Ending price – Beginning price), then dividing it by the beginning price. The formula is given by:

$R = \frac{P_1 - P_0}{P_0}$

On the other hand, a logarithmic return is given by the formula:

$R = \log \frac{P_1}{P_0} - 1$

	Stock Price	**Arithmetic return**	**Logarithmic return**
31st December 2019	£1.20		
31st March 2020	£0.80	$\frac{0.8-1.2}{1.2} \times 100\% = -33.33\%$	$\text{Log}(\frac{0.8}{1.2}) \times 100\% = -18\%$
30th June 2020	£1.20	$\frac{1.2-0.8}{0.8} \times 100\% = 50\%$	$\text{Log}(\frac{1.2}{0.8}) \times 100\% = 18\%$
30th September 2020	£1.30	$\frac{1.3-1.2}{1.2} \times 100\% = 8.33\%$	$\text{Log}(\frac{1.3}{1.2}) \times 100\% = 3\%$
31st December 2020	£1.25	$\frac{1.25-1.3}{1.3} \times 100\% = -3.85\%$	$\text{Log}(\frac{1.25}{1.3}) \times 100\% = -2\%$

As shown in the table above, logarithmic returns are symmetric, while arithmetic returns are not. A decline of £0.4 from £1.20 is -33%, while an increase of the same amount from £0.80 to £1.20 is not 33% but 50%. Thus, if there is a 33% decrease (in arithmetic terms), more than 33% increase (50%) would be required to return the price to its original value. For the logarithmic, the same change is -18%, and an increase by the same amount is 18% logarithmic return.

(b) Complete the empty cells in this table and interpret your results.

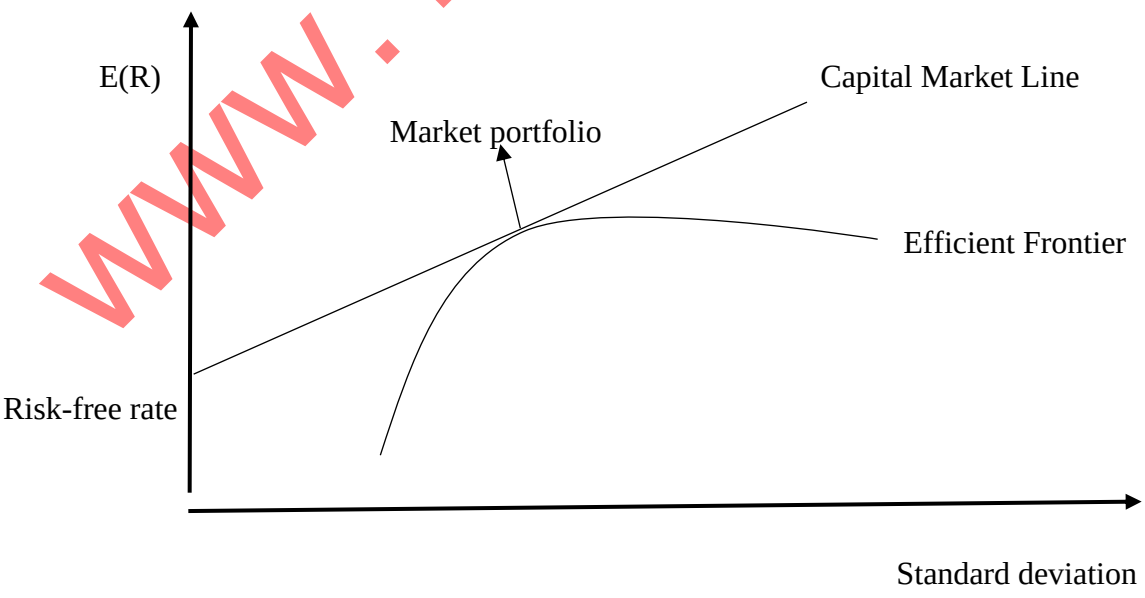
Currency pair	1st May rate	1st June rate	Monthly simple return	Monthly logarithmic return
GBP:USD	1.29	1.24	$\frac{1.24-1.29}{1.29} \times 100\%$ = -3.876%	$\text{Log}(\frac{1.24}{1.29}) \times 100\%$ = -1.717%
USD:GBP	$\frac{1}{1.29}$ =0.7752	$\frac{1}{1.24}$ = 0.8065	$\frac{0.8065-0.7752}{1.29} \times$ 100% = 4.032%	$\text{Log}(\frac{0.8065}{0.7752}) \times 100\%$ = 1.717%

The above table shows how arithmetic can be misleading. The arithmetic mean shows that the GBP depreciated by 3.876% against the US dollar. However, the same show that the USD appreciated 4.032% against the GBP. The logarithmic return shows the GBP depreciated 1.717% against the USD, and the USD appreciated by the same percentage against the GBP.

(c) Using diagrams and examples, explain the following concepts:

(i) The 'market portfolio' of the capital asset pricing model (CAPM)

The capital market line shows a combination of risk-free and risky assets that optimize the risk-return relationship. The intercept of the CML is the risk-free rate. In the CML, the market portfolio represents the risky assets. The efficient frontier shows a set of optimal portfolios that earn the highest return per unit of standard deviation (risk) or minimizes risk (standard deviation) per unit of return.



In the CAPM equation, the market portfolio represents the return on the market index. For instance, a CAPM of UK portfolios would use the FTSE 100 Index as the market portfolio or benchmark, and the return on the UK Treasury Bill represents the risk-free rate.

(ii) Hedging with stock index futures

Stock index futures are based on stock indices and not individual stocks. Since it is not possible to physically deliver stock indices, stock index futures are cash-settled at the expiry of the contract.

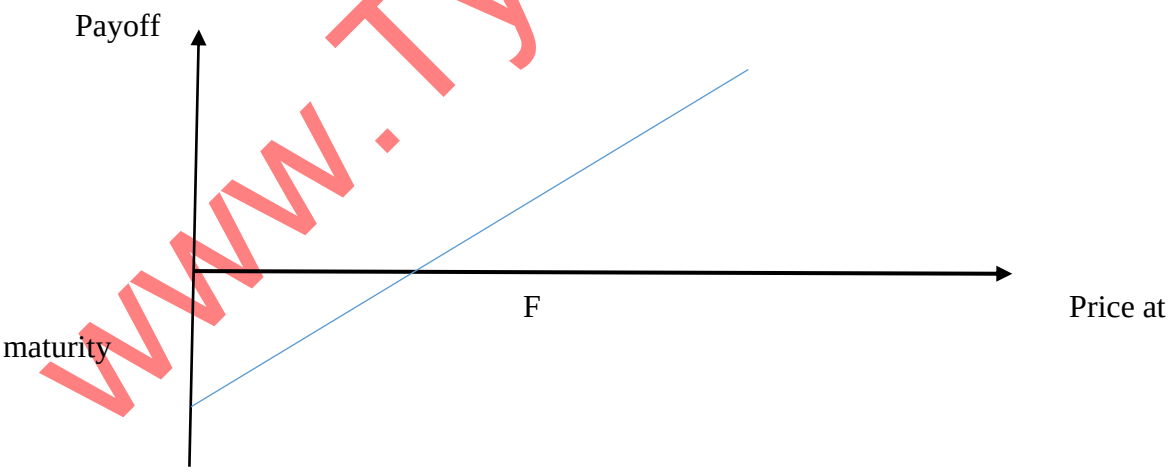
Suppose a trader has an equity portfolio with a current spot price of £700. The FTSE 100 index future is trading at £8 with a strike price of £7,500. The trader will purchase a FTSE index to hedge the equity portfolio against unfavourable price movements. Suppose on the expiry of the contract, the value of the equity portfolio falls to £550, while the price of the FTSE 100 index falls to £7300. Since the FTSE 100 Index future is cash-settled, the trader will be given the difference between the strike price and the sport price. The payoff will be as follows:

Loss on equity portfolio = 550 – 700 = -£150

Gain on Index future = 7,500 – 7,300 = £200

Net payoff = 200 – 150 -7 = £43

In the above example, the cash paid to the trader for settling the index future (£150) will cover the loss on the equity portfolio. As shown in the diagram below, hedging using stock index futures does not limit downside risk.



(d) The following graphic appeared in the Financial Times on 1st October 2020. Use this information as a focus to explain the meaning of asset classes and the limits of diversification

An asset class refers to a group of similar investment vehicles. Securities within have similar risk features. Examples of asset classes include equity stocks, treasury securities, gold, and other commodities, and foreign current, among other classes. The principle of diversification states that a well-diversified portfolio should consist of assets from different classes. This ensures that they are not affected in a similar manner by the same risks. If a portfolio is well-diversified, then unfavourable changes in one class is offset by favourable changes in other asset classes. However, the figure suggests that diversification may not always be sufficient to eliminate unsystematic risk. The figure shows that the decline in global equities (which are considered the riskiest asset class) is not fully offset by the gains in other safer assets like US Treasuries, and gold.

Question 2.

(a) Discuss the potential reasons why initial public offerings (IPOs) are typically underpriced

Information asymmetry. IPOs apply to companies that were initially operating as private companies. At the time of listing, investors do not have much information about the companies. Therefore, they are likely to bid low to avoid taking excessive risks. Investors would not be willing to pay a high price for a new stock.

Secondly, it is always in the interest of investment bankers to underprice shares during the IPO. Investment bankers commit to buying any unsubscribed shares during the IPO. Setting a low price for an IPO increases the chance of selling all the shares.

Investment bankers also underprice IPOs to avoid legal issues and bad publicity associated with overpricing. In some jurisdictions, underwriters are held liable for any misinformation during the IPO. Overstating the value of the IPO can be construed as misinformation. Besides, when an IPO is overpriced, the price is likely to fall toward the fair value. A rapid stock price fall immediately after the IPO date is bad publicity for the company.

(b) Discuss the key features of the Saudi Aramco IPO in 2019 and the aborted Ant Group IPO in 2020.

Saudi Aramco, the world's largest and most profitable company, had its IPO on December 2019. The company listed 1.5% of its 200 billion shares on the Tadawul stock exchange. The IPO price was 32 riyals ($8.53). The IPO sold 3 billion shares raising $25.6 billion, making it the largest IPO in history. The company's shares were to be listed internationally, but the idea was revised after lackluster interest from foreign investors.

Ant Group IPO in 2020 was to be a dual/double listing on the Shanghai and Hong Kong Stock Exchanges. The IPO was to involve an issue of 1.67 billion Shanghai-listed shares at 68.8 yuan each, raising 114.94 billion yuan or $17.23 billion. The Hong Kong-listed shares were to be priced 80 Hong Kong dollars each, raising 133.65 billion Hong Kong dollars or $17.24 billion. This would have made it the largest IPO ever. However, the IPO was aborted after Chinese regulators raised concerns about the structure of the financial technology company.

(c) Consider the following two assets:

(i) Calculate the proportions of assets 1 and 2 that generate a portfolio with a standard deviation of zero. What is the expected return of that portfolio?

Let the weight of Asset 1 be w

Weight of asset 2 = 1 – w

Portfolio variance must be zero for standard deviation to be zero

$w^2 \times 0.3^2 + (1-w)^2 \times 0.1^2 + 2 \times -1 \times w \times (1-w) \times 0.3 \times 0.1 = 0$

$0.09w^2 + 0.01 - 0.02w + 0.01w^2 - 0.06w + 0.06w^2 = 0$

$0.16w^2 - 0.08w + 0.01 = 0$

Using quadratic equation formula, w = 0.25

Weight of Asset 1 = 25%

Weight of Asset 2 = 1 – 25% = 75%

(ii) Calculate the expected returns and standard deviations of three other portfolios with weightings of your choice. Present a graph of your results

1. **Equally weighted portfolio**

Expected return = (50% × 18%) + (50% × 8%)

= 9% + 4%

= 13%

Standard deviation = $\sqrt{0.5^2 \times 0.3^2 + 0.5^2 \times 0.1^2 + (2 \times -1 \times 0.5 \times 0.5 \times 0.3 \times 0.1)}$

= $\sqrt{0.0225 + 0.0025 - 0.015}$

= $\sqrt{0.01}$

= 0.1 or 10%

2. **60% Asset 1, 40% Asset 2**

Expected return = (60% × 18%) + (40% × 8%)

= 10.8% + 3.2%

= 14%

Standard deviation = $\sqrt{0.6^2 \times 0.3^2 + 0.4^2 \times 0.1^2 + (2 \times -1 \times 0.6 \times 0.4 \times 0.3 \times 0.1)}$

= $\sqrt{0.0324 + 0.0016 - 0.0144}$

= $\sqrt{0.0196}$

= 0.14 or 14%

3. **30% Asset 1, 70% Asset 2**

Expected return = (30% × 18%) + (70% × 8%)

= 5.4% + 5.6%

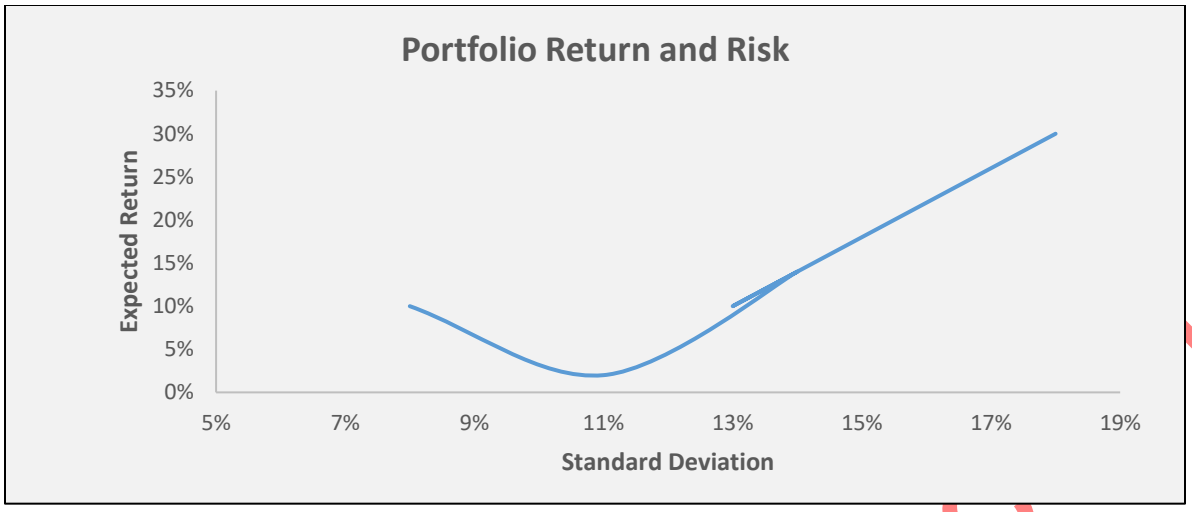
= 11%

Standard deviation = $\sqrt{0.3^2 \times 0.3^2 + 0.7^2 \times 0.1^2 + (2 \times -1 \times 0.3 \times 0.7 \times 0.3 \times 0.1)}$

= $\sqrt{0.0081 + 0.0049 - 0.01126}$

= $\sqrt{0.0004}$

= 0.02 or 2%



(d) An investor obtains the following CAPM beta values for a set of UK stocks:

(i) Calculate the beta value of a portfolio consisting of £100 each in Barlow, Cardy, and Davies, and £400 each in Evermore, Franklin, and Gardener

Stock	Value	Weight in the Portfolio
Barlow plc	£300	14.29%
Cardy plc	£300	14.29%
Davies plc	£300	14.29%
Evermore plc	£400	19.05%
Franklin plc	£400	19.05%
Gardener plc	£400	19.05%
	£2,100	**100.00%**

Portfolio beta = (0.1429 × 0.1) + (0.1429 × -0.2) + (0.1429 × 1.1) + (0.1905 × 1.6) + (0.1905 × 0.4) + (0.1905 × 1.8)

= 0.6762

(ii) Construct a portfolio that achieves the twin objectives of having a shareholding in only one company while having the same beta value as 'the market'.

A portfolio with only one share and beta as the market beta value can be constructed using one share and the risk-free rate. For instance, a portfolio of Davies plc and the UK treasury bill. The weights to achieve the twin objective are as follows:

$W_{Rf} \times \beta_{RF} + W_{Davies} \times \beta_{Davies} = 1$

$W_{Rf} \times 0 + W_{Davies} \times 1.1 = 1$

$0 + W_{Davies} \times 1.1 = 1$

$W_{Davies} = \frac{1}{1.1}$

$= 90.91\%$

$W_{Rf} = 100\% - 90.91\% = 9.09\%$

The portfolio can be attained by investing 90.91% of the funds in Davies plc and 9.09% in the UK treasury bond (risk-free asset). The beta of the portfolio will be 1, which is the same as the beta value for the market portfolio. The portfolio is analogous to portfolios on the capital market line of CAPM since its beta is 1. The CML assumes that the beta value of the market portfolio is 1.

(iii) If the investor anticipates a sharp rise in the UK stock market over the next three months, explain two alternative strategies that the investor could consider (by using these stocks and/or other investments

If a sharp rise in the UK stock market is expected, the best investment strategy is to select offensive stocks. Stocks with a high systematic risk will be appropriate. In this case, stocks with beta values greater than 1 would be suitable. This is because if the market index increases by 1%, the increase in the portfolio value will be more than 1% (more than proportionate). Thus, a portfolio of Davies and Evermore plc stocks would be most appropriate. If the investor is certain of the expected rise in the UK stock market, then he can invest all the funds in Evermore plc as this will maximize return.

(iv) Explain the concept of 'smart beta'

Smart beta is an enhanced indexing strategy that exploits certain performance factors to outperform a benchmark index. Smart beta aims to enhance returns and reduce risk by investing in customized indexes or ETFs based on predetermined factors. Among the factors considered include the profitability of stocks, size of the company, stability of cash flows, and strength of the balance sheet, among other factors. Smart beta creates a balance between passive and active investment strategies.

Question 3

(a) Explain the similarities and differences between the capital market line (CML) and security market line (SML) of the capital asset pricing model (CAPM)

The CML shows the relationship between expected return and standard deviation (total risk), while the SML shows the relationship between expected return and systematic risk (beta).

The slope of the CML is the Sharpe ratio, while the slope of the SML is the Treynor ratio. The SML only shows the association between return and systematic risk, while the CML shows the association between return and total risk, which includes both systematic and unsystematic risk.

Besides, the CML shows the relationship between risk and return for portfolios, while the SML shows the returns and risks for individual stocks/assets. The CML shows efficient portfolios, while the SML shows both efficient and non-efficient portfolios.

One similarity is that both the CML and SML show relationship between expected return and risk associated with portfolios or individual assets.

(b)

(i) This market is currently in equilibrium according to the CAPM. Calculate the beta values for each of the three stocks and interpret the values.

CAPM equilibrium implies CAPM required return is equal to the expected return.

Hove plc

Return = Rf + Beta(Rm – Rf)

Beta = (R – Rf)/(Rm – Rf)

R = 5%

Rf = 1%

Rm = 14%

Beta of Hove Plc = $\frac{5\%-1\%}{14\%-1\%}$

= 0.31

Indigo plc

R = 15%

Beta = $\frac{15\%-1\%}{14\%-1\%}$

= 1.08

Jayden plc

R = 25%

Beta = $\frac{25\%-1\%}{14\%-1\%}$

= 1.85

The above values show that Jayden has the highest systematic risk, followed by Indigo. Hove's beta (0.3) is less than 1, implying that its systematic risk is 69% lower than the market's. If the market index increases by 1%, Hove's stock increases by only 0.31%. Indigo's beta suggests that its systematic risk is 8% higher than the market index's. A 1% change in the market index is associated with a 1.08% change in Indigo's stock. Jayden's systematic risk is 85% higher than the market index's. A 1% change in the market index is associated with a 1.85% (more than proportionate) change in Jayden's stock.

(ii) Calculate whether the three stocks plot on the CML. What conclusions do you draw from this?

Stock	**Expected Return**	**Standard Deviation**	**Sharpe ratio = (ER-Rf)/SD**
Hove plc	5%	7%	$= \frac{(5\%-1\%)}{7\%} = 0.57$
Indigo plc	15%	16%	$= \frac{(15\%-1\%)}{16\%} = 0.88$
Jayden plc	25%	27%	$= \frac{(25\%-1\%)}{27\%} = 0.89$
Market index	14%	12%	$= \frac{(14\%-1\%)}{12\%} = 1.08$

The slope of the CML should be equal to the Sharpe ratio of the market portfolio. As shown above, the Sharpe ratios of the three stocks are lower than the Sharpe ratio of the market index. It implies that they do not plot on the CML. They plot below the CML, indicating that they are generating a lower return considering their risk levels. This suggests that the two are overpriced.

(iii) New stock (Kevan plc) with an expected return of 19% and a beta value of 1.3. Comment on the likely outcome of this situation

CAPM RR = 1% + 1.3(14% - 1%)

= 1% + 16.9% = 17.9%

Its CAPM required return is less than its expected return, indicating that it is underpriced. The demand for the stock will increase, thereby increasing its market price and lowering its return. This will continue until the stock is in CAPM equilibrium such that the required return is equal to its expected return.

c) Consider European-style call and put options

(i) Payoffs

ST	Buying call	Writing Call	Buying Put	Writing Put
£10	=MAX(10-25,0) **= £0.00**	=MIN(25 – 10,0) **= £0.00**	=MAX(25 – 10,0) **= £15.00**	=MIN(10-25,0) **= -£15.00**
£20	=MAX(20-25,0) **= £0.00**	=MIN(25 – 20,0) **= £0.00**	=MAX(25 – 20,0) **= £5.00**	=MIN(20-25,0) **= -£5.00**
£30	=MAX(30-25,0) **= £5.00**	=MIN(25 – 30,0) **= -£5.00**	=MAX(25 – 30,0) **= £0.00**	=MIN(30-25,0) **= £0.00**
£40	=MAX(40-25,0) **= £15.00**	=MIN(25 – 40,0) **= -£15.00**	=MAX(25 – 40,0) **= £0.00**	=MIN(40-25,0) **= £0.00**

(ii) Payoffs with Option premiums

Option premium = 20% × £25 = £5

ST	Buying call	Writing Call	Buying Put	Writing Put
£10	=MAX(10-25,0) - 5 **= -£5.00**	=MIN(25 – 10,0) + 5 **= £5.00**	=MAX(25 – 10,0) - 5 **= £10.00**	=MIN(10-25,0) + 5 **= -£10.00**
£20	=MAX(20-25,0) - 5 **= -£5.00**	=MIN(25 – 20,0) + 5 **= £5.00**	=MAX(25 – 20,0) - 5 **= £0.00**	=MIN(20-25,0) + 5 **= £0.00**
£30	=MAX(30-25,0) - 5 **= £0.00**	=MIN(25 – 30,0) + 5 **= £0.00**	=MAX(25 – 30,0) - 5 **= -£5.00**	=MIN(30-25,0) + 5 **= £5.00**
£40	=MAX(40-25,0) - 5 **= £10.00**	=MIN(25 – 40,0) + 5 **= -£10.00**	=MAX(25 – 40,0) - 5 **= -£5.00**	=MIN(40-25,0) + 5 **= £5.00**

(ii) Use the table to explain the terms' at-the-money', 'in-the-money' and 'out-of-the-money'.

An option is said to be at-the-money when the spot price of the underlying asset is equal to the strike price of the option. In the above table, if the spot price is £25, the option will be at-the-money.

An in-the-money option is an option that has value. A call option is in-the money when the spot price of the underlying asset is greater than the option's strike price. When the option is in-the-money, it is profitable to exercise the option. The above table shows the call option is in-the-money at strike prices £30 and £40. On the other hand, a put option is said to be in-the-money when the strike price is greater than the spot price of the underlying asset. For instance, at spot prices £10 and £20 in the above table, a put option is in-the-money, and it is profitable to exercise.

An out-of-the-money option is a worthless option. For a call option, it is out-of-the money when the strike price exceeds the spot price. The option holder will not exercise the option since it is worthless. For instance, the call option is out-of-the-money at strike prices £10 and £20. For the put option, if the spot price at the expiration date is greater than the exercise price, then the option is out-of-the-money. For instance, at strike prices £30 and £40, the put option is out-of-the-money.

SECTION B

Question 6

a) compare the relative merits of forward contracts and option contracts for hedging this risk.

A forward contract is a contract between two parties to buy or sell an underlying asset at an agreed price on a future date. A forward contract fixes the exchange rate, thereby protecting the holder from unfavorable price movements. For instance, a UK trader expects to pay a German firm €2,000 in three months. The trader buys a forward currency contract with a strike price of

€1.15/£. If, at the expiry of three months, the spot exchange rate is €1.1/£, the benefit from hedging is as follows:

Number of pounds required to settle the German trader without hedging = $\frac{2,000}{1.1}$ = £1,818.18

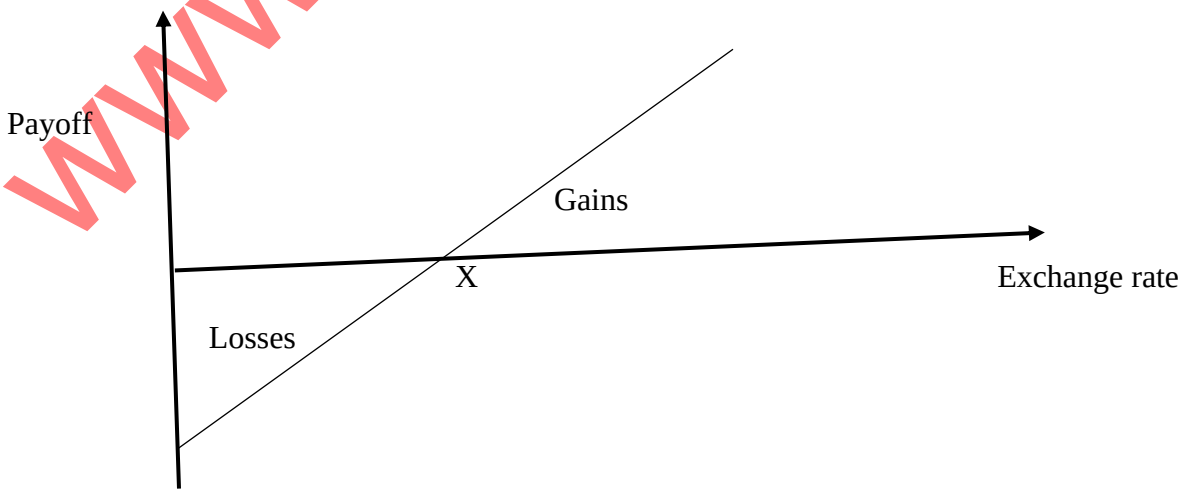
Number of pounds to settle the German trader with forward contract = $\frac{2,000}{1.15}$ = £1739.130

As shown above, the forward contract will help the trade save £79. However, the forward contract does not allow the holder to benefit from favourable changes in the exchange rate. For instance, if the exchange rate changed to €1.2/£, the holder would still pay £1,739.130, instead of £1,666.67(2000/1.2) at an arm's length transaction.

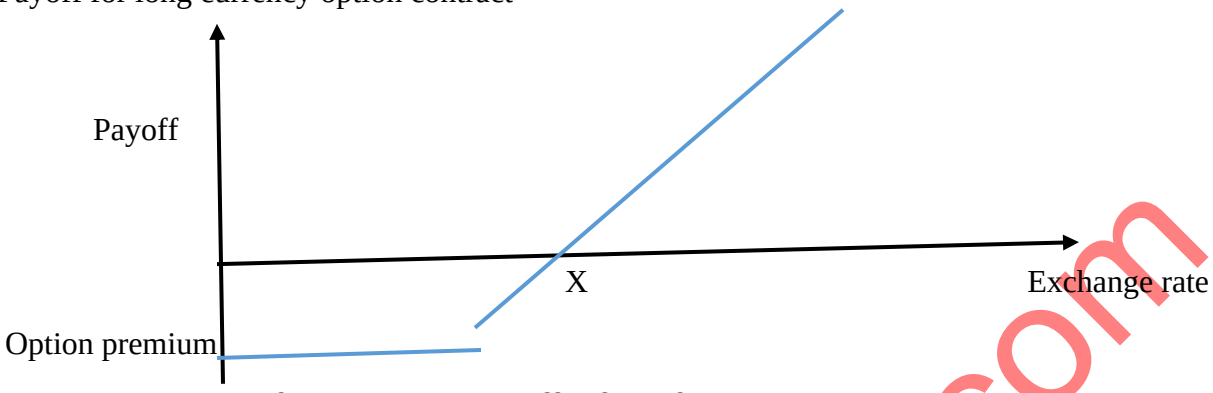
Option contracts, unlike forward contracts, protect the holder from unfavourable movements and enables the holder to gain from favourable changes. For instance, in the above example, assume the UK trader purchased a call option with a strike price of €1.15/£. If the spot rate at the expiry of the contract is €1.1/£, the UK trader will exercise the option and pay £1739.130 instead of £1,818.18. However, if the rate changes to €1.2/£, the UK trader will not exercise the option and will instead settle the German trader at the market rate. Thus, the UK trader will pay £1,666.67(2000/1.2).

As shown in the above example and graphs below, the payoff for hedging using options is limited to the price of the option (premium). On the other hand, forward contracts do not limit the downside risk.

Payoff for long forward currency contract



Payoff for long currency option contract



(c) Explain how futures contracts differ from forward contracts and compare exchange-based trading with over-the-counter trading

A forward contract is usually a private and customized contract, while futures contracts are standardized. Futures contracts are exchange-traded, while forward contracts are traded over the counter. There are several differences between exchange-traded and over-the-counter derivatives:

Exchange-traded derivatives eliminate counterparty default risk. This is because the exchange acts as the counterparty, either seller or buyer of the derivative. If the real seller of the derivative defaults, the exchange fulfills the obligations under the contract. Conversely, over-the-counter derivatives are associated with high default risk. This implies that futures contracts have lower default/counterparty risk than forward contracts.

Exchange-traded derivatives are also associated with higher liquidity than over the-counter derivatives. Exchanges are highly regulated and link numerous buyers and sellers. Thus, selling and buying a derivative does not depend on individual traders. It is easier and faster to sell a futures contract than forward contracts.

Exchange-traded derivatives are also standardized, while over the-counter derivatives are not standardized. Standardization implies that they have uniform features such as lot size, terms, and the amount required, among other features. Standardization makes it easier to use exchange-traded derivatives.

(d) Explain the term 'implied volatility' and critically analyse the merits and applications of the CBOE Volatility Index (VIX).

Implied volatility refers to market expectations of how the asset or security will be risky. It measures how much a security will move up or down in a specific time period. Implied volatility is a theoretical measure since it is predictive. Based on the historical movements in the prices of a security, one can predict how much the prices of the security will move up and down over a given period. If a stock price is £100, an implied volatility of 20% suggests that the stock price is expected to fall within the range of £80 to £120. Implied volatility is applied in the determination of the price of an option. Since option pricing is based on expected cash flows over a given future period, the volatility can only be implied.

The Chicago Board Options Exchange's (CBOE) Volatility Index is a real-time market index showing the volatility expectations of the market over the coming 30 days. It is a measure of the level of risk based on price movements of the S&P 500 Index. The CBOE volatility index is applied in derivatives pricing. It is convenient since it is easier to track and predict the volatility of the index than that of individual stocks.