

Institute of Actuaries of India

Subject SA5 – Finance

October 2009 Examination

INDICATIVE SOLUTION

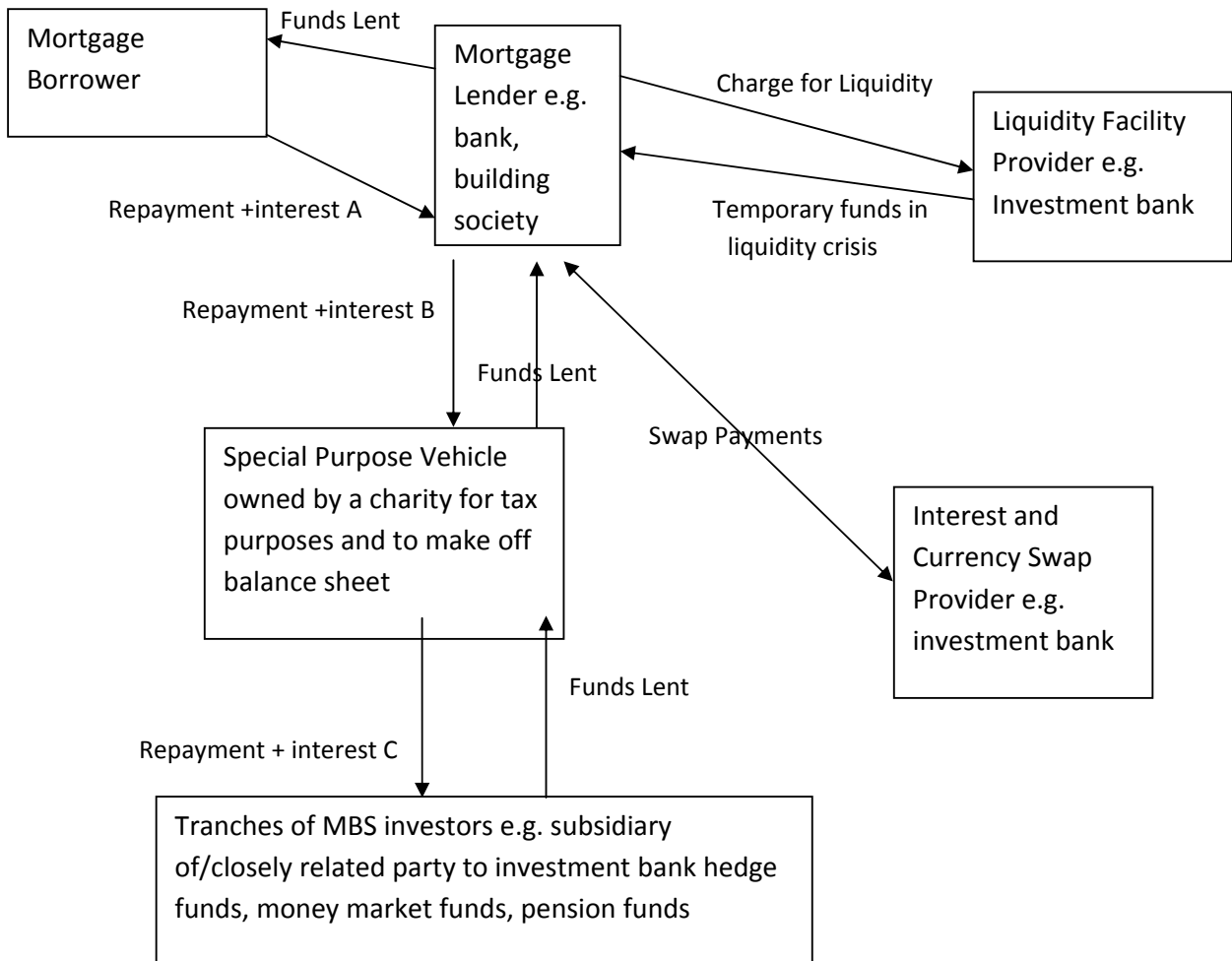
Introduction

The indicative solution has been written by the Examiners with the aim of helping candidates. The solutions given are only indicative. It is realized that there could be other points as valid answers and examiner have given credit for any alternative approach or interpretation which they consider to be reasonable

Question 1 A (i)

With the help of a diagram, provide a detailed description of a mortgage backed security [MBS] transaction.

Answer :

**Key Aspects of the Transaction:**

[a] the provision of a mortgage to a borrower is a long term loan [example: 20 years] and can be at either fixed or floating rates of interest. However, the MBS investors may provide funds for a shorter period of time [example: 7-10 years]. Hence there may be a need for a liquidity facility provider to cover the period when the initial MBS investor bonds are redeemed and second set of MBS investors are found.

[b] The MBS investors may require a floating rate of return [example: LIBOR+20 BP]. On the other hand, the mortgage borrower may pay a fixed rate [say 8% pa]. Hence there is a mismatch which can be rectified by entering into an interest rate swap with an investment bank.

[c] Often the different tranches can also be denominated in different currencies and hence a currency swap/ cross currency swap may be required to match the expected capital and interest payments.

[d] In the context of MBS, tranching can be in terms of quality of the underlying assets – assets categorised as AAA being the most likely to payoff while the equity tranche being the least likely to payoff.

Note to Examiner: Credit can be given for points valid features of MBS transaction, which are not covered above.

Question 1(ii)

Briefly describe how the MBS differs from CMO [Collateralized Mortgage Obligation].

Answer:

- With a straightforward MBS, the investor is at the risk of early repayment because the home loan borrowers can repay their mortgages at any time during the life of the mortgage.
- Collateralized mortgage obligations [CMOs] are an attempt to manage the pre-payment risk from a pool of mortgages by splitting the securities issued into different classes or tranches.
- CMOs are therefore a subset of MBS.
- Under the CMO structure, each tranche receives interest payments at the rate specified in the mortgages in the pool. The capital repayments are directed at each tranche in turn until the tranche is paid off. Then the repayments are directed at the next tranche.
- CMOs may also include structures that define the maximum and the minimum rates of repayment in each class, thereby further reducing the pre-payment risk to the holder.

Question 1(iii) (a)

From an investor's standpoint discuss the risks associated with MBS.

Answer:

- From the investors' standpoint, the two key sources of risk are: Credit Risk and Prepayment Risk.
- Credit Risk is the risk that the mortgage owners will default on their contractual commitment to effect interest and capital payments at the scheduled points of time.
- The two factors which will impact credit risk in this context will be [a] the volatility of the credit exposure itself; and [b] the volatility of the default experience.
- The MBS investor has a highly uncertain maturity date due to the risk of very rapid prepayments. This risk is referred to as the prepayment risk.

Question 1(iii) (b)

Explain how the securitisation can be structured to address these risks.

Answer:

[a] Addressing Default Risk:

- One method can be to over-collateralise the MBS by issuing the security with a coupon rate below the average of the mortgage interest rates on the underlying mortgages.
- An alternative will be to sell the mortgages to a third party [example : Federal Home Loans Mortgage Company in the US] who would then securitize the mortgages and guarantee the payments on the MBS
- An equivalent of the above alternative would be to purchase a credit guarantee from a third party rather than selling the entire mortgage portfolio to a third party.
- The issuer can set up a "cash collateral account" which would stand ready to pay the MBS coupons and capital in the event of defaults.

- Another approach can be to issue more than one tranche of security. The first tranche will accept all of the default risk until its coupon has been completely paid off; only then would the second tranche begin to suffer the effect of further defaults by homebuyers. Capital defaults would also be distributed in a similar manner.
- The issuer can have the MBS issue thoroughly analysed by one or more rating agencies to uncover any uncertainty regarding the default risk and provide more information to the investors.

[b] Addressing Prepayment Risk:

- The securitisation can be structured as a CMO [Collateralised Mortgage Obligation] whereby the MBS is issued in several tranches. The first tranche accepts all of the early repayments [prepayments] from the mortgage owners thereby insulating the other CMO tranches from the impact of prepayment. When the first tranche is paid off, the prepayments tend to impact the second tranche and so on.
- Thus in a CMO each tranche can be targeted at investors with specific maturity requirements.

Question 1(iv):

Briefly discuss the recent problems encountered with MBS in the US market and suggest measures to avoid recurrence of such problems.

Answer:

[a] Recent Problems Encountered with MBS in the US Market:

- Individuals providing false information on mortgage applications
- Unbridled speculation particularly among individual borrowers that house prices can only increase.
- Government policy to encourage house ownership.
- Legal structure of mortgages in BS whereby defaulting on mortgage means the underlying property being repossessed by the mortgage lender. The lender

cannot recover his losses by having recourse to the other assets of the mortgage borrower.

- Failure of mortgage lenders to adequately underwrite the loans probably influenced by the fact that the risk would be transferred via securitisation to other investors.
- Over reliance on credit rating agencies' models to assess the default risk. Many investors did not conduct their own due diligence and invested in these assets based solely on the ratings assigned by the credit rating agencies.
- Some investors in these securitisations funded their long term investment in these assets by issuing short term debt instruments to money market funds.
- Over reliance on pricing and valuation models which did not allow for significant increase in correlations between asset classes in the event of extreme market scenarios.
- Low returns on other asset classes driving investors to invest increasingly in risky assets.
- Many MBS transactions were on a revolving basis. In other words the long term [example : 30 year] mortgages were financed through MBS with a 7-10 year maturity which means that a second MBS had to be issued so as to repay the principal to the first set of MBS investors. This wholesale market closed with the sub-prime crisis impacting some retail banks.

[b] Measures to Avoid Recurrence of Such Problems:

- Detailed Understanding of the original assets and how they were sourced.
- Appropriate due diligence
- Not to over-rely on external rating agency models; but validate the ratings using appropriate internal risk assessment models.
- Consider worst case scenarios for the key sources of risk like the default risk and the prepayment risk; and realistically assess the impact of these scenarios on the investor's cash flow profiles. It is also important to get a better handle over how correlations between asset classes can increase in the event of extreme market scenarios.

- Set appropriate concentration limits for asset categories like ABS. For example, geographical concentration limits may be appropriate for MBS.
- Instituting a compliance system which incorporates appropriate review process of trades and audit trails. Where trades occur at a significant distance from the main group, there is a need for stronger risk controls and more oversight.
- Ensuring that the risks over and above the risk budget are appropriately hedged.

Note to Examiner: Credit can be given for any other valid statement not covered under [a] and [b] above.

Question 1 (v) (a)

Describe the valuation process for valuing the MBS taking into account your expectation as described above

Answer:

Since we expect the lending rates in future to fall below the current lending rate and hence expect pre-payments, the Monte Carlo simulation Approach will be the appropriate approach for valuing the MBS.

Thereby we can capture the fact that the periodic cash flows are path dependant [the cash flow received in one period is determined not only by the current interest rate level but also by the path that interest rates took to get to the current level].

The inputs required for this approach are

- Current term structure of interest rates
- A volatility assumption

The steps involved are as follows:

- The random paths of interest rates should be generated from an arbitrage free model of the future term structure. The simulation works by generating many scenarios of future interest rate paths. In each period of the scenario, an interest rate and the mortgage refinancing rate are generated.

The interest rates will be the simulated Treasury rates and the refinancing rates typically will be the Treasury rates plus a suitable margin for the mortgage market.

- Prepayments are projected by feeding the refinancing rate and loan characteristics [such as age] into a pre-payment model.

It needs to be noted that mortgages will not refinance as soon as the refinancing rate falls below the mortgage rate because there are fees & expenses associated with moving the mortgage. However as the gap increase more and more will refinance.

- Given the projected prepayments, the cash flows along an interest rate path can be determined.
- Given the cash flows on an interest rate path, its present value can be calculated using the spot rates determined from the simulated interest rates
- The present value for path n is then the sum of the present values of the cash flows for each period in path n. The theoretical value of the MBS can be then determined by calculating the average of the present values of all the interest rate paths.
- Because of the existence of the prepayment option against the investor, the yield on the MBS will be higher than those of equivalent non-callable bonds, and the price will be lower.

Question 1 (v) (b)

Briefly explain how your valuation process can be used to calculate the OAS [Option Adjusted Spread].

Answer:

- The option-adjusted spread is the additional yield which the investor gets for assuming the risks inherent in the security.
- The option-adjusted spread in the context of the above model will be that spread which needs to be added to all the spot rates on all interest paths to make the average present value of all the paths equal to the observed market price of the MBS [plus the accrued interest].

Question 1 B (vi) (a)

Explain “Operational Risk”.

Answer:

- Operational risk is defined as the risk of direct or indirect loss resulting from inadequate or failed internal processes, people and systems or from external events.
- The term “loss” in the above definition captures not just the direct expense but also items like the foregone income and other indirect costs [such as a reduction in the value of the firm through loss of reputation].
- There are two types of operational; risk :
 - Business Risk which includes risks such as transaction risk [example : human errors], operational control risk [example : fraud] and systems risk [example : failure in the IT system]
 - Event Risk which includes disaster risk [natural disaster, war or market collapse], legal risk and regulatory risk
- The principal causes of operational risk are varied and include :
 - System Failures & Deficiencies
 - Confidentiality or Security Breaches
 - Human Error
 - Fraud & Theft
 - Physical Disasters [example : terrorism]
 - Core business failures
 - Product liability
 - Delivery failures
 - Non-Compliance with Health & Safety / Regulatory Requirements
 - Staff Resource Deficiencies [including succession]

- Dependency on third party contractors or outsourcing

Question 1 B (vi) (b)

Describe the approaches you would use for assessing operational risk on a relative basis – relative to comparable banks

Answer:

- The numbers of factors which influence operational risk [listed above] are very varied and it is hard to quantify the way in which each factor would impact operational risk.
- Also the events that impact operational risk occur very infrequently and may be different each time. Hence it is difficult to quantify the expected loss arising from these events.
- Very little information is ever published [except for “headline events”] which means often the only source of data for assessing this risk is the internal data.
- Hence it is best to use a combination of the following approaches to obtain a reasonable assessment of this risk :
 - Subjective Judgement [particularly from experts in the field]
 - Peer Group Analysis [using data from peer group experience]
 - Modelling [possibly drawing on insurance industry data]
 - Insurance costs [where the cover available equates to the losses under consideration].
- The operational risk, on a relative basis, can be estimated using the market betas. Using this approach we assume that the variations in performance which are not market-driven are instead due to operational risk. Hence, if a bank has a higher beta than its competitors, then it has more operational risk.
- Another approach to assess operational risk on a relative basis is to compare the gross income [or costs] of each bank and assume that larger the gross income, the greater the operational risk. This approach is simplistic and is akin to the “Basic Indicator” approach used for assessing operational risk.

A variant of the above approach is to split the gross income by line of business [example: retail banking, FX Trading, Derivatives Trading, Mortgage Lending etc]. The gross income for each sector is assigned a weighting to reflect its riskiness. The weightings applied to each sector can be determined based on bank's internal experience or using an industry standard.

Question 1 B (vii)

You are required to develop a risk aggregation model for estimating the likelihood of incurring a loss in excess of the given amounts arising from market risk, credit and operational risk. What do you think should be the key features of this model?

Answer:

- Using the Dynamic Financial Analysis framework, we can construct a simulation model which [a] identifies the various risks including event risks facing the bank; and [b] attaches either a given probability of the risk occurring [frequency] & the loss incurred [severity] or a probability distribution of each of the frequency & severity.
- The main output of the model will be the VaR [Value at Risk] at a given level of confidence taking into account the interaction of all risks identified together.
- The model forecast period can be a year or longer [say, 3 years] broken down by quarters or months depending upon how the results of the model will be used by the bank.
- The model needs to incorporate a risk aggregation methodology/ methodologies [example: Gaussian Copula Approach] for aggregating the different sources of risks taking into account their correlations with one another.
- It needs to be noted that correlations between different sources of risk can be very difficult to estimate. Historically observed correlations may not be a good guide to the future. The estimation process becomes harder as the number of potentially correlated risks increases.
- It will be necessary to create a bespoke Risk Database from the other data bases. The other databases need to automatically feed data into the risk database after data scrubbing.

- In addition to the simulation approach, it will be necessary to estimate aggregation of risks using stress testing.

Question 1 C (viii)

- (a) Define Value at Risk

Answer:

Value at Risk (VaR) is a measure of downside risk.

This measure assesses the maximum potential losses on a portfolio over a given future period of time with a given degree of confidence

- (b) Discuss whether VaR should be calculated using a stochastic method or a historical method.

Answer:

The stochastic method is a forward looking method that uses the current asset and liability portfolios as the starting point. Thus the measure will be relevant for the current portfolio.

The historical method involves collecting data about the values of assets and liabilities over a specified historical time period and identifying an appropriate point in the tail of the distribution.

This means that if the portfolio has changed over time then the resulting numbers will not reflect the risk of the current asset and liability portfolios.

The stochastic method tends to be more complex, time consuming and costly. It involves many assumptions, some of which will be based on historical information.

The historical method is simpler and less subjective.

- (c) Discuss how you will modify the standard VaR methodology for calculating the VaR for the asset portfolio of a pension fund

Answer:

For a pension fund VaR may be measured in terms of the decrease in the value of surplus of assets over liabilities over a period of one or more years.

VaR is frequently calculated assuming a normal distribution of future investment returns. However a pension fund portfolio that is exposed to credit risk and/or derivatives will typically experience investment returns that are non-normally distributed.

In particular, the usefulness of VaR is likely to depend on the realistically modelling skewed or fat-tailed distributions of investment returns.

This can be done either by: [a] using non-normal statistical distributions such as Grumbel, Fretchet or Weibull Distributions; or [b] using a Monte Carlo Simulation Approach.

However it is difficult to assess accurately the exact shape of the tails of the distribution of investment returns and hence difficult to assess accurately the value at risk.

This is because of the very limited historical data that is likely to be available with respect to the tails of the distribution. Hence the choice of the underlying probability distribution may be somewhat arbitrary.

Also the VaR methodology does not take into account the simultaneous increase in the asset volatilities and correlations, which usually happen during extreme market events.

This problem can be addressed through financial stress testing whereby the standard VaR approach can be modified by adjusting the model parameters – by increasing the variances and correlations of investment returns- in order to make them more representative of those observed during extreme market events.

Question 1 D (ix)

What do you think can be the reasons for the company to adopt a Zero-debt capital structure?

Answer:

The plausible reasons for the company to adopt a zero-debt capital structure can be as follows:

The company is not earning any profit and therefore cannot benefit from the tax-efficiency of debt.

Personal tax levels on debt are higher than those on equity dividends or retained earnings.

The formula : $(1-t_d)/[(1-t_e)*(1-t_c)]$ where t_d denotes the tax rate applicable to loan interest , t_e denotes the effective tax rate applicable to equity returns and t_c denotes the corporate tax rate help to assess whether debt or equity is preferable overall.

The company wants to avoid the risks of bankruptcy and the associated legal & administrative costs [example: layoffs]. These risks tend to increase with increasing gearing.

The company believes that gearing can adversely impact its ability to attract talented staff and also adversely impact the company's relationship with the customers and suppliers. This is because the employees, customers and suppliers may perceive gearing as a significant source of risk particularly for a medium sized IT company which is exposed to a significant degree of operating [business] risk.

The company may want to avoid the conflicts between the debt holders and the equity shareholders which can be quite pronounced during times of financial distress

The company may not want to lose the flexibility to exploit opportunities which can happen if there are concerns about gearing levels or cash flows.

The company may not want the restrictive covenants that accompany debt, which can reduce the company's ability to increase shareholder value.

The company has a negative view on the short-term business prospects and hence does not want to introduce gearing at this stage. It wants to meet any additional funding requirement through internal and/or external equity.

The size of the company [medium scale] may be a deterrent to issue quoted debt security; and the costs of other debt alternatives like private debt and bank debt are too high. In this context costs will include both the interest cost and the issue [floatation] cost.

Question 1 D (x) (a)

What can be the rationale underlying the CFO's belief?

As per the dividend irrelevance theorem propounded by Modigliani and Miller, a company's market valuation is independent of its dividends.

This theorem is predicated on the assumption of perfect markets - there are no taxes or transaction costs and that the market is efficient.

In a perfect market if the company offers lower dividends than what an investor requires, the investor can sell some of the shares to raise the cash. Since the market is perfect, the amount realised on selling these shares reflects the true value of these shares.

Given this is the case, potential investors will be indifferent between a company paying high or low dividends. In other words, the market valuation will be unaffected by a company's dividend strategy.

Question 1 D (x) (b)

Briefly discuss the factors you would take into account while setting a dividend policy for this company. Contrast these factors with those that would be relevant for a large listed company.

Answer:

The important factors to be considered by the company are:

[a] the expansion and diversification plans of the company which will determine the magnitude and timing of the funding requirements

[b] the cost of raising capital in the market vis-a-vis the cost of retained earnings

[c] The target payout ratio – the company may have a long-term target which is typically industry, age and size dependent

[d] the dividend expectations of the principal shareholders of the company

[e] the tax treatment of dividends vis-a-vis alternative forms of compensation

[f] Administrative & Processing Costs: The expenses of paying a dividend may mean that it is not cost-effective to pay a small dividend.

A large listed company is likely to consider the following additional factors:

- Trends in Long Term Sustainable Earnings : The dividend policy will be determined by the level of regular dividend that can be supported by the company's operation over the long term
- The need to avoid reducing dividends in the future because reduction in dividends can trigger adverse market reactions
- The amount of smoothing to be applied to the dividend payments in order to maintain a relatively smooth dividend policy and thereby meet the shareholders' expectations
- The level of competitors' dividends
- The information content of the dividend policy - this is particularly important if the market uses the level of dividend payout as a key indicator of the future prospects
- The restrictions imposed by lending institutions [which have lent money to the company] on the dividend policy and dividend payout ratio.

[80]

Question 2 (i)

Briefly discuss the advantages of having a self-regulated system vis-a-vis a system regulated by the Government.

Answer:

- A self regulatory system is organised and operated by the participants in a particular market without government intervention.
- The key advantages of self regulatory system are :
 - The system is implemented by the people with the greatest knowledge of the market, who also have the greatest incentive to achieve the optimal cost-

benefit ratio i.e., the optimal balance between the costs & benefits of regulation.

- The proponents of self regulation argue that statutory regulation is more costly and may not achieve the desired aim. According to them, attempts by the government to improve market efficiency usually fail and that financial services regulation is an economic good that is best developed by the market.
 - Self regulation is expected to respond rapidly to changes in the market needs. On the other hand statutory regulations tend to inflexible as compared to self regulation.
 - It is easier to persuade firms and individuals to co-operate with a self-regulatory organisation than with a Government bureaucracy.
- It is however important to be sensitive to the following limitations of a self regulatory system :
 - Closeness of the regulator to the industry it is regulating: This phenomenon can lead to a weaker regime than is acceptable to consumers and thus can lead to a low public confidence in the system.
 - Self regulatory organisations can frame rules & regulations which tend to act as entry barrier for the prospective new entrants. This may be done in order to protect the interests of the existing participants and thereby maintain an oligopolistic market for financial services.

Question 2 (ii)

List the key principles underlying the financial services regulations in the UK

Answer:

The key principles underlying the financial services regulations in the UK are as follows:

[a] Integrity: The firm should share high standards of integrity and fair dealing.

[b] Skill, Care & Diligence: The firm should act with due skill, care and diligence.

[c] Market Practice: A firm should observe high standards of market conduct. It should also comply with any code or standard as in force from time to time.

[d] Information about Customers: A firm should seek from customers it advises or for whom it exercises discretion, sufficient information about their circumstances and investment objectives in order to fulfil its responsibilities to them.

[e] Information for Customers: A firm should take reasonable steps to provide its customer with such information [in a comprehensible and timely manner] which will enable him to make balanced & informed decision.

[f] Conflicts of Interest: A firm should avoid any conflict of interest arising or where conflicts arise, should ensure fair treatment to the customers by disclosure, internal rules of confidentiality, declining to act or otherwise. A firm should not unfairly place its interests above those of the customers.

[g] Customer Assets: where a firm has control of or is otherwise responsible for, the assets of a customer which it is required to safeguard, it should arrange proper protection for them, by way of segregation and identification of those assets or otherwise in accordance with the responsibility it has accepted.

[h] Financial Resources: A firm should ensure that it maintains adequate financial resources to meet its investment business commitments and to withstand the risks it is subject to.

[i] Internal Organisation: A firm should organise and control its internal affairs in a responsible manner and maintain proper records. It should ensure that its staff are adequately trained, properly supervised and there are well-defined compliance procedures in place.

[j] Relations with Regulators: A firm should deal with its regulator in an open and co-operative manner and must keep the regulator properly informed of anything concerning the firm which might be reasonably expected to be disclosed to it.

Question 2 (iii)

What should be the key objectives of the proposed regulatory body?

Answer: The key objectives of the proposed regulatory body can be in line with the objectives of the FSA. These objectives are as follows:

[a] to maintain confidence in the financial system which will include the financial markets, exchanges, regulated activities and other activities connected with them

[b] to promote public understanding of the financial system including awareness of the benefit & risks of different kinds of investment and the provision of appropriate advice & information.

[c] to secure the appropriate degree of protection for customers having regard to

- The different degree of risk for different customers
- the differing degrees of experience of consumers
- the needs that consumers may have for advice & information
- The general principle that consumers should take responsibility for their decisions.

[d] To reduce the possibilities for financial crime [including fraud, dishonesty, misuse of information or handling of the proceeds of crime].

Question 2 (iv)

The Central Bank is also planning to introduce a code for regulating corporate mergers and takeovers. Discuss the key factors you would take into account for drafting an appropriate code

The regulations must ensure that the following objectives are met:

- # All shareholders [particularly the minority shareholders] are treated fairly
- # The rights of the employees [including pension benefits] of the two companies are protected.
- # The interest of the customers [particularly the customer segment with a weak bargaining power] are protected
- # The suppliers are treated fairly

The regulation needs to be simple to understand and apply so as to minimise the cost of administering the regulation.

The regulation must not be so onerous as to discourage appropriate mergers.

The scope of the regulation must be considered. For example, will the regulations apply to all mergers or only mergers in selected industries or to only large scale mergers across all industries?

The regulation must be generic enough to be applied to a wide spectrum of industries without substantial modification. Of course special regulations may be necessary for certain industries [example: natural monopolies].

The regulations must have set procedures and time scales so as not to hold up deals inappropriately.

The regulations must also be able to deal with cross-border mergers. Ideally the regulations must be broadly consistent with similar regulations in other countries.

A decision needs to be made as to who will enforce the regulations. Will it be self-regulated or regulated by the government or a combination of the two?

[20]

[Total 100 Marks]
