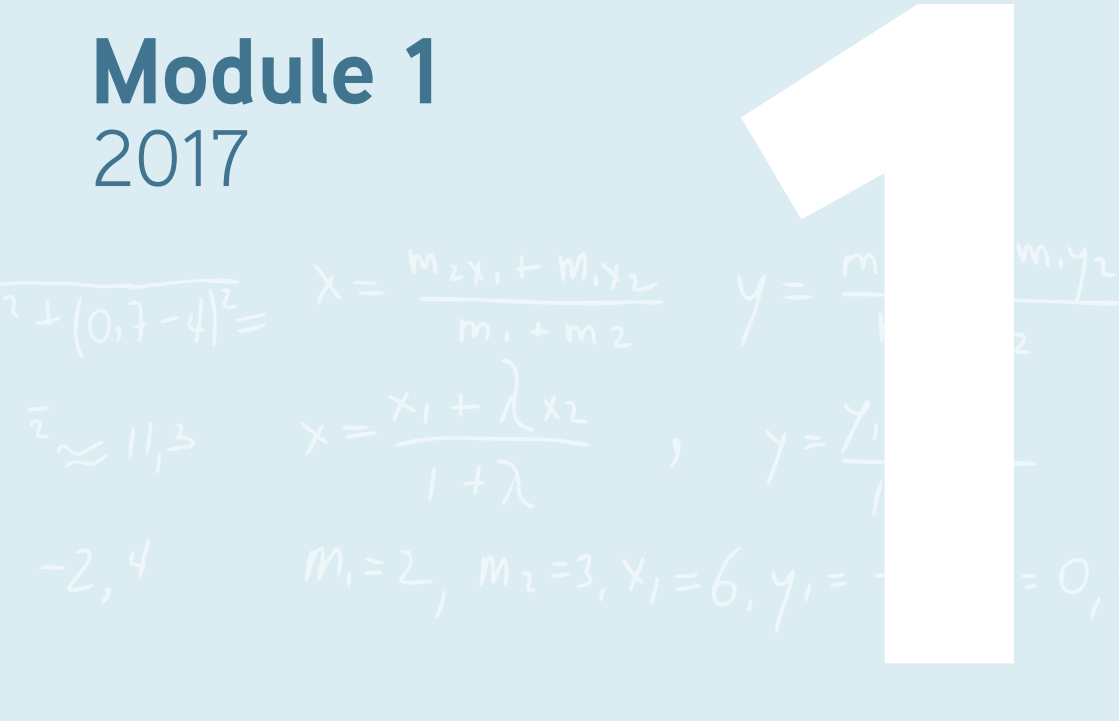
Certified Actuarial Analyst Resource Guide

Module 1

2017



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Contents

Welcome to Module 1 – the Entry exam of the Certified Actuarial Analyst qualification

The Certified Actuarial Analyst (CAA) is a professional qualification from CAA Global.

It is designed to provide you with a technical skills qualification if you:

- work alongside actuaries – in areas such as data analysis, pricing and marketing
- work in the wider financial services area – perhaps you already have other qualifications, and would like to develop a skill set that will mark you out in a competitive environment
- work in a service centre environment – the analytical skills you'll learn can then be added to your business knowledge
- have strong maths skills, and you want to and learn on the job rather than going to university.

The aim of the Module 1 Finance and Financial Mathematics exam is to provide grounding in finance and financial mathematics with simple applications.

This Resource guide for Module 1 gives you the syllabus you will cover for the exam, and details of some online and other resources that will help you study for the Module 1 exam. There is also a specimen exam paper giving examples of the type of questions you will be asked.

Additional information about the Module 1 exam, including:

- How to enter for the exam
- What will happen at the exam centre

can be found in the:

- Guide to Module 1
- Student Actuarial AnalystHandbook.

If you have any further questions contact the CAA Administration Team who will be happy to help you.

Email the team at:

enquiries@caa-global.org

The Certified Actuarial Analyst qualification

There are seven exams which you will need to complete for the qualification:

Module title	Assessed by
Fundamental Mathematics & Statistics – Module 0	2 hour Computer Based Assessment
Finance and Financial Mathematics – Module 1	**2 hour Computer Based Assessment of 60 questions**
Statistics and Models – Module 2	2 hour Computer Based Assessment
Long Term Actuarial Mathematics – Module 3	2 hour Computer Based Assessment
Short Term Actuarial Mathematics – Module 4	2 hour Computer Based Assessment
Models and Audit Trails – Module 5	3 hour examination
Online Professional Awareness Test (PAT)	90 minute examination

In addition to passing the above exams, you must complete at least one year of relevant work experience (Work-based skills).

The syllabus for the Module 1 exam

The mathematical topics covered by the Module 1 exam are:

- The key principles of finance
- Cash flow models
- The time value of money using the concepts of compound interest and discounting
- Loan repayments by regular instalments of interest
- The use of discounted cash flow techniques in investment project appraisal
- Investment and risk characteristics
- Elementary compound interest problems assuming a tax-free investor
- The "term structure" of interest rates

You can find the full Module 1 syllabus in Appendix 1 of this Resource guide

Assessment of the Module 1 exam

The Module 1 exam is assessed by a 2 hour computer based exam containing 60 multiple choice questions.

Before you start your 2 hour exam you will have an extra 15 minutes for:

- reading the exam instructions, and
- working through some basic sample questions so that you become familiar with the format of the exam.

You will also need to sign a statement of confidentiality in relation to the exam materials.

Pass standards for the exam are set by CAA Global. Details of pass standards for CAA exams will be published in due course.

Pearson | VUE

You can sit the exam at one of the many centres worldwide managed by Pearson VUE.

You can find details of your local exam centre on their website by using their regional contact details:

www.pearsonvue.com/caaglobal

Studying for the Module 1 exam

Recommended study hours

We recommend that you spend 125-150 hours studying to prepare for the exam.

Tuition

BPP ACTUARIAL EDUCATION

BPP Actuarial Education (ActEd), provides online study material for this exam.

Details of their training materials and services are available on their website.

Website: **www.bppacted.com**

Email: **ActEd@bpp.com**

Tel: +44 (0)1235 550 005

> **Please note**
> Education providers are listed here for information purposes. CAA Global has not assessed the quality of the services provided.

Textbooks

Alternatively the following textbook should cover most of the content of the Module 1 syllabus.

- An Introduction to the mathematics of finance: a deterministic approach, Stephen Garrett, 2nd Edition, 2013, Butterworth-Heinemann.

Free online resources

Listed below are samples of free web-based resources in which learning support links covering most, though not all, of the topics in Module 1 have been identified.

Please note
The content of these websites has not been quality assured by CAA Global.
The material should not be used as your primary learning resource, but may reinforce and/or supplement other sources.

The following may be useful

Topic 1 – The key principles of finance
http://en.wikibooks.org/wiki/Principles_of_Finance
https://faculty.unlv.edu/pthistle/FIN301-London/Chapter01.pdf

Topic 2 – Cash flow models
www.ftadviser.com/2012/09/20/training/adviser-guides/guide-to-cash-flow-modelling-wOtRUYN32o2i948eSNsl0L/article.html

Topic 3 – The time value of money using the concepts of compound interest and discounting
http://en.wikibooks.org/wiki/Principles_of_Finance - Chapter 2

Topic 4 – Loan repayments by regular instalments of interest
http://en.wikipedia.org/wiki/Flat_rate_(finance)
http://en.wikipedia.org/wiki/Effective_interest_rate

Topic 5 – The use of discounted cash flow techniques in investment project appraisal
http://en.wikibooks.org/wiki/Principles_of_Finance - Chapters 2 and 4.

Topic 6 – Investment and risk characteristics
http://njaes.rutgers.edu/money/investmentrisk.asp
http://en.wikipedia.org/wiki/Financial_risk
www.fcac-acfc.gc.ca/Eng/resources/educationalPrograms/ft-of/Pages/invest-2-3.aspx
www.wikijob.co.uk/wiki/risk-characteristics-investments
http://en.wikipedia.org/wiki/Derivative_(finance)

Topic 7 – Elementary compound interest problems assuming a tax-free investor
www.mathsisfun.com/money/compound-interest.html

Topic 8 – The "term structure" of interest rates
www.investopedia.com/terms/t/termstructure.asp
http://en.wikipedia.org/wiki/Yield_to_maturity

Specimen exam paper

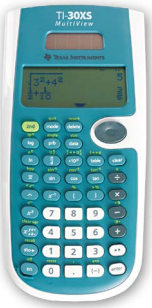
A specimen exam paper for Module 1, with sample exam questions, is given in Appendix 2. This will show you they types of questions which will be asked in the exam.

Please note
Only 20 sample questions are given in the Specimen exam paper. There will be a total of 60 questions in the Module 1 exam you sit.

The questions found in the specimen paper will not be included in the Module 1 exam.

Resources available at the exam centre

Calculators



There is only one authorised calculator for all the CAA exams:

- **Texas Instruments TI-30 Multiview** (with or without suffix).

You should bring your own calculator with you to the exam. It will be checked by exam centre staff, and the memory will be cleared.

If you bring a different calculator model it must be left in the locker with your other personal belongings.

An on-screen scientific calculator will also be available for you to use during the exam. However, some students have reported that they found this on-screen calculator difficult or cumbersome to use, and so you may prefer to take your own TI-30 calculator to the exam with you.

The TI-30 Multiview calculator is available to buy from shops or online retailers.

To clear the memory and reset the calculator:

2nd [reset] 2 or on & clear	Resets the TI-30XS MultiViewTM Calculator. Returns unit to default settings; clears memory variables, pending operations, all entries in history, and statistical data; clears the constant feature, K and Ans

Making notes during the exam

You will be provided with an erasable note board at the centre to use during the exam.

You will only be given one board at a time but are entitled to as many as you need during the exam, and you will be able to keep these at your desk for the duration of the exam. You should ask the supervisor for more if needed. The Pearson VUE staff will not provide you with an eraser for the note boards.

The note boards will be collected by Pearson VUE staff at the end of the exam.

On occasion you may instead be given scrap paper to make notes on.

Formulae and Tables for actuarial examinations

The book of Formulae and Tables for examinations has been published to help students who sit actuarial exams.

The book gives you formulae for:

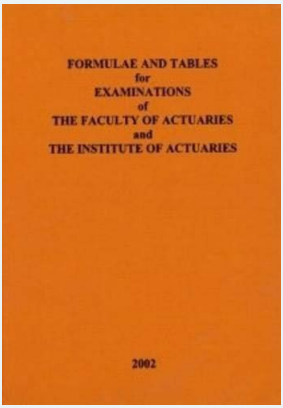
- selected mathematical and statistical methods,
- calculus, time series and economic models, and many other topics.

There are also tables for:

- compound interest calculations,
- selected statistical distributions, and
- other actuarial calculations.

You should make yourself familiar with these tables and formulae during your exam preparation.

You will not be able to use your own copy of the book during your exam, but a PDF copy will be available on your exam screen for you to use.



You can buy a copy by following this link:

www.actuaries.org.uk/catalog/formulae-and-tables

Appendix 1
Syllabus: Module 1 - Finance and Financial Mathematics

Aim

The aim of the Finance and Financial Mathematics syllabus is to provide grounding in finance and financial mathematics with simple applications.

Topic 1
The key principles of finance

1

Indicative study and assessment weighting 5%

Learning objectives

(i) Define the principal terms in use in investment and asset management.

(ii) Explain the following key principles of finance:

- (a) the relationship between finance and the real resources and between finance and the objectives of an organisation
- (b) the relationship between the stakeholders in an organisation (including lenders and investors)
- (c) the role and effects of the capital markets
- (d) agency theory
- (e) the theory of the maximisation of shareholder wealth.

Topic 2
Cashflow models

Indicative study and assessment weighting 5%

2

Learning objectives

(i) Describe how to use a generalised cashflow model to describe financial transactions.

(ii) For a given cashflow process:

- (a) State the inflows and outflows in each future time period
- (b) Explain whether the amount or the timing (or both) is fixed or uncertain.

(iii) Describe, in the form of a cashflow model, the operation of: a zero-coupon bond; a fixed-interest security; an index-linked security; cash on deposit; an equity; an "interest-only" loan; a repayment loan; a property; and an annuity certain.

Topic 3
The time value of money using the concepts of compound interest and discounting

Indicative study and assessment weighting 15%

3

Learning objectives

(i) Accumulate a single investment at a constant rate of interest under the operation of:

- simple interest
- compound interest.

(ii) Define the present value of a future payment.

(iii) Describe how a compound interest model can be used to represent the effect of investing a sum of money over a period.

(iv) Demonstrate how interest rates or discount rates may be expressed in terms of different time periods:

- (a) Define the relationship between the rates of interest and discount over one effective period arithmetically and by general reasoning
- (b) Define the relationships between the rate of interest payable once per effective period, the rate of interest payable p times per time period and the force of interest
- (c) Explain the difference between nominal and effective rates of interest and derive effective rates from nominal rates.

(v) Explain what is meant by real and money interest rates.

(vi) Calculate the present value and the accumulated value of a stream of payments using specified rates of interest and the present value at a real rate of interest, assuming a constant rate of inflation.

(vii) Discount and accumulate a sum of money or a series (possibly infinite) of cashflows to any point in time where:

- (a) the rate of interest or discount is constant
- (b) the rate of interest or discount varies with time but is not a continuous function of time
- (c) the rate of cashflow and/or the force of interest are continuous functions of time.

(viii) Calculate the present value and accumulated value of a series of payments made at regular intervals under the operation of specified rates of interest where the first payment is:

- (a) deferred for a period of time
- (b) not deferred.

(ix) Apply the more important compound interest functions including annuities certain:

- (a) Apply formulae in terms of *i, v, n, d,* δ, $i^{(p)}$ and $d^{(p)}$ for $a_{\overline{n}|}$, $s_{\overline{n}|}$, $a^{(p)}_{\overline{n}|}$, $s^{(p)}_{\overline{n}|}$, $\ddot{a}_{\overline{n}|}$, $\ddot{s}_{\overline{n}|}$, $\ddot{a}^{(p)}_{\overline{n}|}$, $\ddot{s}^{(p)}_{\overline{n}|}$, $\overline{a}_{\overline{n}|}$ and $\overline{s}_{\overline{n}|}$.
- (b) Apply formulae in terms of *i, v, n, d,* δ, $i^{(p)}$ and $d^{(p)}$ for ${}_{m|}a_{\overline{n}|}$, ${}_{m|}a^{(p)}_{\overline{n}|}$, ${}_{m|}\ddot{a}_{\overline{n}|}$, ${}_{m|}\ddot{a}^{(p)}_{\overline{n}|}$ and ${}_{m|}\overline{a}_{\overline{n}|}$.

(x) Calculate quantities using an equation of value, where payment or receipt is certain.

Topic 4
Loan repayments by regular instalments of interest and capital

4

Indicative study and assessment weighting 20%

Learning objectives

(i) Describe how a loan may be repaid by regular instalments of interest and capital.

(ii) Describe flat rates and annual effective rates of interest.

(iii) Calculate a schedule of repayments under a loan and identify the interest and capital components of annuity payments where the annuity is used to repay a loan for the case where annuity payments are made once per effective time period or p times per effective time period/ and identify the capital outstanding at any time.

Topic 5
Loan repayments by regular instalments of interest and capital

5

Indicative study and assessment weighting 20%

Learning objectives

(i) Calculate the net present value and accumulated profit of the receipts and payments from an investment project at given rates of interest.

(ii) Calculate the internal rate of return implied by the receipts and payments from an investment project.

(iii) Calculate the money-weighted rate of return, the time-weighted rate of return and the linked internal rate of return on an investment or a fund.

Topic 6
Investment and risk characteristics

Indicative study and assessment weighting 5%

6

Learning objectives

(i) Describe the investment and risk characteristics of the following types of asset available for investment purposes:

- (a) fixed interest government borrowings
- (b) fixed interest borrowing by other bodies
- (c) shares and other equity-type finance
- (d) derivatives.

Topic 7
Elementary compound interest problems assuming a tax-free investor

Indicative study and assessment weighting 25%

7

Learning objectives

(i) Calculate the present value of payments from a fixed interest security where the coupon rate is constant and the security is redeemed in one Instalment.

(ii) Calculate the running yield and the redemption yield from a fixed interest security [as in 7 (i)], given the price.

(iii) Calculate the present value or yield from an ordinary share and a property, given simple (but not necessarily constant) assumptions about the growth of dividends and rents.

(iv) Calculate the present value of an index-linked bond, given assumptions about the rate of inflation.

Topic 8
Investment and risk characteristics

Indicative study and assessment weighting 5%

8

Learning objectives

(i) Describe the main factors influencing the term structure of interest rates.

(ii) Explain what is meant by the par yield and the yield to maturity.

(iii) Explain what is meant by discrete spot rates and forward rates.

(iv) Define the relationships between discrete spot rates and forward rates.

(v) Calculate discrete spot rates and forward rates.

END OF SYLLABUS

Appendix 2
Specimen Examination Paper: Module 1 - Finance and Financial Mathematics

Please note:

- This Specimen Examination Paper acts as an example of the types of questions that will appear in the Module 1 Exam Paper.
- Although only 20 sample questions are listed in this specimen paper, there will be a total of 60 questions in the actual Module 1 examination.
- The questions found in the Module 1 Specimen Examination Paper will not be included in the actual Module 1 examination.

1 Credit risk is:

A. The risk that a bond will be given a low credit rating.

B. The risk that a lender will not provide a loan.

C. The risk that the borrower will not repay the loan.

D. The risk that a bond will be given a high credit rating.

Answer: **C**
[Topic 6]

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2 A local authority issues a fixed interest security. The local authority cash flows will be:

A. An initial positive cash flow, a single known negative cash flow on the specified future date, and a series of smaller known negative cash flows on a regular set of specified dates in the future.

B. An initial negative cash flow, a single known positive cash flow on the specified future date, and a series of smaller known positive cash flows on a regular set of specified dates in the future.

C. An initial positive cash flow, a single known negative cash flow on the specified future date, and a series of smaller variable negative cash flows on a regular set of specified dates in the future.

D. An initial negative cash flow, a single known positive cash flow on the specified future date, and a series of smaller variable positive cash flows on a regular set of specified dates in the future.

Answer: **A**
[Topic 2]

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3 £500 is invested in a fixed interest account. No further deposits or withdrawals are made. At the end of 10 years the value of the account has increased to £700.

What is the annual rate of compound interest that has been paid over the 10 years?

A. 3.3%

B. 3.4%

C. 4.0%

D. 14.0%

Answer: **B**
[Topic 7]

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4 An investment is discounted for 28 days at a simple rate of discount of 4.5% p.a. You may assume that a year is 365 days.

The annual effective rate of interest is:

A. 4.41%

B. 4.50%

C. 4.52%

D. 4.61%

Answer: **D**
[Topic 4]

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5 An individual needs to meet a liability of £5,000 due in exactly 5 years' time. To save to meet this liability the individual wishes to save a fixed amount each year in a savings account that pays 2% p.a. compound interest. The first payment will be made today and a further three payments will be paid on each anniversary of today. No further deposits or withdrawals are made.

How much should the individual save each year?

A. £942
B. £1,166
C. £1,189
D. £1,250

Answer: **B**
[Topic 3]

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6 A bank offers a customer a loan of £65,000 repayable by level annual instalments of £5,127.69 payable annually in arrear over a period of 20 years.

The effective rate of interest per annum that will be paid by the customer on the loan is?

A. 4.8%
B. 4.9%
C. 5.0%
D. 5.1%

Answer: **A**
[Topic 4]

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7 A credit company offers a loan of £50,000. The loan is to be repaid by level monthly instalments in arrears of £407.63 over a 25 year term. Interest is to be charged at an effective rate of 9% p.a.

Calculate the interest paid in the final year to the nearest £1.

A. £222
B. £408
C. £4671
D. £4892

Answer: **A**
[Topic 4]

8 A bank makes a loan of £3,710 to be repaid in instalments annually in arrear. The first instalment is £500, the second £480 and so on with the payments reducing by £20 per annum until the end of the 15th year after which there are no further payments. The rate of interest charged by the lender is 6% per annum effective.

Calculate the capital component of the second payment to the nearest £1.

A. £206

B. £223

C. £274

D. £277

Answer: **C**
[Topic 4]

9 A bank made a loan of £100,000 to be repaid by level instalments of £14,902.91, payable annually in arrear for 10 years from the date the loan was granted. The annual repayments were calculated at an effective rate of interest of 8% p.a.

At the start of the 8th year, immediately after the 7th payment has been made, the borrower asked for the term of the loan to be extended by 2 years. The bank agreed to do this on condition that the rate of interest is increased to an effective rate of 12% per annum for the remainder of the term and that all future payments are paid quarterly in arrear.

Calculate the new quarterly payment to the nearest £1.

A. £2,336

B. £2,551

C. £3,726

D. £10,206

Answer: **B**
[TOPIC 4]

10 The owner of a café is considering investing in a small project. The project involves buying a vegetable juicing machine for $10,000. She expects to be able to sell 1,000 vegetable juice drinks each year at $2.00 per cup. Each cup will cost $0.20 to produce. She expects the machine to have a life of 6 years after which she will sell it to a scrap metal merchant for $1,000.

Calculate, to the nearest $1, the net present value of the project at an interest rate of 5% p.a. assuming that the drinks are sold continuously throughout each year.

A. -$637

B. -$118

C. +$109

D. +$1,149

Answer: **C**
[Topic 5]

11 A property developer is considering investing in a project. The project is a special arrangement with a local business that owns an empty office building and is in need of short-term cash.

Under the terms of the arrangement the developer will buy the building for £5,000,000. In order to make the building suitable as a business premises he will need to spend £1,500,000 continuously during the first 6 months. At the end of the six-month period, he will let the property to the business for a further 10 years at a fixed annual rent, payable annually in advance. The business will then buy back the property from him at twice the original sale price i.e. £10,000,000.

Calculate to the nearest £5,000 the annual rent the developer needs to charge in order to obtain an internal rate of return of 7% p.a. from this project.

A. £120,000

B. £200,000

C. £215,000

D. £245,000

Answer: **C**
[Topic 5]

12 An investor places £25,000 into a fund on 1 January and holds the fund for 2 years. He invests a further £5,000 on 1 July of the 1st year. At the end of the 2-year period on 31 December of the 2nd year, the fund is valued at £32,700.

Calculate, to one decimal place, the annual money weighted rate of return that the investor achieved on the fund over the period.

A. 4.4%

B. 4.6%

C. 4.8%

D. 5.0%

Answer: **B**
[Topic 5]

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13 A pension fund was valued at $40,000,000 on 1 January. The returns achieved on the pension fund during the year were as follows:

1 January to 31 March	+ 5.4%
1 April to 30 June	+ 0.1%
1 July to 30 September	+ 0.6%
1 October to 31 December	+ 8.2%

The fund manager invested $5,000,000 into the fund on 31 March and withdrew $8,000,000 from the fund on 30 September. At the end of the year he calculated the time weighted return (TWRR) on the fund to be 14.8%.

What can you deduce about the money weighted rate of return (MWRR) on the fund?

A. No conclusions can be drawn about the MWRR

B. The MWRR was greater than 14.8%

C. The MWRR was 14.8%

D. The MWRR was less than 14.8%

Answer: **D**
[Topic 5]

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14 A call option is where:

A. The holder has the option to buy a specified asset at an agreed price

B. The holder has the option to sell a specified asset at an agreed price

C. The holder has the obligation to buy a specified asset at an agreed price

D. The holder has the obligation to sell a specified asset at an agreed price

Answer: **A**
[Topic 1]

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15 A bond is redeemable at par in 5 years' time. Coupons are paid quarterly in arrear at a rate of 5% p.a.

The price of the bond per £100 nominal which would give an investor a redemption yield of 7% p.a. effective is:

A. £155.42

B. £92.69

C. £92.33

D. £91.80

Answer: **C**
[Topic 7]

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16 A fixed interest bond was issued at £110 per £100 nominal 6 years ago and will be redeemed in 2 years' time at £105 per £100 nominal. An investor has just purchased the bond for £97 per £100 nominal. Coupons of £4.50 are paid annually in arrear with the next coupon due in exactly 1 year's time. The bond will be redeemed at par in exactly 2 years' time.

The current running yield on the bond is:

A. 4.6%

B. 4.5%

C. 4.3%

D. 4.1%

Answer: **A**
[Topic 7]

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17 An investor wishes to purchase a portfolio of shares in a company. The company does not expect to pay dividends for the next 2 years at which point it will pay a dividend of $0.10 per share. Dividends are expected to be paid annually thereafter and increase at 5% p.a.

The price per share the investor should pay to achieve a return of 7% p.a. on the portfolio, based on the assumption that the shares are held in perpetuity is:

A. $1.25

B. $2.00

C. $4.59

D. $5.20

Answer: **C**
[Topic 2]

18 An investor is considering purchasing a share currently priced at £25.00 Dividends are paid annually. The next dividend is expected in 1 year's time.

The dividend that has just been paid was £0.50. Based on previous company accounts the investor expects annual dividends to continue and to increase in line with inflation at 3% p.a.

Assuming that the share is held in perpetuity, calculate the annual yield, to the nearest 1%, implied by the share price.

A. 2%

B. 3%

C. 4%

D. 5%

Answer: **D**
[Topic 7]

19 An index-linked bond is issued with a term of 10 years. The bond will be redeemed at par and annual coupons are to be paid at 5%. Both coupons and the redemption payment will increase in line with inflation from the date of issue. Inflation is assumed to be 2.5% p.a. throughout the term.

Assuming an interest rate of 7% p.a. effective, what is the purchase price of the bond per £100 nominal?

A. £85.95
B. £90.61
C. £103.88
D. £104.85

Answer: **D**
[Topic 7]

20 The following spot rates apply:

1-year spot rate	2.5%
2-year spot rate	3.0%
3-year spot rate	3.5%
4-year spot rate	4.0%

Calculate the 2-year forward rate from time t=2, expressed as an annual rate of interest to one decimal place.

A. 3.2%
B. 3.7%
C. 4.5%
D. 5.0%

Answer: **D**
[Topic 8]

US OFFICE

475 N. Martingale Road
Suite 600
Schaumburg, IL 60173
USA

Tel: +1-847-273-8890
1-844-839-1679 (Toll Free)

UK OFFICE

7th Floor, Holborn Gate,
326 - 330 High Holborn,
London, WC1V 7PP
United Kingdom

Tel: +44 01865 268266

E: enquiries@caa-global.org