Financial Mathematics – Question Set

Simple Interest and Comparisons

Q1 A term deposit of $7 500 earns simple interest at 4.2 % p.a. for 18 months. Find the interest and maturity value.

Q2 $18 400 is invested at 3.6 % p.a. simple for 230 days. Use a 365 day year. Find the interest.

Q3 How long (in years) will $12 000 take to earn $2 700 interest at $r = 5.4$ % p.a. simple?

Q4 What simple rate r gives $1 980 interest on $22 000 over 8 months?

Compound Interest, Nominal and Effective Rates

Q5 $12 000 is invested at 5.6 % p.a. compounded quarterly for 4 years. Find the future value.

Q6 $9 500 is invested at 6.1 % p.a. compounded monthly. Find the value after 2 years 3 months.

Q7 Find the effective annual rate equivalent to 18.0 % p.a. compounded monthly.
Find the effective annual rate equivalent to 12.0 % p.a. compounded quarterly.

Q8 A fund advertises an EAR of 6.35 %. What nominal rate compounded monthly is equivalent?

Q9 Money triples under continuous compounding at rate r. Find r to 3 d.p.

Q10 At what time will an investment double at 6.0 % p.a. compounded: (a) annually (b) monthly(Use the same nominal rate 6.0 %.)

Present Value, Discounting and Real Rates

Q11 You need $25 000 in 5 years. If the annual compounding rate is 5.1 %, how much must be invested now?

Q12 A machine replacement will cost $48 000 in 4 years. The firm earns 7.0 % effective. What is the present value?

Q13 Inflation averages 2.6 % p.a. while an account returns 7.2 % effective. Find the real rate to 2 d.p. %.

Q14 A scholarship pays $6 000 in three years. If the fund earns 4.4 % effective, what single deposit now will finance it?

Annuities – Savings (payments at period ends)

Q15 You deposit $350 at the end of each month into an account paying 4.8 % p.a. compounded monthly. What is the balance after 6 years?

Q16 A saver deposits $120 fortnightly into an account earning 5.2 % p.a. compounded fortnightly. Find the balance after 8 years.

Q17 You plan to accumulate $180 000 in 15 years using monthly payments into an account at 5.1 % p.a. compounded monthly. Find the required monthly payment.

Q18 A parent invests $2 000 at the start of each year for 12 years into an account earning 6.0 % p.a. compounded annually. Find the future value. (Hint: convert to an equivalent end-of-year annuity.)

Loans and Amortisation

Q19 A car loan of $28 000 is to be repaid monthly over 5 years at 6.6 % p.a. compounding monthly. Find the monthly repayment.

Q20 On the loan in Q0, find the principal remaining after 2 years of payments.

Q21 A home loan of $560 000 is repaid monthly for 30 years at 5.40 % p.a. compounding monthly. Find the monthly repayment.
Find the total interest paid over the life of the loan.

Q22 A student borrows $18 000 at 7.2 % p.a. compounded monthly to be repaid by equal monthly payments over 4 years. After 18 payments the student makes a lump sum of $4 000 and continues regular payments. Find the number of remaining payments (nearest whole).

Q23 A loan of $96 000 is repaid quarterly over 8 years at $i = 1.35$ % per quarter. Construct the first two lines of the amortisation schedule showing opening balance, interest, principal repaid and closing balance.

Annuities – Present Value Streams

Q24 A company leases equipment for 5 years, paying $1 250 at the end of each month. If the discount rate is 6.0 % p.a. compounded monthly, find the present value of the lease.

Q25 A retiree wants $3 200 per month for 20 years. The fund earns 4.8 % p.a. compounded monthly. How much must be in the account at retirement?

Q26 A trust will pay $15 000 at the end of each year for 10 years. If money earns 5.5 % effective, what single deposit now is equivalent?

Depreciation

Q27 Equipment costing \$62 000 depreciates at 18 % p.a. reducing balance. Find its value after 5 years.

Q28 A vehicle depreciates from \$48 500 to \$24 700 over 4 years using straight line. Find the annual depreciation and the book value after 3 years.

Q29 A computer system costs \$32 000 and is depreciated at 30 % p.a. reducing balance. After how many years will its value first fall below \$5 000?

Mixed Applications

Q30 You borrow \$3 500 on a credit card charging 18 % p.a. compounded monthly. If you pay \$150 at the end of each month, how many months to clear the balance?

Q31 A saver invests \$400 per month for 10 years at 4.2 % p.a. compounded monthly, then leaves the accumulated amount for a further 5 years at 5.0 % p.a. compounded annually. Find the final amount.

Q32 A project requires initial capital \$220 000 and pays \$52 000 at the end of each year for 6 years. If the discount rate is 8.0 % effective, find the net present value (NPV) and state whether the project is acceptable.

Q33 A car dealer offers two options on a \$42 000 car:
(A) \$2 000 cashback and a loan for the balance at 6.9 % p.a. compounded monthly over 5 years.
(B) No cashback, but 4.9 % p.a. compounded monthly over 5 years.
Compare monthly repayments and total cost to decide the cheaper option.

Q34 An account advertises 6.0 % p.a. interest compounded monthly with a \$5 monthly account fee charged at month end. You deposit \$10 000 and make no further transactions. Model the balance B_n at the end of month n and compute B_{24}.

Challenge Question

Q35 Saving for a home deposit with step-up contributions
You aim to save a \$120 000 deposit in 7 years. An account pays 5.1 % p.a. compounded monthly. You can contribute \$900 per month for the first 24 months, then increase the monthly contribution by \$150 every 12 months thereafter (i.e. months 25–36: \$1 050, months 37–48: \$1 200, months 49–60: \$1 350, months 61–72: \$1 500, and months 73–84: \$1 650). All deposits are made at month ends.

  (a) Write the balance after 7 years as a sum of annuity future values and compute the total.

  (b) If the total is short of \$120 000, find the single extra lump sum required at the end of month 84 to reach the goal.

(c) Alternatively, if you insist on no final lump sum, determine the constant monthly contribution for all 84 months that reaches $120 000.

(d) If inflation averages 2.7 % p.a., what is the real value of the $120 000 target in today's dollars?