TRINITY COLLEGE

Year 12 Mathematics Applications
Test 4   2017
Calculator Assumed
Finance

STUDENT'S NAME _Solutions_

DATE: Thursday 29th June   **TIME:** 50 minutes   **MARKS:** 51

INSTRUCTIONS:

Standard Items: Pens, pencils, drawing templates, eraser

Special Items: Three calculators, notes on one side of a single A4 page (these notes to be handed in with this assessment)

Questions or parts of questions worth more than 2 marks require working to be shown to receive full marks.

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1.   (9 marks)

Aaron is investigating obtaining a loan for a new car. Use the screen capture below to answer the following the questions regarding his loan.

(a)   Fill in the blank spaces.   [6]

A loan of _$9100_, with an annual

interest rate of _7.8 %_, will be reduced to

a balance of _$214.15_ after _9_ years,

when interest is compounded _quarterly_,

i.e _4_ times per year.

Compound Interest	
N	36
I%	7.8
PV	9100
PMT	−350
FV	−214.1490296
P/Y	4
C/Y	4

(b)   Determine the interest rate per compounding period?   [1]

$$\frac{7.8}{4} = 1.95\% \text{ per quarter}$$

(c)   How much will Aaron's final repayment be?   [2]

$$214.149 \times 1.0195 = \$218.32$$

2. (3 marks)

Determine the principal that would need to be invested at 3.7% p.a. compounded daily to earn $1400 interest in 6 years.

$$1400 + P = P\left(1 + \frac{0.037}{365}\right)^{365 \times 6}$$

$$P = \$5632.50$$

3. (5 marks)

Ryan would like to invest some money. By first determining the effective interest rate, rank the following options from the best (number 1) to the worst.

Scheme	Effective Interest Rate	[ ]Rank ✓
10.5% p.a. compounding daily	$N = 365$ [1] $R = 10.5$ $E = 11.0605\ \%\ p.a$	2
11% p.a. simple interest	[1] $E = 11\ \%\ p.a$ ✓	3
0.9% per month compounding monthly	$N = 12$ [2] $R = 0.9 \times 12$ $E = 11.35\ \%\ p.a$ ✓ $= 10.8$	1

4. (9 marks)

Luke is depreciating his car for tax purposes. He can choose between using flat rate depreciation at a rate of $2000 per year or reducing balance depreciation at rate of 15% per year. Luke purchased the car at the beginning of 2014 for $38 000.

$$2014 = T_0$$
$$2015 = T_1$$

(a) Using the flat rate depreciation method,

   (i) determine the value of the car in 2017. [2]

   $$T_3 = 38\,000 - 3(2000)$$
   $$= \$32\,000$$

   (ii) after how many years will the value of the car first fall below $15 000 [2]

   $$15000 = 38\,000 - 2000x$$
   $$x \geqslant 11.5$$
   $$\therefore \text{ after } 12 \text{ years}$$

(b) Using the reducing balance depreciation,

   (i) write a recursive rule that gives the value of the car n years after 2014. [2]

   $$V_{n+1} = 0.85\,V_n \quad, \quad V_0 = 38\,000$$

   (ii) determine the value of the car in 2017. [1]

   $$V_3 = \$23\,336.75$$

   (ii) after how many years will the value of the car first fall below $15 000 [2]

   $$15\,000 = 38\,000 \times 0.85^n$$
   $$n = 5.7 \text{ years}$$
   $$\therefore \text{ after } 6 \text{ years.}$$

5. (20 marks)

Liam is planning to borrow money from the bank to purchase a new car. He will get a reducible interest loan that compounds monthly and he will make regular monthly repayments.

The table below shows the progress for the first 6 months. All values have been rounded to the nearest cent.

Month	Amount owing at the beginning of the month	Interest for the month	Repayment	Amount owing at the end of the month
1	$ 25,000.00	$ 150.00	$ 700.00	$ 24,450.00
2	$ 24,450.00	$ 146.70	$ 700.00	$ 23,896.70
3	$ 23,896.70	$ 143.38	$ 700.00	$ 23,340.08
4	$ 23,340.08	$ 140.04	$ 700.00	$ 22,780.12
5	$ 22,780.12	$ 136.68	$ 700.00	$ 22,216.80
6	$ 22,216.80	$ 133.30	$ 700.00	$ 21,650.10
7	21 650.10	$129.90	$ 700	$ 21 080.00

(a) Determine the values of **A, B, C** and **D** to complete the table below. [5]

0.6% or 0.006 1 mark

$\frac{150}{25000} \times 12 \times 100$

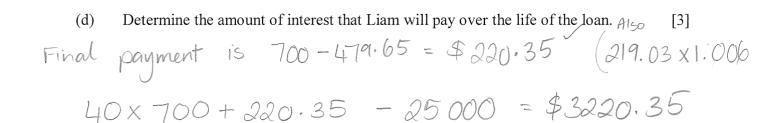|	
Annual Interest Rate (%)	**A** 7.2 %
Number of compounds p.a	**B** 12 ✓
Monthly loan repayment	**C** 700 ✓
Starting amount	**D** 25 000 ✓

(b) Complete the last row of the table, to show the progress for the 7th month. [2]

✓ ✓

(c) In which month will Liam pay off the loan? [1]

$T_{40} = 219.03$

$T_{41} = -479.65$

∴ at the end of 41st month

(d)   Determine the amount of interest that Liam will pay over the life of the loan. Also   [3]

Final payment is $700 - 479.65 = \$220.35$ (219.03×1.006

$40 \times 700 + 220.35 - 25000 = \$3220.35$

(e)   What affect will it have on the loan if Liam repays $150 per month?   [2]

He will never pay off the loan as he is paying interest only.   Steady state

(f)   Write a recurrence relation where V_n is the value of Liam's investment ~~Loan~~ after n years.   [3]

$V_{n+1} = 1.006 V_n - 700, \quad V_0 = 25000$

$\dfrac{7.2\%}{100} = 0.6\%$ per month

After 2 years Liam explores some options to determine if he can pay the loan back quicker.

(g)   If, after 2 years Liam decides to double the repayment he makes each month, by how much will he shorten the life of the loan?   [2]

The loan will be paid in month 32, reducing length by 9 months.

(use spreadsheet, change month 25 & beyond to 1400).

(h)   If Liam would like to repay the remaining amount in 6 equal monthly repayments. How much, to the nearest cent, should he repay each month?   [2]

After 2 year Liam owes $10 847.83

On Finance App.

$N = 6$
$I = 7.2$
$PV = 10 847.83$
$PMT = ?$
$FV = 0$ $PY = CY = 12$

$PMT = -1846.1283$

∴ payments of $1846.13

6. (5 marks)

To save up to buy a new car James opens a savings account that earns 11.4% p.a. compounded monthly. He initially deposits $2700 when he opens the account at the beginning of the month and then he deposits $420 at the end of every month.

(a) How much is in James' account after 2 years? [2]

Finance App.

$N = 24$
$I = 11.4$
$PV = -2700$
$PmT = -420$
$PY = CY = 12$

$FV = \$14\ 649.7185$

$\therefore \approx \$14\ 649.72$

(b) Calculate the interest earned in the two years as a percentage of James' total contributions to the account. [2]

$$= \frac{14\ 649.72 - 2700 - 24 \times 420}{2700 + 24 \times 420} \times 100$$

$$= \frac{1869.72}{12\ 780} \times 100$$

$$= 14.63\%$$

$$\frac{14\ 649.72}{2700 + 24 \times 420} \times 100$$

$$= 114.63\%$$

$$\therefore 14.63\%$$

(c) Explain why the percentage in part (b) is different from the annual interest rate. [1]

James earnt 14.63% on the investment over 2 years, compared to 11.4% p.a. because the loan compounds every month, earning interest on interest.