GRADE 12 APPLIED   Name:_____
UNIT B – PERSONAL FINANCE   Date: _____
LOANS

Recall Grade 11 Essential Interest and Credit Studies.

We had used pre-computed values in **tables** to determine the regular monthly loan payments ('annuities') to pay off a loan over some amortization period. The tables were provided in your notes and printed as a separate coloured table.

You had learned about Simple and Compound interest on an investment or a loan in which you invest or borrow a fixed sum of money (present Value, PV) for a certain time and the re-payment (Future Value, FV) occurs all in one shot.

For example, you borrow $2,000 from your uncle and he gets $3,000 back in one single payment after two years. In reality though, very few banks are willing to loan you money and say: "come back in a couple years and pay us back". They want monthly installments to make sure you are still in town! Further, paying off the loan (amortizing the loan) in installments makes it cheaper for you too because you start paying it off right away and you don't end up with a big 'surprise' at the end of the loan period for a lot of money to pay back. There is a huge unwieldy formula you can use to calculate your loan payments and loads of apps and websites that readily do the calculation.

If you do Pre-calculus you'll be able to derive ← this formula yourself!

$$P = \frac{r * M}{1 - \left(1 + \dfrac{r}{n}\right)^{-nt}} \div n$$

where '**P**' is the monthly payment, ; '**r**' the annual interest rate;

'**M**' the mortgage amount; '**t**' the number of years to 'amortize'; and '**n**' is the number of payments per year. So a computer or an App is preferred!

The **loan tables** we used were a simple way to calculate a monthly loan payment instead of that ugly formula above.

2. You borrow $6,500 from the bank at 9% interest (compounded monthly) and want to pay it off (amortize it, 'mort' in French means kill) after 5 years. Using tables answer the following:

    a. what will your monthly payments be?

    b. how many monthly payments do you make pay off the loan?

    c. how much will you have paid at the end of the loan total?

    d. what was your cost to borrow that money (ie: the interest you paid)

3. Now do it on a TVM App

Mode   ●End ○Beginning

Present Value   +6,500   Positive

Payments   ??

Future Value   0 ← Amount owing after 5 years

Annual Rate (%)   9   NoT 0.09

Periods   60 months = 5yr · $\frac{12 month}{1 yr}$

Compounding   Monthly

PV. The PV is **positive** since it is money you got loaned.

PMT. We are solving for the Payments (PMT)

FV. We want the future value to be zero amount owing after the 5 years.

Rate. The Interest rate is entered as the % rate, *not* as a decimal.

Periods. 5 years is 60 monthly periods.

Compounding. The dropdown menu we select the Compounding Frequency

4. Recall **our** tables only worked for monthly payments. The TVM App allows us to get considerably more fancy!

5. Would you believe that if you made your regular loan payments every two weeks ('bi-weekly') on pay day, that you would end up paying less for the $6,500 loan in the end!

Try it. →

Hint: there are 26 bi-weekly periods in a year

Mode	◉ End ◯ Beginning	
Present Value		PV
Payments		PMT
Future Value		FV
Annual Rate (%)		Rate
Periods		Periods
Compounding	Bi-Weekly ⌄	

6. If you paid bi-weekly how did that compare with the monthly loan payment calculation? Complete the table below:

	Periodic Payment	Total Amount Paid	Cost of Loan (Interest)
Monthly			
Bi-Weekly			

7. You borrow $250,000 from the bank for a house loan (ie: mortgage) at 8.5% interest and want to pay it off after 10 years. Use the manual method with tables again. (*need to interpolate the table value, halfway between 8% and 9%*)

    a. what will your **monthly** payments be from tables?

    b. how many monthly payments do you make to pay off the loan?

    c. how much will you have paid at the end of the loan total?

d. what was your cost to borrow that money (ie: the interest you paid)?

e. how much would the loan have cost you in interest if you had paid it off in 5 years instead? (Need to look it up in tables again!)

8. Calculate it again on a TVM App to find the **monthly** payments.

Why do you not get exactly the same answer as the table method??

Table values were rounded

Mode	● End ○ Beginning	
Present Value		PV
Payments		PMT
Future Value		FV
Annual Rate (%)		Rate
Periods		Periods
Compounding	Monthly	

9. Calculate it with bi-weekly payments now and bi-weekly compounding.

So in effect you are making 13 payments a year instead of 12. Paying it down quicker ·

Mode	● End ○ Beginning	
Present Value		PV
Payments		PMT
Future Value		FV
Annual Rate (%)		Rate
Periods		Periods
Compounding	Bi-Weekly	

10. If you paid off your $250,000 mortgage bi-weekly how did that compare with the monthly loan payment calculation? ·Complete the table:

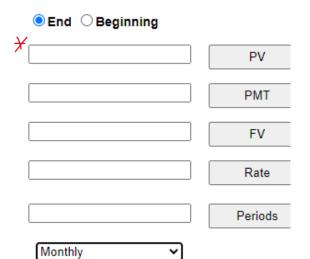|	Periodic Payment	Total Amount Paid	Cost of Loan (Interest)
Monthly			
Bi-Weekly			

Solving for other arguments (variables) in the Loan Equation

11. Say you know you can afford $1,200/month mortgage payments. Present mortgage rates are 3.75% compounded the end of every month. You will take a fixed rate mortgage of that 3.75% for 25 years. So how much of a house mortgage can you afford if you pay monthly.

Caution: *There are of course many other monthly costs to affording a house: heat and property taxes being biggies; perhaps another $350 - $450 per month. Maybe also regular maintenance, home insurance [~$700 / year], etc.*

N=
I%=
*PV=
PMT=
FV=
P/Y=
C/Y=
PMT:**END** BEGIN

TI 83 App ⇑

○ End ○ Beginning

* [   ] PV

[   ] PMT

[   ] FV

[   ] Rate

[   ] Periods

[Monthly ⌄]

12. As per the previous question how much house could you afford if you decide instead to work lots of over time; be a hermit, …no smoking, …no parties, …no bingo, no kids, ….maybe renting out a room; and pay off the house in 10 years. Say you will make monthly payments of $3,000.

PV
* PmT
FV
Int %
Pds
Compounding:
⟶

13. Your partner has their eye on the perfect house for your young family. A great neighbourhood, school down the block, it is only $285K. Of course, you will need to make a down payment of 10% of that up-front. So, you will need to finance at the bank for a mortgage of $256.5K (256,500). You have done a budget an determined you can afford $1,700 / month for the mortgage payments.

14. Determine what interest rate you will need to acquire / negotiate for 25 years to afford the mortgage.

You need an interest rate of _____ or better (less).

PV

PmT

FV

$*$ Int %

Pds

COMPOUNDING:

$\rightarrow$

15. How does a bank determine initially if you can afford a mortgage?

They calculate a **Gross Debt Service Ratio**. They want to make sure you can afford the house and not be spending more than 32% of your Gross Income on your house.

$$\text{Gross Debt Service ratio (\%)} = \frac{\left(\begin{array}{ccc}\text{Monthly} & \text{Monthly} & \text{Monthly} \\ \text{Mortgage} + \text{Property} + \text{Heating} \\ \text{Payment} & \text{Taxes} & \text{Costs}\end{array}\right)}{\text{Gross Monthly Income}} * 100; \text{ max } 32\%$$

16. Mr. and Mrs. Spence have a total monthly gross income of $6,000.00. They are interested in purchasing a house with a mortgage payment of $1,300.00 per month, annual heating costs of $2,100.00, and annual property taxes (including school taxes) of $3,675.00.

    a. Calculate the gross debt service ratio (GDSR).

    b. Determine if a bank is likely to offer them a mortgage.

17. Marshall and Kim are renting a house that they hope to purchase. They pay $1,800 in annual heating costs and know that the annual property taxes are $2,500. Their combined gross income is $5,200 per month.

    a) Based on the gross debt service ratio (GDSR), what is the maximum monthly mortgage payment they can afford?

    b) If they have saved $30,000.00 for a down payment, what is the maximum house price they can afford based on a 25-year amortization period at an interest rate of 4.64%, compounded semi-annually?

MONTHLY LOAN PAYMENT TABLE FOR A LOAN OF $1,000

Annual Rate	1 Year Monthly	2 Years Monthly	3 Years Monthly	4 Years Monthly	5 Years Monthly	10 Years Monthly	15 Years Monthly	20 Years Monthly	25 Years Monthly
2%	$84.24	$42.54	$28.64	$21.70	$17.53	$9.20	$6.44	$5.06	$4.24
3%	$84.69	$42.98	$29.08	$22.13	$17.97	$9.66	$6.91	$5.55	$4.74
4%	$85.15	$43.42	$29.52	$22.58	$18.42	$10.12	$7.40	$6.06	$5.28
5%	$85.61	$43.87	$29.97	$23.03	$18.87	$10.61	$7.91	$6.60	$5.85
6%	$86.07	$44.32	$30.42	$23.49	$19.33	$11.10	$8.44	$7.16	$6.44
7%	$86.53	$44.77	$30.88	$23.95	$19.80	$11.61	$8.99	$7.75	$7.07
8%	$86.99	$45.23	$31.34	$24.41	$20.28	$12.13	$9.56	$8.36	$7.72
9%	$87.45	$45.68	$31.80	$24.89	$20.76	$12.67	$10.14	$9.00	$8.39
10%	$87.92	$46.14	$32.27	$25.36	$21.25	$13.22	$10.75	$9.65	$9.09
12%	$88.85	$47.07	$33.21	$26.33	$22.24	$14.35	$12.00	$11.01	$10.53
14%	$89.79	$48.01	$34.18	$27.33	$23.27	$15.53	$13.32	$12.44	$12.04
16%	$90.73	$48.96	$35.16	$28.34	$24.32	$16.75	$14.69	$13.91	$13.59
18%	$91.68	$49.92	$36.15	$29.37	$25.39	$18.02	$16.10	$15.43	$15.17
20%	$92.63	$50.90	$37.16	$30.43	$26.49	$19.33	$17.56	$16.99	$16.78
25%	$95.04	$53.37	$39.76	$33.16	$29.35	$22.75	$21.36	$20.98	$20.88
30%	$97.49	$55.91	$42.45	$36.01	$32.35	$26.36	$25.30	$25.07	$25.02
35%	$99.96	$58.52	$45.24	$38.97	$35.49	$30.12	$29.33	$29.20	$29.17