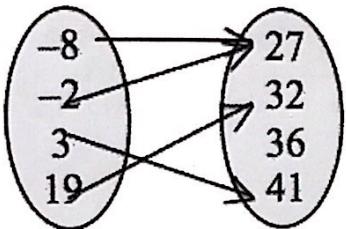


1. Which relation is a function?

- a.  $\{(-3, -2), (-1, 3), (0, -2), (3, 4)\}$     c.  $\{(-7, -7), (-2, 5), (-1, 6), (-2, -5)\}$   
 b.  $\{(0, 1), (3, 2), (5, -3), (0, 2)\}$     d.  $\{(-4, -7), (-9, 5), (4, -2), (-9, 0)\}$

1. A

2. What are the domain and range of the relation?



- a. Domain = {27, 32, 41}  
 Range = {-8, -2, 3, 19}    c. Domain = {-8, -2, 3, 19}  
 Range = {27, 32, 41}    d. Domain = {27, 32, 36, 41}  
 Range = {-8, -2, 3, 19}

2. C

3. Which of the following transformations is required to graph  $y = \sqrt{-x - 6}$  from its parent function?

$$= \sqrt{-(x+6)}$$

3. C

- a. Reflect the graph  $f(x) = \sqrt{x}$  in the x-axis, then translate it 6 units to the left.  
 b. Reflect the graph  $f(x) = \sqrt{x}$  in the y-axis, then translate it 6 units to the right.  
 c. Reflect the graph  $f(x) = \sqrt{x}$  in the y-axis, then translate it 6 units to the left.  
 d. Reflect the graph  $f(x) = \sqrt{x}$  in the x-axis, then translate it 6 units to the right.

4. d

4. Which pair of functions is equivalent?

- a.  $f(x) = 7(9x^2 + 12) + 3(8x^2 - 23)$   
 $g(x) = 6(5x^2 + 11) + 10(4x^2 - 9)$   
 b.  $f(x) = (14x^2 + 5x) + (8x^2 + 19x)$   
 $g(x) = 22x^2 + 23x$     c.  $f(x) = (14x^2 - 5x) - (2x^2 + 8x)$   
 $g(x) = 12x^2 + 3x$   
 d.  $f(x) = 3(15x^2 - 11) + (19x^2 - 79)$   
 $g(x) = 6(6x^2 - 10) - 4(13 - 7x^2)$

5. A

5. Which of the following represents factoring  $g^3 + 5g^2 + 2g + 10$  by grouping?

- a.  $g^2(g + 5) + 2(g + 5)$     c.  $(g + 5)^3$   
 b.  $(g^2 + 5) + (2g + 5)$     d.  $(g + 5)(g + 5) + (g + 2)(g + 2)$

6. B

6. The Canada Calendar Company reduces the prices of its calendars each January.

The function  $f(x) = -25(x - 9)^2 + 200$  models the company's profits, where  $x$  is the price of a calendar in dollars.

At what calendar price will the company receive maximum profits?

- a. \$5    c. \$10  
 b. \$9    d. \$15

7. C

7. For what value(s) of  $k$  will the function  $g(x) = x^2 + kx + 1$  have only one zero?

- a. 0    c. -2, 2  
 b. 2    d. No values will work

$$\begin{aligned} b^2 - 4ac &= 0 \\ (k)^2 - 4(1)(1) &= 0 \\ k^2 - 4 &= 0 \end{aligned}$$

7. T

Determine the value of  $\theta$  to the nearest degree if  $\cot \theta = 2$ .

- a.  $51^\circ$    c.  $27^\circ$   
b.  $45^\circ$    d.  $63^\circ$

$$\tan \theta = \frac{1}{2}$$

8. C

9. Determine the number of terms in the sequence: 5240, 4365, 3490, 2615, ..., -2635

- a. 8   c. 11  
b. 10   d. 9

9. B

10. What is the common ratio for a principal, \$P, invested in an account that compounds annually for  $n$  years at  $1\%/\text{a}$ ?

- a.  $P(1+i)$    c.  $n-1$   
b.  $1+i$    d.  $A-P$

10. B

### Part B: Fill in the blanks: 10 marks

Answers must be placed in the space provided. It is not necessary to show work. Each question is worth one mark.

11. State the domain for the following function:  $y = \sqrt{x-7}$

11.  $x \geq 7$

12. Given the point  $(2, -5)$  on  $y = f(x)$ , what would be the image of the point under the following transformation:  $y = 2f\left(\frac{1}{3}x\right)$

12.  $(6, -10)$

13. Simplify the following expression:  $\frac{m^2 + 2m - 15}{2m^2 + 5m - 25} \quad \frac{(m+5)(m-3)}{(2m-5)(m+5)}$

13.  $\frac{m-3}{2m-5}$

14. Evaluate:  $125^{-\frac{2}{3}}$  (No decimals)  $\frac{1}{125^{\frac{2}{3}}} = \frac{1}{25}$

14.  $\frac{1}{25}$

15. Write the recursive sequence for 3, 12, 48, 192, ...

15.  $t_1 = 3, t_n = 4t_{n-1}, n > 1$

16. What is the horizontal asymptote of the function  $y = 4^x - 3$ ?

16.  $y = -3$

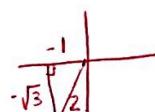
17. What is the principal angle of  $875^\circ$ ?

17.  $155^\circ$

18. State the period of the function  $y = 2 \sin 4\theta - 5$  in degrees.

18.  $90^\circ$

19. What is the exact value of  $\cot 240^\circ$ ?



19.  $\sqrt{3}$

20. How much simple interest is on a deposit of \$750 at  $4\%/\text{a}$  for 121 days?

20. \$9.95

21. 3

21.  $\frac{3}{4 \times \sqrt{5}x}$

22.  $4x\sqrt{5}x$

22.  $\frac{x+5}{2}$

23.  $f(x) = \frac{x+5}{2}$

23.  $1.1$

24. 1.1

24. 68

\* 25. 68

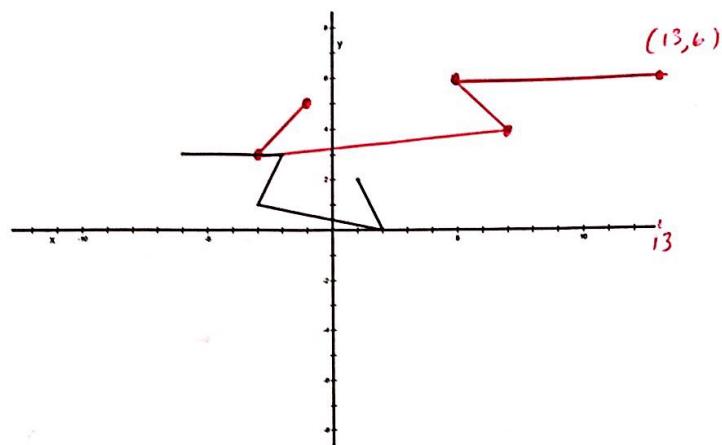
TB  
TB

### C: Full Solutions

Answer the following questions in the space provided. Complete solutions are required and all answers should be expressed in their simplest form.

1. Given the graph  $y = f(x)$ , sketch  $y = f\left[-\frac{1}{2}(x-1)\right] + 3$ . State all of the transformations.

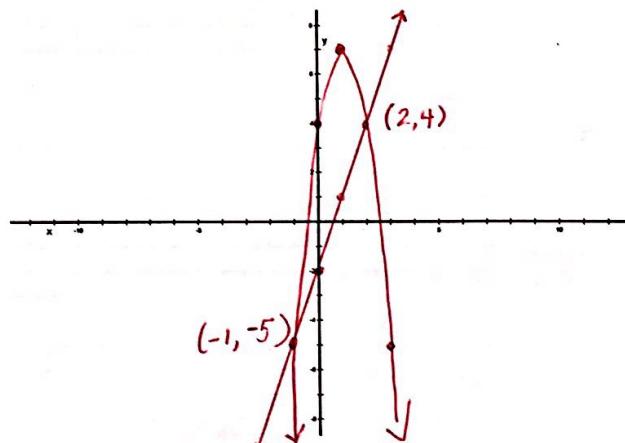
[6]



reflection in the  $y$ -axis  
h.s. by a factor of 2  
1 right  
3 up

2. Determine the point(s) of intersection of the functions  $f(x) = -3x^2 + 6x + 4$  and  $g(x) = 3x - 2$  algebraically and by graphing.

$$\begin{aligned} f(x) &= -3(x^2 - 2x + 1 - 1) + 4 \\ [6] \quad &= -3(x^2 - 2x + 1) + 3 + 4 \\ &= -3(x-1)^2 + 7 \end{aligned}$$



Algebraically:

$$\begin{aligned} -3x^2 + 6x + 4 &= 3x - 2 \\ -3x^2 + 3x + 6 &= 0 \\ x^2 - x - 2 &= 0 \\ (x-2)(x+1) &= 0 \\ (x=2), (x=-1) \end{aligned}$$

$$\begin{cases} y = 3(2) - 2 \\ y = 3(-1) - 2 \end{cases} \quad \begin{cases} y = 4 \\ y = -5 \end{cases}$$

$$\boxed{(-1, -5) \text{ and } (2, 4)}$$

Simplify and state any restrictions on the variables:

$$\frac{6x}{x^2 - 5x + 6} - \frac{3x}{x^2 + x - 12}$$

$$= \frac{6x}{(x-2)(x-3)} - \frac{3x}{(x+4)(x-3)}$$

$$[4] = \frac{6x(x+4) - 3x(x-2)}{(x-2)(x-3)(x+4)}$$

$$= \frac{6x^2 + 24x - 3x^2 + 6x}{(x-2)(x-3)(x+4)}$$

$$= \frac{3x^2 + 30x}{(x-2)(x-3)(x+4)} \quad \text{or} \quad \frac{3x(x+10)}{(x-2)(x-3)(x+4)}$$

restrictions.

$$x \neq 2, 3, -4$$

[4]

4. Determine the equation of the quadratic function in standard form that has roots

$$(2 + \sqrt{3}) \text{ and } (2 - \sqrt{3}) \text{ and passes through the point } (1, 4).$$

$$y = a(x-s)(x-t)$$

$$[4] y = a(x - (2+\sqrt{3}))(x - (2-\sqrt{3}))$$

$$y = a((x-2)^2 - (\sqrt{3})^2)$$

$$y = a(x^2 - 4x + 4 - 3)$$

$$y = a(x^2 - 4x + 1)$$

$$4 = a((1)^2 - 4(1) + 1)$$

$$4 = a(-2)$$

$$a = -2$$

$$y = -2(x^2 - 4x + 1)$$

$$y = -2x^2 + 8x - 2$$

5. A bus company has 3000 passengers daily, each paying a fare of \$2. For each \$0.10 increase, the company estimates that it will lose 30 passengers per day. If the company needs to take in \$9072 per day to stay in business, what range of fares should be charged?

Revenue = #of tickets  $\times$  price per ticket

[4]

$$R = (3000 - 30x)(2 + 0.10x)$$

$$9072 = (3000 - 30x)(2 + 0.10x)$$

$$9072 = 6000 + 300x - 60x - 3x^2$$

$$3x^2 - 240x + 3072 = 0$$

$$x = \frac{240 \pm \sqrt{(-240)^2 - 4(3)(3072)}}{2(3)}$$

$$x = \frac{240 \pm \sqrt{20736}}{6}$$

$$x = \frac{240 \pm 144}{6}$$

$$x = 64 \text{ or } 16$$

$$\therefore 2 + 0.1(16)$$

$$= 2 + 1.6$$

$$= 3.6$$

and

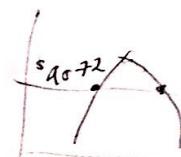
$$x = 2 + 0.1(64)$$

$$x = 2 + 6.4$$

$$x = 8.4$$

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$\therefore$  between \$3.60 + \$8.40

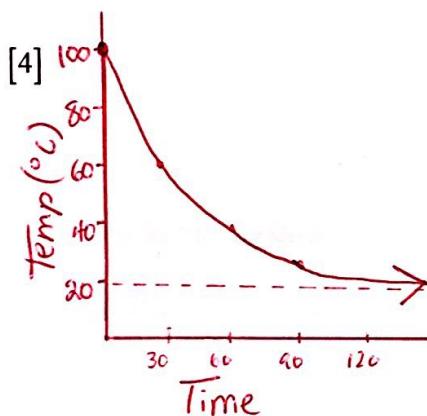


12

A piece of rock contains 4.6 grams of Carbon. Scientists estimate that it originally contained 234 grams of carbon. Determine the age of the rock if the half life is 120 years.

$$\left. \begin{array}{l} M = C \left(\frac{1}{2}\right)^{t/h} \\ [4] 4.6 = 234 \left(\frac{1}{2}\right)^{t/120} \\ 0.019658 = (0.5)^{t/120} \\ \frac{\log 0.019658}{\log 0.5} = \frac{t}{120} \\ 5.67 = \frac{t}{120} \end{array} \right\} t \approx 680 \text{ years}$$

7. A cup of hot liquid was left to cool in a room whose temperature was  $19^\circ\text{C}$ . The temperature changes with time according to the function  $T(t) = 81\left(\frac{1}{2}\right)^{\frac{t}{30}} + 19$ . Use your knowledge of transformations to sketch this function. Explain the meaning of the y-intercept and the asymptote in the context of this problem.

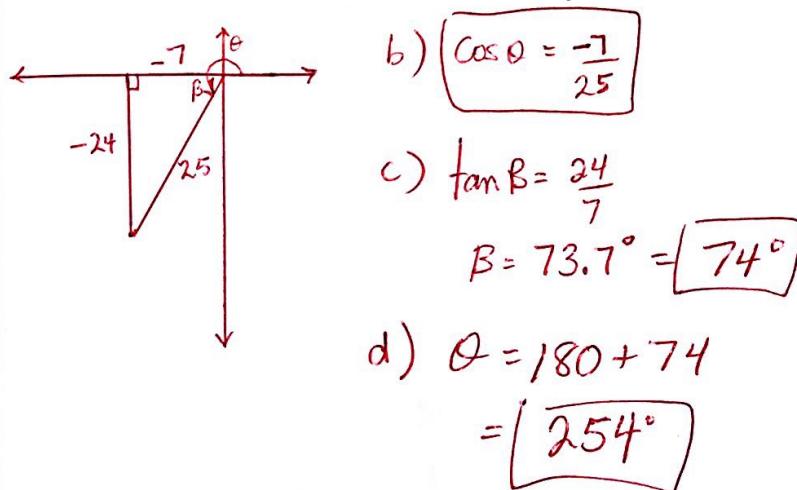


The y-intercept is the initial temp of the liquid. In this case,  $100^\circ\text{C}$ .

The horizontal asymptote refers to the room temperature of  $19^\circ\text{C}$ .

8. Point  $(-7, -24)$  is on the terminal arm of the angle  $\theta$  in standard position.

- a) Sketch the principal angle  $\theta$ . /1  
 b) What is the value of  $\cos \theta$ . /1  
 c) What is the measure of the related acute angle to the nearest degree? /1  
 d) What is the measure of  $\theta$  to the nearest degree? /1



Cosθ

Solve for θ to the nearest degree, if  $\tan \theta = -0.3341$ , where  $-180^\circ \leq \theta \leq 360^\circ$ .

$$\beta = \cos^{-1}(0.3341)$$

$$\beta = 70.48$$

$$\beta = 70^\circ$$

$$\theta_1 = 180 - 70 \\ = 110^\circ$$

$$\theta_2 = 180 + 70 \\ = 250^\circ$$

$$\therefore \theta = -110^\circ, 110^\circ, 250^\circ$$

$$\theta_3 = -180 + 70 \\ = -110^\circ$$

10. Prove the following identity:

$$\tan \theta + \frac{1}{\tan \theta} = \frac{1}{\sin \theta \cos \theta}$$

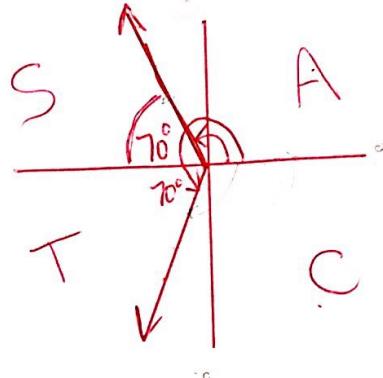
$$[4] \quad \frac{\sin \theta}{\cos \theta} + \frac{1}{\frac{\sin \theta}{\cos \theta}}$$

$$\frac{\sin \theta}{\cos \theta} + \frac{\cos \theta}{\sin \theta}$$

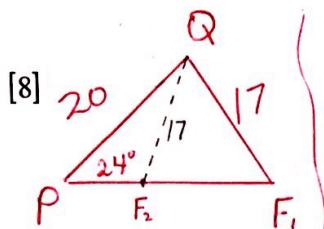
$$\frac{\sin^2 \theta + \cos^2 \theta}{\cos \theta \sin \theta}$$

$$\frac{1}{\cos \theta \sin \theta}$$

= R.S.



- Two forest fire stations, P and Q, are 20 km apart. A ranger at station Q sees a fire 17 km away. If the angle between the line PQ and the line from P to the fire is  $24^\circ$ , how far, to the nearest tenth of a kilometre, is station P from the fire? There are 2 answers.



$$\frac{\sin 24^\circ}{17} = \frac{\sin F}{20}$$

$$\sin F = 0.4785$$

$$\angle F = 28.6^\circ$$

$$\angle Q = 127.4^\circ$$

$$\frac{\sin 24^\circ}{17} = \frac{\sin 127.4^\circ}{x_1}$$

$$x_1 = 33.2 \text{ Km}$$

$$\text{Also, } \angle F = 151.4^\circ$$

$$\angle Q = 4.6^\circ$$

$$\therefore \frac{\sin 24^\circ}{17} = \frac{\sin 4.6^\circ}{x_2}$$

$$x_2 = 3.35 \text{ Km}$$

[3.3] if round at end.

$$[33.2 \text{ Km or } 3.3 \text{ Km}]$$

12. The average monthly temperature,  $T(t)$ , in degrees Celsius in Ottawa, Ontario, can be modelled by the function  $T(t) = 15.4 \sin 30(t - 4.2) + 4.7$ , where  $t$  represents the number of months. For  $t = 1$ , the month is January; for  $t = 2$ , the month is February; and so on.

- a) What is the period and what does this represent? [1]

$$P = \frac{360}{30} = 12 \text{ represents the 12 months of the year}$$

- b) What is the temperature range in Ottawa? [1]

$$-10.7^\circ C \leq T \leq 20.1^\circ C$$

- c) What is the average temperature in Ottawa? [1]

$$4.7^\circ C$$

- d) When does the temperature reach  $17^\circ C$ ? [4]

$$17 = 15.4 \sin 30(t - 4.2) + 4.7$$

$$12.3 = 15.4 \sin 30(t - 4.2)$$

$$\frac{12.3}{15.4} = \sin 30(t - 4.2)$$

$$53 = 30(t - 4.2)^\circ \text{ or } 180 - 53 = 30(t - 4.2)$$

$$53 = t - 4.2$$

$$\frac{30}{30}$$

$$1.77 = t - 4.2$$

$$5.97 = t$$

$$127 = 30(t - 4.2)$$

$$4.23 = t - 4.2$$

$$8.43 = t$$

13

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$\therefore$  Late May & Mid August

- Determine the number of terms in the following arithmetic sequence:  
 $-226, -195, -164, -133, \dots, 549$ . (Show appropriate work)

$$\begin{aligned} [4] \quad d &= -195 - (-226) \\ &= 31 \end{aligned}$$

$$t_n = a + d(n-1)$$

$$549 = -226 + 31(n-1)$$

$$549 = -226 + 31n - 31$$

$$549 = -257 + 31n$$

$$806 = 31n$$

$$n = 26 \text{ terms}$$

14. Ernie bought a plasma TV for \$500 down and 36 monthly payments of \$60 each. The first payment is due at the beginning of next month.

a) The interest is 12% compounded monthly. What is the selling price of the TV? [3]

$$\left. \begin{aligned} PV &= R \times \frac{[1 - (1+i)^{-n}]}{i} \\ PV &= \frac{60}{0.01} [1 - (1.01)^{-36}] \\ PV &= 1806.45 \end{aligned} \right\} \begin{aligned} &\therefore 1806.45 + 500 \\ &\$2306.45 \end{aligned}$$

- b) Because of the financing, how much interest did Ernie pay? [2]

$$36 \times 60 = 2160 + 500$$

$$= 2660$$

$$\therefore 2660 - 2306.45$$

$$=\$353.55$$

# Mr. Flynn

expand and simplify the first three terms of  $(2x - 4y)^9$ .

From Pascal's Triangle, use 1, 9, 36

$$(2x - 4y)^9 = 1(2x)^9(-4y)^0 + 9(2x)^8(-4y)^1 + 36(2x)^7(-4y)^2 \\ = 512x^9 - 9216x^8y + 73728x^7y^2$$

This confuses kids

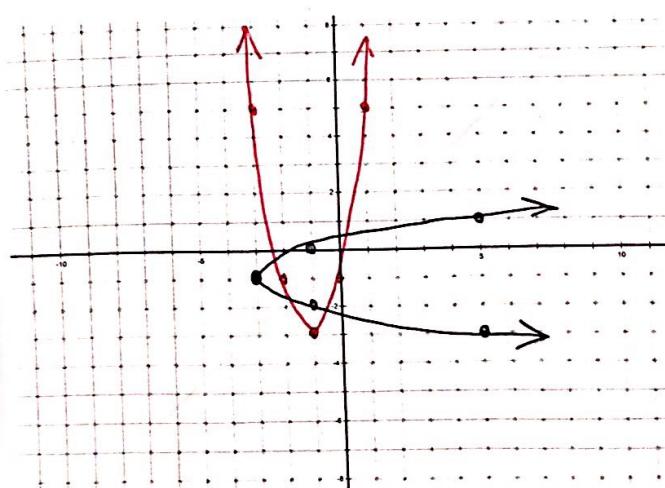
16. At the end of every three months, Mr. Anderson deposited \$400 in a savings account that paid 6%/a, compounded quarterly. He made the first deposit when his son was three months old and he made the last deposit on his son's 17<sup>th</sup> birthday. The money remained in the account until his son turned 23, when Mr. Anderson gave him the money. How much did he receive? [4]

$$FV = \frac{400[1.015^{68} - 1]}{0.015} \\ = \$46727.17$$

$$\left. \begin{array}{l} A = P(1+r)^n \\ = 46727.17(1.015)^{24} \\ = \$66796.62 \end{array} \right\}$$

17. Given the quadratic function  $f(x) = 2(x+1)^2 - 3$ ,

- a) graph  $f(x)$  and its inverse. [2]  
b) determine the equation of the inverse. [2]



$$\begin{aligned} x &= 2(y+1)^2 - 3 \\ \frac{x+3}{2} &= (y+1)^2 \\ \pm \sqrt{\frac{x+3}{2}} &= y+1 \\ y &= -1 \pm \sqrt{\frac{x+3}{2}} \end{aligned}$$