

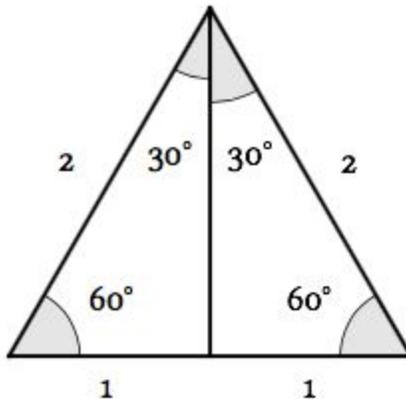
Math SL PROBLEM SET 1

Section A

1. **(F2.4 - R)** (CI) Given the quadratic function $f(x) = 4x^2 - 4x - 15$. *(Cirrito 2.4.2, p44)*

- Find the zeroes of this function.
- Find the optimal point of this function.
- Is this optimal point a maximum or minimum? Show/explain your reasoning.

2. **(T3.2 - R)** (CI) By considering an equilateral triangle with side length 2, find in exact form the values of $\sin 30$, $\cos 30$, $\tan 30$, $\sin 60$, $\cos 60$, $\tan 60$. *(Cirrito 10.1.1, p315)*



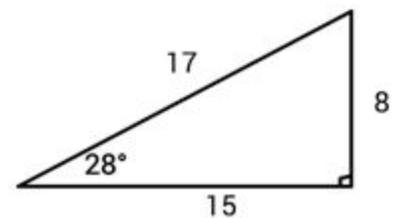
3. **(T3.4, T3.5 - R)** (CI) Given the function $g(\theta) = 2 \sin(\theta) + 1$ on the domain of $0^\circ \leq \theta \leq 360^\circ$, *(Cirrito 10.4.1, p351)*

- Find the zeroes of this function. (HINT: special triangles?)
- Determine the range of this function.

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4. **(F2.1, F2.4, F2.7 - R)** (CI) Given the quadratic function $Q(x) = 3(x - 1)^2 + 5$; (*Cirrito 2.4.1, p39; Cirrito 2.4.2, p44*)
- Determine the equation of the inverse function.
 - Write the equation for $Q(x)$ in standard form.
 - Given your work in Q(b), find the value of the discriminant of $Q(x)$.
 - Explain the graphical significance of the **sign of your discriminant**, given your answer to Q(c).
 - The graphical significance you just noted about the sign of the discriminant of $Q(x)$ could have been determined from **the original function as presented** (as $Q(x)$). Explain how you could have made the same conclusion from the form .

5. **(T3.2, T3.4 - R)** (CI) You are given this special right triangle as well as the measure of one of its angles. Use this diagram to answer the following questions. (*Cirrito 10.1.2, p316*)



- Evaluate the following:
 - $\cos(28^\circ)$
 - $\tan^{-1}\left(\frac{15}{8}\right)$
- Use this special triangle and your knowledge of angles in standard position to evaluate $\sin(332^\circ)$.
- The terminal arm of the angle goes through the point $A(-8, -15)$. Draw the angle and label the principal angle and the related acute angle.
- Explain WHY Sara knows that the measure of the principal angle in Q(c) is 242° .

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Section B

6. **(F2.5, F2.7, F2.8, T3.6 - R; A1.3 - N)** (CA) Mr. S's sister is the publisher of a magazine. To model the **monthly revenues**, she uses the equation $R(t) = -0.025t(t - 30)(t^2 - 31t + 250)$, where R is revenues (in hundreds of dollars) and t is the number of months since she began the business, on Jan 1st, 2015. She models the **monthly expenses** using $E(t) = 100 + \frac{200(t+2)}{t+5}$, where E is expenses (in hundreds of dollars) and t is, again, the number of months since she began the business.

(To clarify again: $t = 0$ is January 1st and $t = 1$ is Feb 1st and $t = 4.75$ would be 4 complete months and then $\frac{3}{4}$ of the way through the 5th month, so 3rd week of May and $t = 29$ would be today, June 1st, 2017).

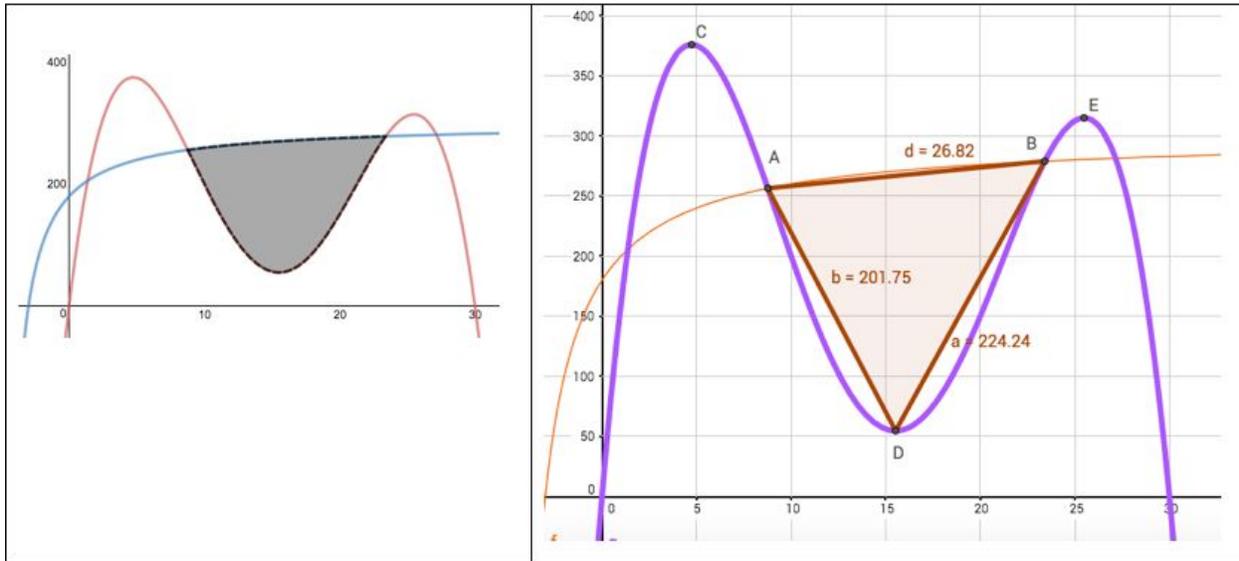
- Determine the equations of the asymptotes of the expense function, $E(t) = 100 + \frac{200(t+2)}{t+5}$.
- Explain what the horizontal asymptote of the expenses function, $E(t)$, means in the context of this problem.
- Rewrite the equation for $E(t)$ in the form of $E(t) = \frac{At+B}{Ct+D}$.

Recall that **PROFIT** is difference between the revenues and the expenses and for our common understanding, can be either POSITIVE (making money) or NEGATIVE (losing money)

- The inequality $R(t) \geq E(t)$ can be used to calculate when the business GAINS money (i.e. have positive profits). In what domain interval(s) does the business GAIN money?
- Determine the maximum profit that my sister earned.

To get an idea of the TOTAL LOSSES that she incurred between October ($t = 9$) and Dec the next year ($t = 23$), my sister suggests that I should calculate the AREA between the two functions (see DESMOS diagram). So I used GEOGEBRA to estimate the area as a triangle and get some data (see GEOGEBRA diagram).

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- f. Using the information presented on the GEOGEBRA diagram,
- determine the measure of the angle at D. (NOTE: the graphs are NOT to scale!!!)
 - hence or otherwise, calculate the area of the triangle.
- g. Given your work in Q(f), what is the estimate of my sister's losses in this 14 month period?
- h. She would now like to confirm this estimate by working through the following "formula"
$$\sum_{i=9}^{23} P(x_i)$$
. Explain what this "formula" means and then use the formula to find the estimate of her losses in this 14 month period.