By providing my signature below I acknowledge that I abide by the University's academic honesty policy. This is my work, and I did not get any help from anyone else during the exam:

Name (sign): _____ Name (print): _____

Student Number: _____

Instructor's Name: _____ Class Time: _____

Problem Number	Points Possible	Points Made
1	0	
2	10	
3	20	
4	10	
5	15	
6	15	
7	15	
8	15	
Total:	100	

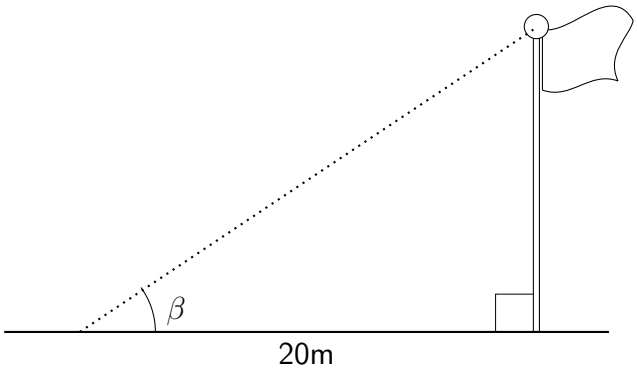
- If you need extra space use the last page.
- Please show your work. **An unjustified answer may receive little or no credit.**
- If you make use of a theorem to justify a conclusion then state the theorem used by name.
- Your work must be **neat**. If I can't read it (or can't find it), I can't grade it.
- The total number of possible points that is assigned for each problem is shown here. The number of points for each subproblem is shown within the exam.
- Please turn off your mobile phone.
- A calculator is not necessary, but numerical answers should be given in a form that can be directly entered into a calculator.
- Common identities:

$$\begin{aligned}\cos(\alpha+\beta) &= \cos(\alpha)\cos(\beta)-\sin(\alpha)\sin(\beta),\\ \sin(\alpha+\beta) &= \sin(\alpha)\cos(\beta)+\cos(\alpha)\sin(\beta).\end{aligned}$$

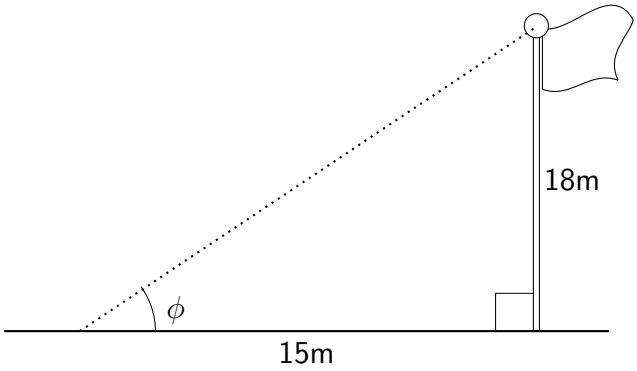
1. [2 Bonus] Common Knowledge: Will Annemiek van Vleuten repeat at this year's Tour de Femme?

2. Determine the values of the requested quantities in each question below. All values should be either exact or within 0.01 of the true value. (**All angles are given in radians and should be expressed in radians if you have to determine their value**.)

   (a) [5 pts] The angle of elevation to the top of the flagpole is $\beta = 35°$, and the angle is measured 20 meters from the base of the pole. Determine the height of the flagpole.

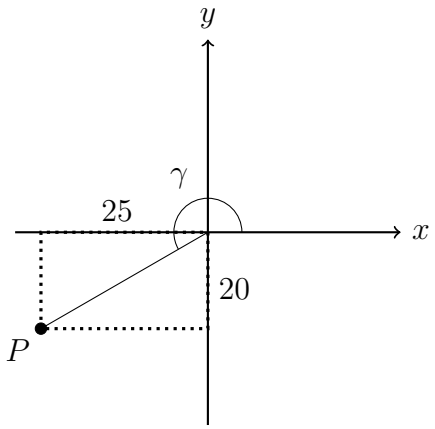


   (b) [5 pts] The height of the flagpole in the diagram below is 18 meters, and the angle of elevation, ϕ, to the top of the flagpole is measured 15 meters from the base of the flagpole. What is the angle of elevation measured in radians?

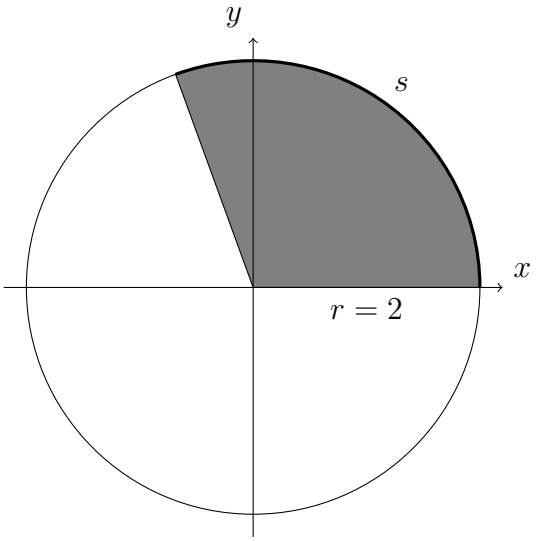


3. Determine the values of the requested quantities in each question below. All values should be either exact or within 0.01 of the true value. (**All angles are given in radians and should be expressed in radians if you have to determine their value**.)

   (a) [10 pts] Determine the values of the cosine, sine, and tangent of the angle γ as shown in the diagram.



   (b) [10 pts] The radius of the circle shown in the diagram below is two, and the area of the sector defined by the shaded region is 3.8. Determine the value of the arc length, s, of the sector.



4. Each of the following questions refer to points on the edge of a circle that is centered at the origin.

   (a) [5 pts] A point on a circle of radius three is in the second quadrant. The point is given by $P(-1.8, y)$. Determine the cosine and sine of the angle formed by the ray to P and the positive x-axis.

   (b) [5 pts] What are coordinates (The x and y values) of the point on the unit circle where the angle between the ray through the point and the positive x-axis is $\frac{5\pi}{6}$ radians?

5. An object moves on level ground directly towards and away from a light that is on the ground as part of an exhibit. The light has a narrow beam that will shine directly at the top of the object. The object is five meters tall, and it moves from twenty meters in front of the light to thirty meters.

   (a) [5 pts] What is the angle of elevation of the light when the object is twenty meters away?

   (b) [5 pts] What is the angle of elevation of the light when the object is thirty meters away?

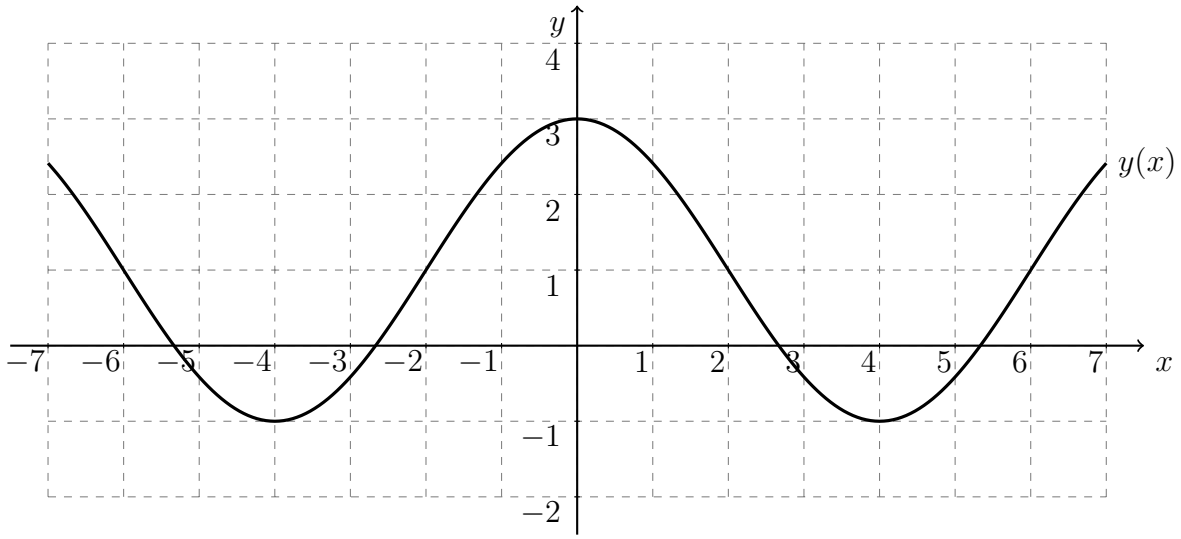
   (c) [5 pts] Determine the function that gives the angle of elevation of the light given the horizontal distance, x, the object is from the light.

6. [15 pts] A person is standing in a field looking due North. The person is looking directly at a building that is thirty meters away. Another building is directly West of the first building. The person turns 27° to look directly at the second building. How far is the second building away from the person?

7. [15 pts] Express the function whose graph is shown below as a sine function,

$$y(x) \;=\; A\sin(Bx + C) + D,$$

where $A > 0$ and $B > 0$.



8. [15 pts] Retail sales for an item can change in time, and the changes can be influenced by the yearly cycles of the seasons. One way to predict these changes is to add trigonometric functions to the projected average sales[1]. The simplest adjustment is to add a seasonal adjustment to the projected average sales forecast,

$$SA(t) = A\cos(\omega t + \beta),$$

where the time is measured in days since the start of the year and SA is the amount to add to the projected sales. The maximum adjustment is predicted to be 1,000 units over the average and will occur at the middle of the year. The minimum adjustment for sales is predicted to be 1,000 units below the average and will occur at the very end of the year. Determine the equation for the seasonal adjustment. (Determine A, ω, and β in the formula above.) If it takes two months for a shipment to arrive, when should an order be placed so that it will arrive right when the seasonal adjustment is zero and rising?

[1]Ching-Wu Chu, Guoqiang Peter Zhang, A comparative study of linear and nonlinear models for aggregate retail sales forecasting, International Journal of Production Economics, Volume 86, Issue 3, 2003, Pages 217-231.

Extra space for work. **Do not detach this page.** If you want us to consider the work on this page you should print your name, instructor and class meeting time below.

Name (print): _____ Instructor (print): _____ Time: _____