

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	15	
3	20	
4	10	
5	15	
6	15	
7	15	
8	10	
Total:	100	

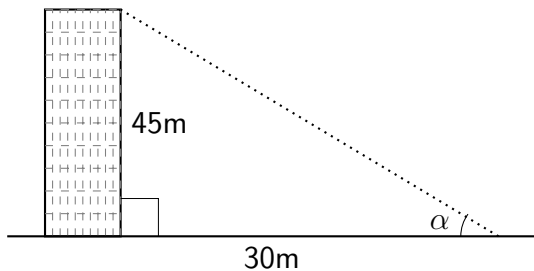
- If you need extra space use the last page.
- Please show your work. **An unjustified answer may receive little or no credit.**
- If you make use of a theorem to justify a conclusion then state the theorem used by name.
- Your work must be **neat**. If I can't read it (or can't find it), I can't grade 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:

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

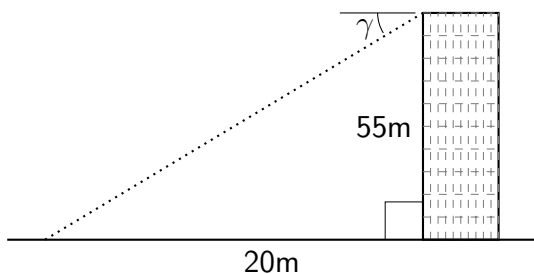
1. [2 Bonus] Common Knowledge: Will Marianne Vos repeat as cyclocross world champion this season?

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] A surveyor measures the angle of elevation to the top of a building as shown in the diagram below. Determine the value of $\sin(\alpha)$.

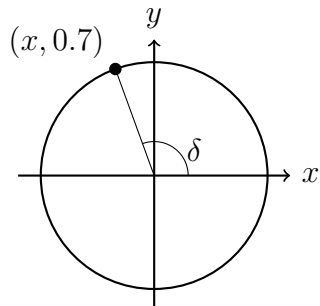


_____ (b) [10 pts] A surveyor measures the angle of depression from the top of a building as shown in the diagram below. Determine the value of $\cos(\gamma)$.

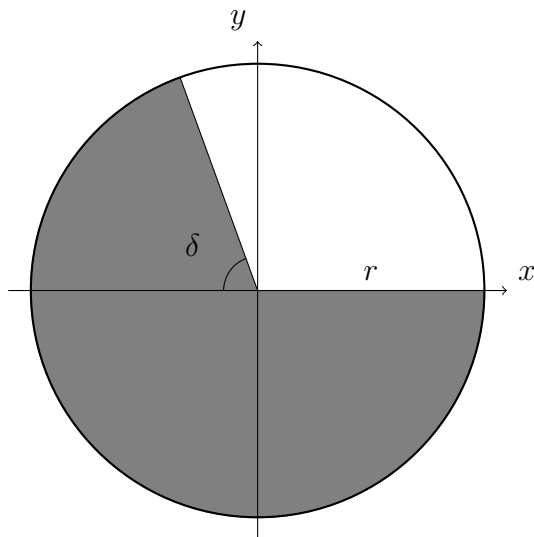


3. Determine the values of the requested quantities in each question below. All values should be either exact or within 0.01 of the true value. **(All angles are given in radians and should be expressed in radians if you have to determine their value.)**

_____ (a) [10 pts] The point shown in the diagram below is on the **unit circle**. Determine the values of the cosine, sine, and tangent of the angle δ as shown in the diagram.



_____ (b) [10 pts] The radius of the circle shown in the diagram below is two, and the arclength of the sector defined by the shaded region is 8.4. Determine the value of the angle δ in the diagram.



4. [10 pts] The sine of an angle is -0.4, and the angle's radian measurement is between $\frac{3\pi}{2}$ and 2π . Determine the radian measure of the angle. (A numerical value should be to within _____ 0.01 of the true value.)

5. The radian measure of the angle α satisfies $\frac{\pi}{2} < \alpha < \pi$. The radian measure of the angle β satisfies $\pi < \beta < \frac{3\pi}{2}$. Given the values below determine the values of each of the quantities below:

$$\begin{aligned}\sin(\alpha) &= \frac{4}{7}, \\ \cos(\beta) &= -\frac{1}{3}.\end{aligned}$$

(a) [5 pts] $\cos(\alpha)$

(b) [5 pts] $\sin(-\beta)$

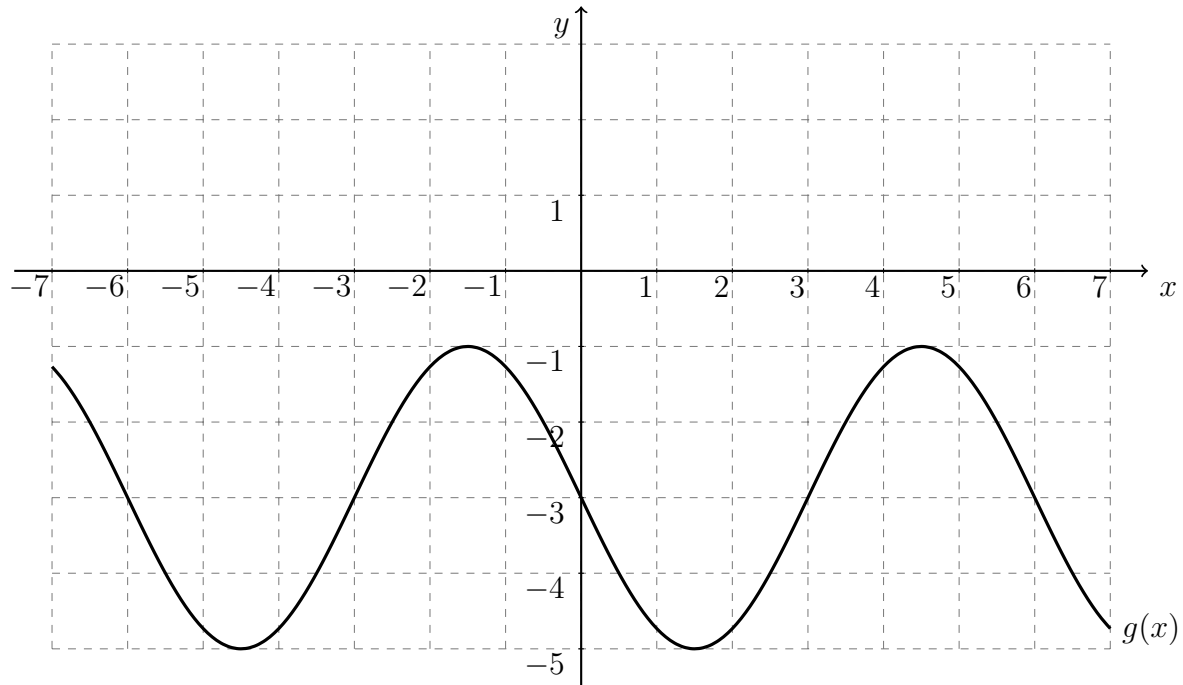
(c) [5 pts] $\sin(\pi + \alpha)$

6. [15 pts] A tree will be harvested once it reaches a height of 18 meters. A forester is standing a distance of 28 meters from the base of the tree on flat, level ground. The forester uses a clinometer held at eye level (two meters above the ground) to measure an angle of elevation to the top of the tree. What will the angle of elevation be when the tree is just able to be harvested?

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

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

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



8. [10 pts] The relative expression of a gene in a fungus was found to vary depending on how much daylight the fungus was exposed to¹. The relative expression was found to vary by

$$RE(t) = A \cos(\omega t) + b,$$

where t is number of hours of daylight, and A , b , and ω are constants. (The relative expression does not have any units.) In their experiment the authors found a period of the oscillations of 44 hours. Also, the maximum relative expression was five with a minimum of one. Determine the values of the constants.

¹Hevia MA, Canessa P, Müller-Esparza H, Larrondo LF. A circadian oscillator in the fungus *Botrytis cinerea* regulates virulence when infecting *Arabidopsis thaliana*. *Proc Natl Acad Sci USA*. 2015 Jul 14;112(28):8744-9.

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: _____