MATH1040 Assignment 9

All questions should be submitted by 6pm on Wednesday 23 May. You should show full working where possible. Assignments are to be submitted during your tutorial. **Make sure that your name and student number are on each sheet of your answers.** Solutions will be distributed in class later.

1. (a) Convert each of the following angles from radians to degrees:

\[ 2\pi \quad -\frac{5\pi}{2} \quad -\frac{3\pi}{2} \quad \frac{\pi}{6} \]

(b) Convert each of the following angles from degrees to radians:

\[ 180^\circ \quad 90^\circ \quad 240^\circ \quad -150^\circ \]

2. The Cairns “Coral me Wild” team is playing in a Rugby Union Grand Final. In the dying seconds of the game, they score a try, crossing the goal-line \( n \) metres to the right of the right-hand goal-post. (In Rugby Union the right-hand and left-hand goal-posts are 5.6 metres apart.)

Larren Dockyer is going to attempt to kick the potentially game-winning goal for the “Corals”. Larren is allowed to kick the ball from anywhere on a line perpendicular to the goal-line, passing through the point where the try was scored. He has chosen to attempt the goal from a point \( m \) metres back from the goal-line, such that the angle to the right-hand goal-post is \( 14^\circ \) and the angle to the left-hand goal-post is \( 30^\circ \).

(a) How far to the right of the right-hand goal-post did they score the try (that is, find \( n \))? How far back did Larren choose to attempt the goal (that is, find \( m \))? (Hint: use \( \tan 30^\circ = \frac{1}{\sqrt{3}} \) and \( \tan 14^\circ \approx \frac{1}{\sqrt{3}} \).

(b) If Larren wants to aim his kick towards the point exactly half-way between the two goal posts, what angle should choose? (You will need a calculator with trig functions to solve this question. Give your answer in degrees, rounded to two decimal places.)

(c) Larren kicks the ball at an angle of \( 26^\circ \). If the distance to the goal-line at this angle is less than 25 metres, the ball will go over. Does the ball go over? (Hint: Use \( \cos 26^\circ \approx 0.9 \)).

3. (a) Find \( y' \) where \( y = -5x^2 + 6x - 1 \)
(b) Find \( y' \) where \( y = -3x^7 + 4x^5 - 2x^4 - 2x \)
(c) Find \( y' \) where \( y = -x^5 - 5x^2 + \frac{2}{x} + \frac{2}{x^2} - \frac{6}{x^4} \)

(continued over...)
4. The public is bored with traditional Olympic sports. In an effort to improve the broad general appeal of the Beijing Olympics, it has been decided to introduce a new sport: nude stunt pig riding. Contestants have to try to ride their pigs on a difficult course, shaped much like a roller-coaster track, without falling off. Pablo is a member of the Puerto Rican pig riding team.

(a) The first stage of competition involves riding on a track which matches the equation \( y = x^2 - 2x + 6 \), where \( x \) represents horizontal distances in metres, and \( y \) represents the height of the track, in metres.

(i) Find the slope of the track at any point (that is, find the derivative of \( y \)).

(ii) Pablo will fall off his pig if the track has a slope equal to 8 or \(-4\). Find the \( x \)-coordinates of the points at which this happens.

(iii) Find the \( y \)-coordinates of the points in Part (ii).

(iv) Pablo remarks that nude pig riding is quite enjoyable, except for some discomfort where the pig is exactly level (because at that point the slope is changing from a negative slope to a positive slope, or positive to negative, and the changeover hurts!). At what value of \( x \) is Pablo's pig exactly level?

(b) The second stage of competition involves a much harder course, which matches the equation \( y = \frac{1}{3}x^3 + x^2 - 24x + 4 \).

(i) Find out where Pablo and his pig are exactly level?

(ii) Alas! There is controversy over the uniform in this sport! Pablo cheats and attaches a small piece of velcro to himself and his pig. Now he can stay on until the track has slope 11. At what values of \( x \) does the track have this slope?