

**1. (50 points)**

a) The planet Jupiter's largest moon, Ganymede, rotates around the planet at a distance of about 656,000 miles, in an orbit that is perfectly circular. If the moon completes one rotation about Jupiter in 7.15 days,

- (i) find the angle that the moon moves through in 1 day, in both degrees and radians
- (ii) find the angular velocity of the moon in radians per hour
- (iii) find the moon's linear velocity in miles per second as it orbits Jupiter.

b) Do not use the calculator, find the exact values of the expression

- a)  $\tan(\sin^{-1}(-\frac{3}{5}))$
  - b)  $\sin^{-1}(\cos(\frac{9\pi}{14}))$
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**3. (50 points)**

a) A ship leaves port with a bearing of S  $40^\circ$  W. After traveling 8 miles, the ship turns  $90^\circ$  and travels on a bearing of N  $50^\circ$  W for 11 miles. At that time, what is the bearing of the ship from port?

b) Use De Moivre's theorem to write the power of the complex number in standard form:  
 $(4 \cos 33.75^\circ + 4i \sin 33.75^\circ)^4$

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**4. (50 points)**

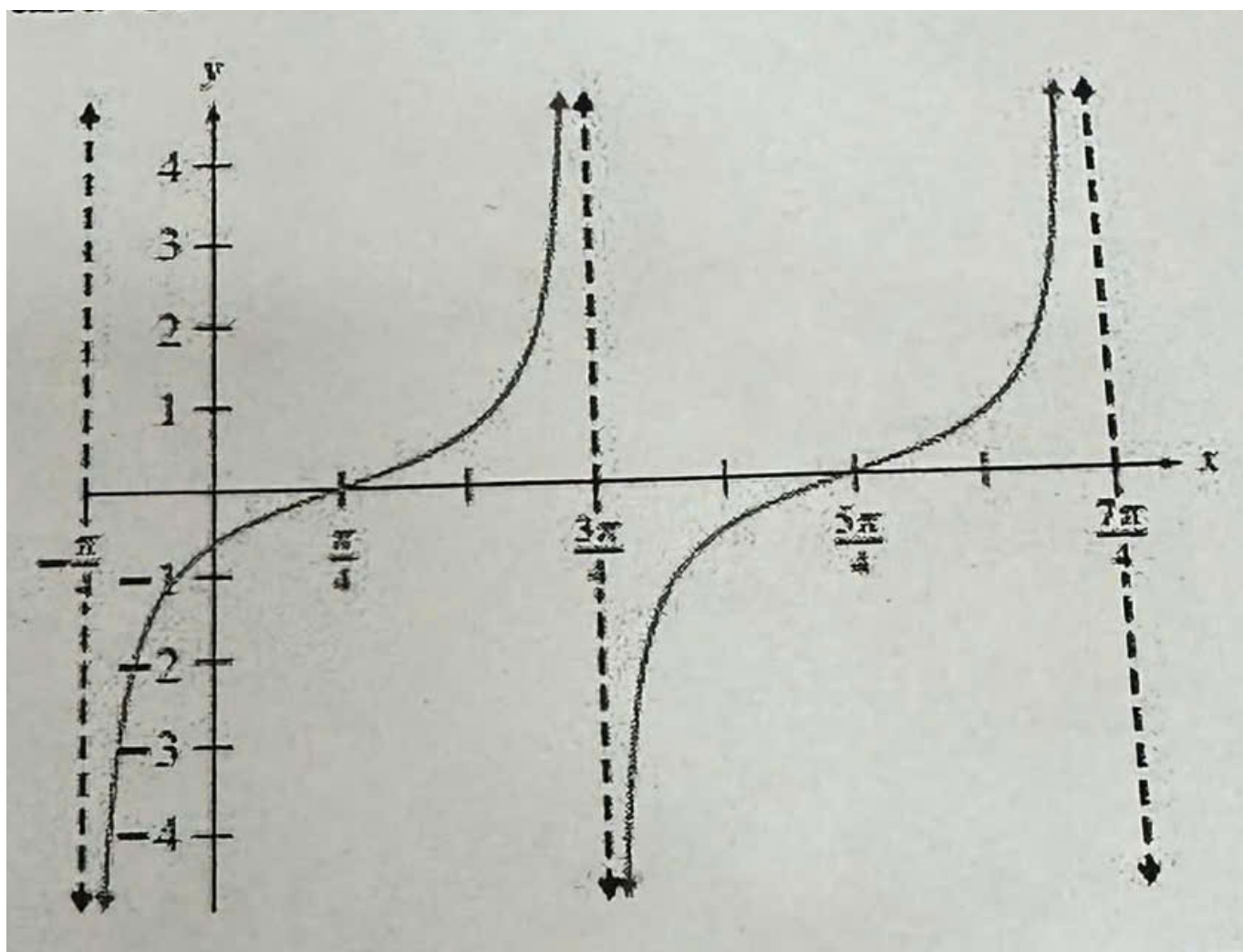
a) Find all the solutions of the equation  $3 \cos(2x) - \cos x + 1 = 0$  in the interval  $[0, 2\pi)$ . Use exact values where possible or give the approximate solutions correct to four decimal places

b) Find the partial fraction decomposition of the rational expression  $\frac{5x^2-6x+7}{(x-1)(x^2+1)}$

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**5. (50 points)**

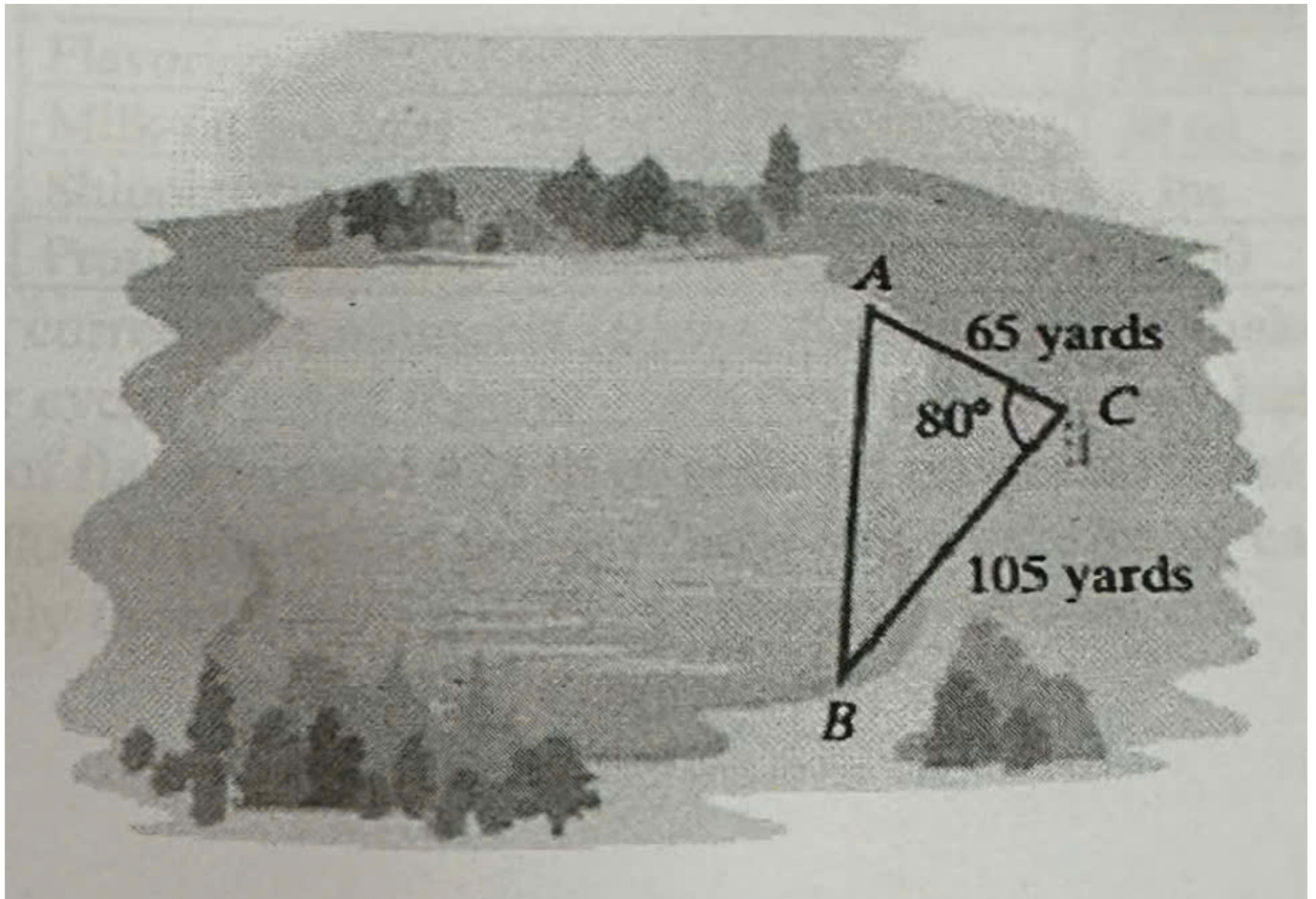
a) The function has the form  $y = \tan(Bx - C)$  and its graph is given below. Find the values of B and C.



b) Find the exact value using sum-to-product formula:  $\sin\left(\frac{17\pi}{12}\right) - \sin\left(\frac{13\pi}{12}\right)$

### 6. (50 points)

a) To find the distance across a protected cove at a lake, a surveyor makes the measurements shown in the figure. Use these measurements to find the distance from A to B to the nearest yard.



b) Write the exact value of all the complex fifth roots of  $z = 16\sqrt{2}(1 + i)$ .

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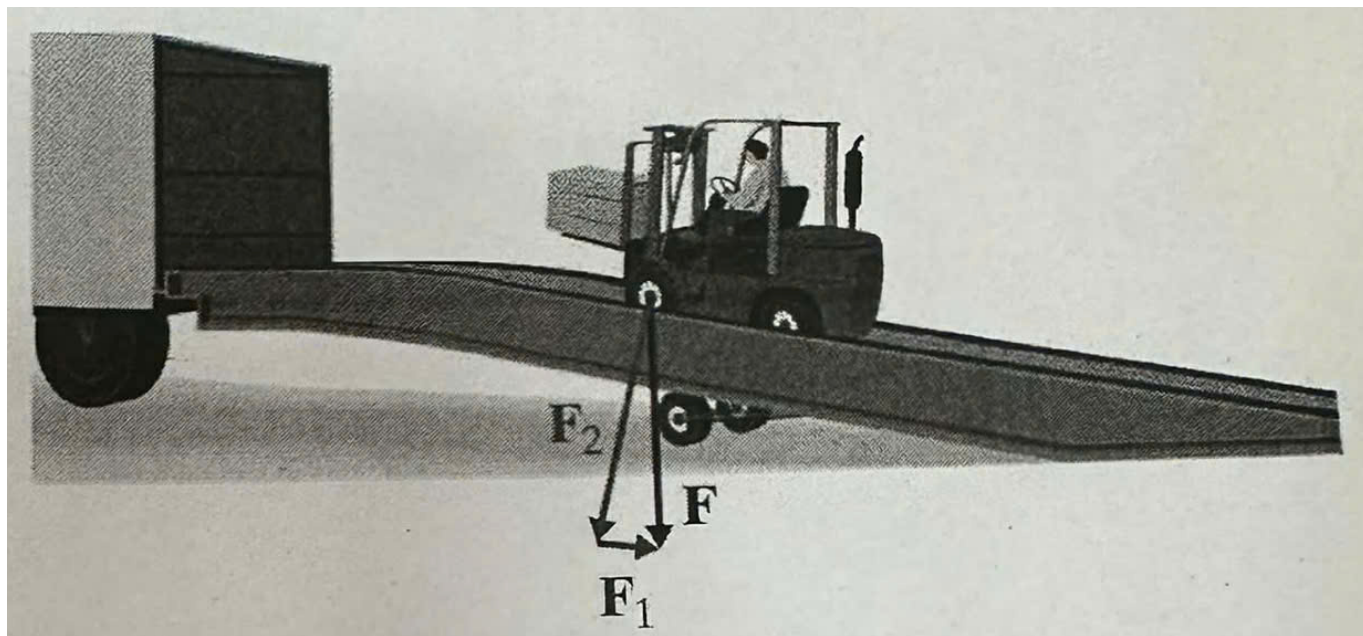
**7. (50 points)** An Ice Cream Company makes two kinds of chocolate ice cream: regular and premium. The properties of 1 gallon (gal) of each type are shown in the table:

|                   | Regular | Premium |
|-------------------|---------|---------|
| Flavoring         | 24 oz   | 20 oz   |
| Milk-fat products | 12 oz   | 20 oz   |
| Shipping weight   | 5 lbs   | 6 lbs   |
| Profit            | \$0.75  | \$0.90  |

In addition, current commitments require the company to make at least 1 gal of premium for every 4 gal of regular. Each day, the company has available 725 pounds (lb) of flavoring and 425 lb of milk-fat products. If the company can ship no more than 3000 lb of product per day, how many gallons of each type should be produced daily to maximize profit? (1 pound = 16 oz)

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**8. (50 points)** A forklift is used to offload freight from a delivery truck. Together the forklift and its contents weigh 800 lb, and the weight is evenly distributed among four wheels. The ramp is inclined  $14^\circ$  from the horizontal.



- Write the force vector  $\mathbf{F}$  in terms of standard unit vectors  $\mathbf{i}$  and  $\mathbf{j}$
- Find the component vector of  $\mathbf{F}$  perpendicular to the ramp.
- Find the component vector of  $\mathbf{F}$  parallel to the ramp.
- Find the magnitude of the force needed to keep the forklift from rolling down the ramp.