SOLUTIONS

Dawson College: Civil Technology: 201-912-DW September 30, 2010

Test 1

The length of the test is 1hr and 45min.

Question 1. *(4 marks)*
Simplify the following expressing your final answer with positive exponents only:

$$\frac{2x^{-2}}{z}\cdot\left(\frac{x^6y^{-2}}{8x^4y^9z^{-3}}\right)^{-1/3} = \frac{2}{x^2z}\cdot\frac{(x^6)^{-1/3}(y^{-2})^{-1/3}}{(8)^{-1/3}(x^4)^{-1/3}(y^9)^{-1/3}(z^{-3})^{-1/3}}$$

$$= \frac{2}{x^2z}\cdot\frac{x^{-2}y^{2/3}}{8^{-1/3}x^{-4/3}y^{-3}z} = \frac{2\cdot 8^{1/3}\cdot y^{2/3}x^{4/3}y^3}{x^2x^2zz} = \frac{2\cdot 2\,y^{2/3+3}x^{4/3}}{x^4z^2}$$

$$= \frac{4y^{11/3}x^{4/3-4}}{z^2} = \frac{4y^{11/3}}{x^{8/3}z^2}$$

Question 2. *(6 marks)*
(a) Solve for x. Express your answer as a fraction:

$$2x-5=\frac{5-3(4x-7)}{4}$$

$$4(2x-5) = 5-12x+21$$

$$8x-20 = 26-12x$$

$$20x = 46$$

$$x = \frac{23}{10}$$

(b) Solve for R_1 in the following equation:

$$P=\frac{QR_1-R_2(5-u)}{t}$$

$$Pt = QR_1 - R_2(5-u)$$

$$Pt + R_2(5-u) = QR_1$$

$$\frac{Pt+R_2(5-u)}{Q} = R_1$$

Question 3. *(8 marks)*

(a) Find the equation of the line passing through the point $(-8, 13)$ and parallel to the line $3 = 5x + 4y$. Graph this line.

$4y = -5x + 3$

$y = -\frac{5}{4}x + \frac{3}{4}$

$\therefore m = -\frac{5}{4}$

$y = mx + b$

$13 = -\frac{5}{4}(-8) + b$

$13 = 10 + b$

$3 = b$

$\therefore \boxed{y = -\frac{5}{4}x + 3}$

y-int: $x = 0$

$y = 3$

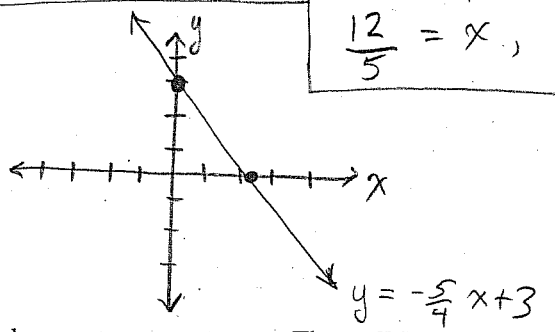
$(0, 3)$

x-int: $y = 0$

$0 = -\frac{5}{4}x + 3$

$-3 = -\frac{5}{4}x$

$\frac{12}{5} = x, \quad (\frac{12}{5}, 0)$



(b) The temperature changes through the wall of a house at a constant rate. The wall is 31cm thick and the temperature is 24°C inside the house. The temperature drops by 2°C for every 3cm moved through the wall from the inside of the house to the outside of the house. Write an equation of the temperature T as a function of the distance x from the inside to the outside of the wall. Use this equation to find the temperature outside the house and halfway through the wall.

$\therefore m = \frac{\Delta T}{\Delta x} = \frac{-2}{3}$ AT $x = 0$ $T = 24$

$\therefore \boxed{T = -\frac{2}{3}x + 24}$

OUT SIDE THE HOUSE:

$T = -\frac{2}{3}(31) + 24 = 3.3°C$

HALFWAY THROUGH THE WALL:

$T = -\frac{2}{3}(15.5) + 24 = 13.7°C$

Question 4. *(10 marks)* (round to 3 significant figures)

(a) Convert 126 lbs/in^3 to kg per cubic cm.

$$126\ \frac{lbs}{in^3} \cdot \left(\frac{1\ kg}{2.20\ lbs}\right) \cdot \left(\frac{1\ in}{2.54\ cm}\right)^3$$

$$= 3.49\ kg/cm^3$$

(c) Covert 346 ft·lbs (foot pounds) to N·m (Newton metres).

$$346\ ft \cdot lbs \cdot \left(\frac{4.45\ N}{1\ lbs}\right) \cdot \left(\frac{1\ m}{3.28\ ft}\right)$$

$$= 469\ Nm$$

(d) Convert 38.2Pa to Newtons per square decimetre (N/ dm^2).

$$38.2\ Pa = 38.2\ \frac{kg}{m \cdot s^2} = 38.2\ \frac{kg \cdot m}{s^2} \cdot \frac{1}{m^2}$$

$$= 38.2\ \frac{N}{m^2} = 38.2\ \frac{N}{m^2} \cdot \left(\frac{10^{-1}\ m}{1\ dm}\right)^2$$

$$= 0.382\ N/dm^2$$

Question 5. *(3 marks)* Find the exact values of the following (no decimals or rounding).

(a) cot 30°

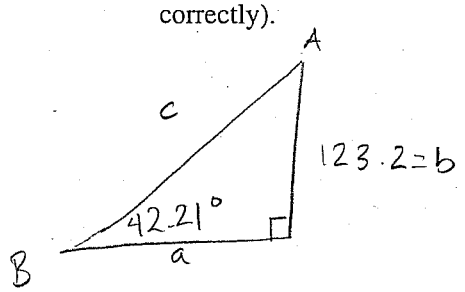
$$\cot 30^\circ = \frac{\cos 30^\circ}{\sin 30^\circ} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}} = \sqrt{3}$$

(b) csc(π/3)

$$\frac{\pi}{3} \cdot \frac{180^\circ}{\pi} = 60^\circ$$

$$\csc\left(\frac{\pi}{3}\right) = \csc 60^\circ = \frac{1}{\sin 60^\circ} = \frac{1}{\frac{\sqrt{3}}{2}} = \frac{2}{\sqrt{3}}$$

Question 6. *(5 marks)* Solve the right triangel with side $b = 123.2$ and angle $B = 42.21°$ (round correctly).



$\sin B = \frac{b}{c} \Rightarrow c = \frac{123.2}{\sin 42.21°}$

$= 183.4$

$a^2 + b^2 = c^2 \Rightarrow a^2 = c^2 - b^2 = 183.3^2 - 123.2^2$

$\therefore a = 135.9$

$A = 180° - 42.21° - 90° = 47.79°$

Question 7. **(3 marks)** State if the following angles are co-terminal or not.

(a) 452° and 812°. CO-TERMINAL

(b) 862° and −578°. CO-TERMINAL

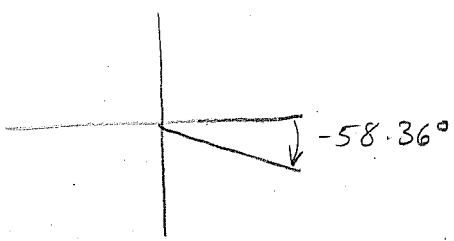
(c) 197° and −377° NOT CO-TERMINAL

Question 8. **(8 marks)** Find θ given (use the correct number of significant figures):

(a) $\tan\theta = -1.623$ and $0° \le \theta < 360°$.

$\tan^{-1}(-1.623) = -58.36°$

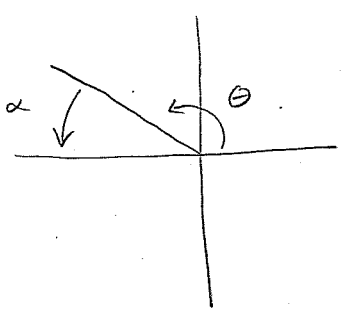
$\tan\theta < 0 \Rightarrow \theta$ IS IN QUADRANT II OR IV.



$\Rightarrow \alpha = 58.36$

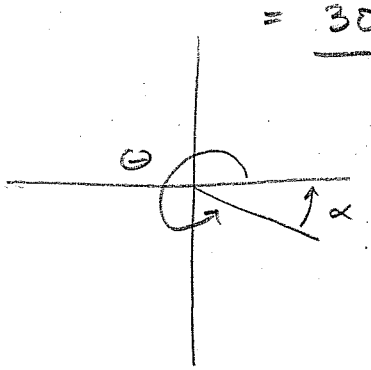
QUAD II : $\theta = 180° - 58.36°$

$= 121.64°$



QUAD IV : $\theta = 360° - 58.36°$

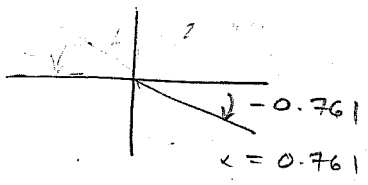
$= 301.64°$



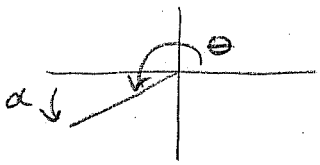
(b) $\csc\theta = -1.45$, $\tan\theta < 0$ and $0 \le \theta < 2\pi$.

$\csc\theta = \frac{1}{\sin\theta} = -1.45 \Rightarrow \sin\theta = -\frac{1}{1.45}$

$\sin^{-1}\left(-\frac{1}{1.45}\right) = -0.761$

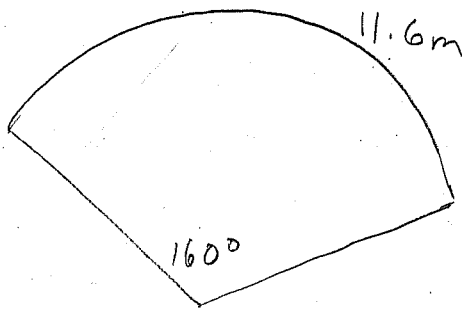


$\sin\theta < 0$ AND $\tan\theta < 0 \Rightarrow \theta$ IS IN QUADRANT IV



$\theta = 2\pi - 0.761 = 5.52$

Question 9. (5 marks) A patio is in the shape of a cicuar sector with a central angle of 160°. It is enclosed by a railing of which the circular part is 11.6m long. What is the area of the patio?



$\theta = 160° \cdot \frac{\pi}{180°} = \frac{8}{9}\pi$

$s = \theta r \Rightarrow r = \frac{s}{\theta}$

$= \frac{11.6}{\frac{8}{9}\pi}$

$= 4.15\text{m}$

$A = \frac{1}{2}\theta r^2$

$= \frac{1}{2}\left(\frac{8}{9}\pi\right)(4.15)^2$

$= \underline{24.1\text{m}^2}$