Problem 1 Solutions:

a) *Total volume = Volume of the rectangular solid + Volume of the triangular solid*
*Vol = (48*84*106) +0.5 *(16*106)*84 = 498624 cubic inches .*

b) *498624 cubic inches times 2.54^3 = 8170983.4 cubic cm which is 22061655.18 g or approximately 48,593.95 lb.*

Problem 2A Solutions:

a) *Handrails:2*(13+42.5)=111" or 9.25 ft, which is almost 1.2 pieces of 8ft (2x4s).*
Steps: Since each step is 48 inches wide(4ft) we need 32 ft which is 4 pieces of 8ft (2x6s).
Posts: 30.5x8=244 inches or approximately 20.33 ft. This will require 2.5 pieces of 8ft(2x4s).
So, overall, for the handrails and the posts we can use 4 pieces of (2x4s) and 4 pieces of (2x6s) for the steps.

b) *2x4s: 4 x $3.07 = $12.28. For the 2x6s: 4 x $5.27 = $21.08. So, for the materials (wood) total = $33.36 plus tax (7%) = $35.7. This total is just for the material not including nails, concrete for the base, labor or the rest of the wood for the structure!*

Problem 2B Solutions:

$$\frac{35000 gal}{1} \times \frac{3.79\ L}{1\ gal} \times \frac{1000\ mL}{1\ L} \times \frac{1\ cm^3}{1\ mL} \times \frac{1\ m}{100\ cm} \times \frac{1\ m}{100\ cm} \times \frac{1\ m}{100\ cm} \times \frac{1\ g}{1\ m^3} = 132.65 \text{ grams of methylparaben}$$

Problem 3 Solutions:

a) Yosef's optimum stride length would be 208" using a 2.6 multiplier.

Problem 4 Solutions:

a) 10
b) 10
c) 11
d) 0.4
e) 0.52
f) No
g) 100 inches or 8 feet and 4 inches
h) For the bottom staircase, tan θ = 5/12.5 or $\theta \cong 21.8°$ and for the top staircase, tan θ = 6/11.5 or $\theta \cong 27.55°$

Problem 5 Solutions:

a) 4 (sides) x(3.5 x 40) = 560 in^2
b) Square Pyramid

Problem 6 Solutions:

Total Volume = $V_1 + V_2$

a) $V_1 = \frac{1 * 41\pi}{3} * (33^2 + 24.75 * 33 + 24.75^2) = 108,124.00\ in^3$

$V_2 = \frac{1*76\pi}{3} * (60^2 + 60 * 33 + 33^2) = 530,765.8\ in^3$

Total volume = 108, 124 in^3 + 530, 765.8 in^3 = **638,889.8 in^3**

b) 369.73 cubic ft
c) Four

Problem 7A Solutions:

Based off of the pictorial representation of the bike rack and the placing of the axes the bike rack best represents a cosine function (see image below). Currently there are 11 slots, which would fit 11 bikes and adding an extra loop would add 2 more slots making it 13.

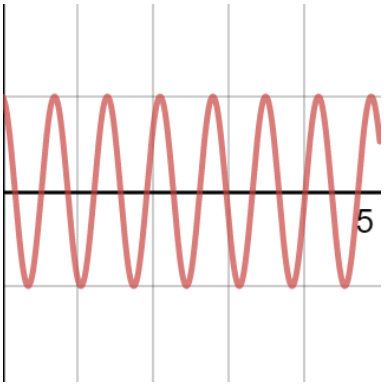

Image was created using https://www.desmos.com/

Problem 7B Solutions:

The volume of one post is $5^2\,\pi(30) + 4^2\,\pi(4) = 814\,\pi = 2557\ in^3 = .0419\ m^3$, it weighs 222 lb. rounded to the nearest pound. You would need 6 first graders that weighed 40 lb. to outweigh the post.

Problem 8 Solutions:

There is no definitive solution. This is about creativity and thought.

Problem 9 Solutions:

a) $\frac{\$65000}{1} \times \frac{1\ kWh}{\$0.06} \times \frac{1\ year}{5782\ kWh} = 187.363\ years$. *So, roughly 187.4 years.*

b) *1554 x 36 = 55944 square inches. 5782 kWh divided by 55944 means each square inch of the panel produces .103 kWh of energy annually or 103 watts/yr.*

Problem 10 Solutions:

a) Area of one block = 64 square inches.

Total area in square ft = (64x10384)/144 = 4615.11

Number of cans of paint = 4615.11/20 = 230.76 (round up to 231 cans).

b) *231 x* $6.25 = $1443.75.

Problem 11 Solutions:

a) 63 in. – 24 in. = 39 in. or 3.25 ft. So the incline of theta can be found by doing arcsin(3.25/30) = 6.2 degrees.

b) To find the slope: $3.25^2 + x^2 = 30^2$. Solving for x, we get x =29.82 ft (357.84 inches). The slope is 3.25/x so the slope = 0.109.

c) The area of the triangle is $\frac{1}{2}(3.25\ ft)(29.82 ft) = 48.46\ ft^2$ *or* $6978.24\ in^2$.

d) The area of the entire ramp is the area of the triangle and the area of the two adjacent rectangles. Total area = (30x63 in^2 *+ 24x357.84* in^2 *+6978.24* in^2*) = 17,456.4* in^2.

e) 360

f) 2142

Problem 12 solutions:

a) *The volume of the rotunda is* $\pi(16)^2(125) = 100{,}531\ cubic\ feet$. *The volume of a book is* $8 \times 12 \times 2 = 192\ cubic\ inches.$ $\frac{192\ in^3}{1} \times \frac{1\ ft}{12\ in} \times \frac{1\ ft}{12\ in} \times \frac{1\ ft}{12\ in} =$ $0.111\ cubic\ feet$. *If the volume of the rotunda is 100, 531 cubic feet and each book is 0.111 cubic feet it would take* $\frac{100{,}531}{0.111} \approx 905{,}685\ books$ *rounded up to fill the rotunda.*

b) *Yes, there are enough books in the library to fill the rotunda.*

c) *939291/18000 = 52.18 so each student would have to carry roughly 52 to 53 books to move the entire library.*

Problem 13 Solutions:

a) 54 degrees
b) 108 degrees
c) 11 children

Problem 14 Solutions:

a) $\frac{\mathbf{30\ Min}}{\mathbf{1}} \times \frac{\mathbf{60\ sec}}{\mathbf{1\ Min}} \times \frac{\mathbf{12m^3}}{\mathbf{1\ sec}} \times \frac{\mathbf{100\ cm}}{\mathbf{1\ m}} \times \frac{\mathbf{100\ cm}}{\mathbf{1\ m}} \times \frac{\mathbf{100\ cm}}{\mathbf{1\ m}} \times \frac{\mathbf{1\ mL}}{\mathbf{1\ cm^3}} \times \frac{\mathbf{1\ L}}{\mathbf{1000\ mL}} \times \frac{\mathbf{0.0001\ g}}{\mathbf{1\ L}} = 2{,}160\ \text{g}$

b) $\frac{\mathbf{4\ L}}{\mathbf{1}} \times \frac{\mathbf{0.0001\ g}}{\mathbf{1\ L}} \times \frac{\mathbf{1000\ mg}}{\mathbf{1\ g}} = 0.4\ \text{mg}$

c) *No. The fish is moved away from you by the water faster than it can swim.*

Problem 15 Solutions:

a) *22.5 degrees*

b) *Since one revolution of the blade = circumference, it goes 69π inches in 1 revolution times 990 rpm gives 214602" per minute and dividing by 12 gives you 17883.5 feet per minute.*

Problem 16 Solutions:

a) *if the base is 36"x36" and the height is 93.5", then the line from the tip of the pyramid down the side to the middle of the base is =* $\sqrt{(18)^2 + (93.5)^2}$*,which is approximately 95" so the surface area is .5(36 base)(95 height of slant)(4 sides) or 6840 sq. inches or 47.5 square feet (1 sq ft = 144 sq in).*

b) *93.5/69.2 = 1.35 – 1 = 0.35 x 100 = 35 % taller than the average American male.*