MATH 249

Today

1. A problem
2. Why Multi?
3. Greeting, roster, syllabus
4. 12.1, 12.2
5. WeBWorK

A problem

A rectangular building is being designed to minimize heat loss. Heat loss is shown in the table.

Surface	Heat loss (units/m^2 per day)
East and west walls	10
North and south walls	8
Floor	1
Roof	5

Each wall must be at least 30m long, and the volume of the building must be exactly 4000m^3, while the height must be at least 4m.

What dimensions minimize heat loss?

Why study Multivariable Calculus?

1. Our world is not two-dimensional.
2. It is useful in a ton of other areas:
   (a) Physics, chemistry
   (b) Computer graphics and animation
   (c) Economics and finance

(d) Statistics

(e) Engineering

(f) etc.

3. It's amazingly cool and beautiful!

12.1 and 12.2 Intro to Vectors

1. 3D coordinates (12-01: 0:00)
2. Distance formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$ (12-01: 8:08)
3. Distance formula example (12-01: 12:15)
4. Spheres: $(x - a)^2 + (y - b)^2 + (z - c)^2 = r^2$ (center (a, b, c), radius r) (12-01: 13:26)
5. Sphere examples (12-01: 15:50)
6. Vectors (12-02a: 0:00)
7. Parallelogram law, scalar multiplication (12-02a: 2:24)
8. Components/displacement vectors (12-02a: 5:30)
9. $< x_1, y_1 >=< x_2, y_2 >$ if and only if $x_1 = x_2$ and $y_1 = y_2$. (12-02a: 10:30)
10. $|\vec{v}| = | < x, y > | = \sqrt{x^2 + y^2}$ (12-2-b: 0:00)
11. A unit vector has length 1. (12-2-b: 2:35)
12. Standard basis vectors (12-2-b: 3:08)
13. $c < x, y >=< cx, cy >$ (12-2-b: 4:23)
14. $< x_1, y_1 > \pm < x_2, y_2 >=< x_1 \pm x_2, y_1 \pm y_2 >$ (12-2-b: 5:38) (Examples at 8:35)
15. Properties of operations (12-2-c: 0:00)

16. If $\vec{v} \neq \vec{0}$, then $\dfrac{\vec{v}}{|\vec{v}|}$ is always a unit vector. (12-2-c: 5:25)
17. $|c\vec{v}| = |c||\vec{v}|$ (12-2-c: 6:06)
18. Physics example (12-2-d: 0:00)
19. Examples: 12.1: 15, 34, 39. WW: 2, 4, 6, 10.
20. Examples: 12.2: 32. WW: 7, 9, 12.

Next Time

1. Watch 12.3a [$\sim$ 33 minutes]
2. Watch 12.3b if you want to see proofs ($\sim$ 9 minutes)
3. HF 1