ICE - Average Value

The polar bear (Ursus maritimus, see Figure 1[1]) is the largest bear in the world. Most polar bears inhabit land masses and near the edge of the polar basin, although polar bear tracks have been found almost as far north as the North Pole[2].

Figure 1: A female polar bear (*Ursus maritimus*) with her cubs.

Figure 2: An example of a modern polar bear habitat.

Polar bears are very well adapted to life in the Arctic. They have two layers of fur and a layer of blubber that can be as much as 4.5 inches thick[3]. In fact, polar bears have far greater problems staying cool rather than staying warm.

The fact that polar bears have trouble with overheating has been recognized in law. The Animal Welfare Act of 1972 specifically mentions temperature conditions for polar bears:

> "The air temperature around any polar bear shall not be allowed to exceed 29.5ºC (85ºF) at any time and no polar bear shall be subjected to surrounding aire temperatures which exceed 23.9ºC (75ºF) for more than 4 hours at any time." (Animal Welfare Act, Section 3.117, 1972)

Polar bear habitats (e.g. see Figure 2[4]) in modern zoos are usually refrigerated to stop the polar bears from overheating. (See, for example, the "Arctic Ring of Life" habitat that opened at the Detroit Zoo[5] in August of 2001.) A design for such a habitat is shown in Figure 3[6]. This habitat will consist of a massive block of ice kept frozen by a huge refrigerator unit. The habitat will be separated from the public by a plexiglass wall 12 meters high.

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[1] Image source: http://www.polarbearsalive.org/

[2] Source: SeaWorld® Adventure Parks Education Resource Development Fact Sheet, 2000.

[3] Source: U.S. Fish and Wildlife Service. "Habitat Conservation Strategy for Polar Bears in Alaska." 1995.

[4] Image source: SeaWorld® Adventure Parks, http://www.seaworld.org/

[5] See: http://www.detroitzoo.org/

[6] Image source: US Coast Guard, http://www.uscg.mil/

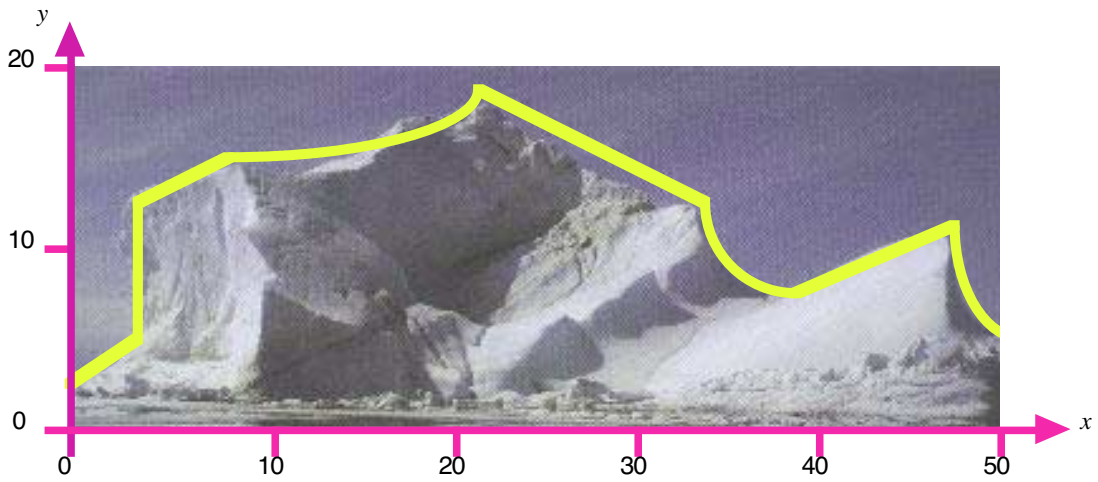

Figure 3: Design for Proposed Polar Bear Habitat. All measurements are in meters.

Interval	0<x<4	4<x<8	8<x<21	21<x<33	33<x<38	38<x<48	48<x<50
$y =$	$0.5x + 3$	$0.25x + 12$	$9.5 \cdot (1.0308)^x$	$-0.42x + 26.75$	$13 - \sqrt{25 - (x - 38)^2}$	$0.3x - 3.4$	$1817762019 \cdot (0.674)^x$

- ***Suppose the refrigerator unit broke down. What potential problems (if any) do you see with the design of the polar bear habitat in Figure 3?***

- ***How could you check your suspicions mathematically?***

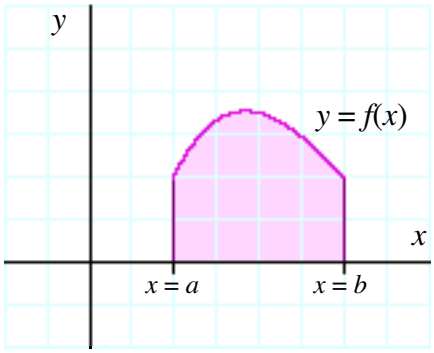

Figure 4: Write down an expression for the height of this area if it were "smoothed out" to form a rectangle.

- ***Suppose that the top of the block of ice was described by a function*** $f(x)$ ***and that the habitat stretched from*** $x = a$ ***to*** $x = b$ ***(see Figure 4). Summarize the calculations that you have done above by deriving a formula for the depth of water in the polar bear habitat when all of the ice has melted.***