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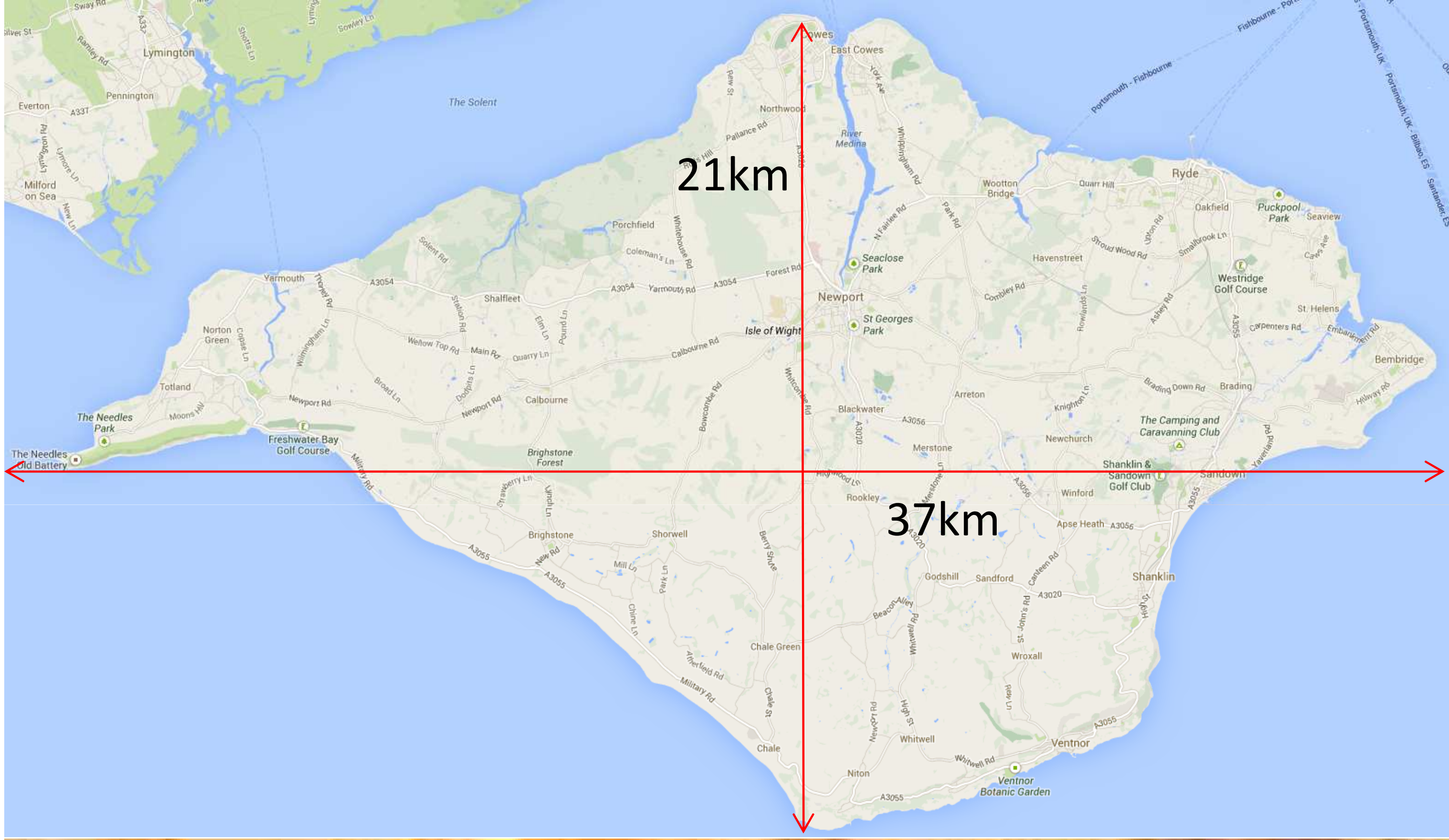
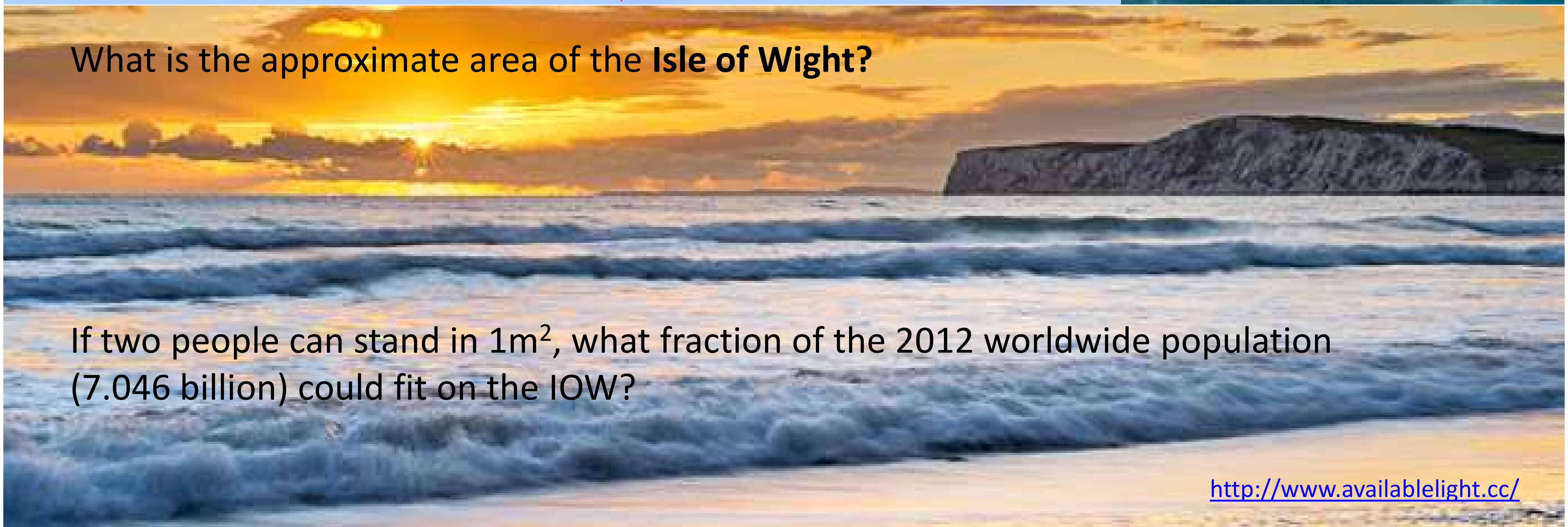




What is the approximate area of the **Isle of Wight?**

If two people can stand in $1m^2$, what fraction of the 2012 worldwide population (7.046 billion) could fit on the IOW?

http://www.availablelight.cc/

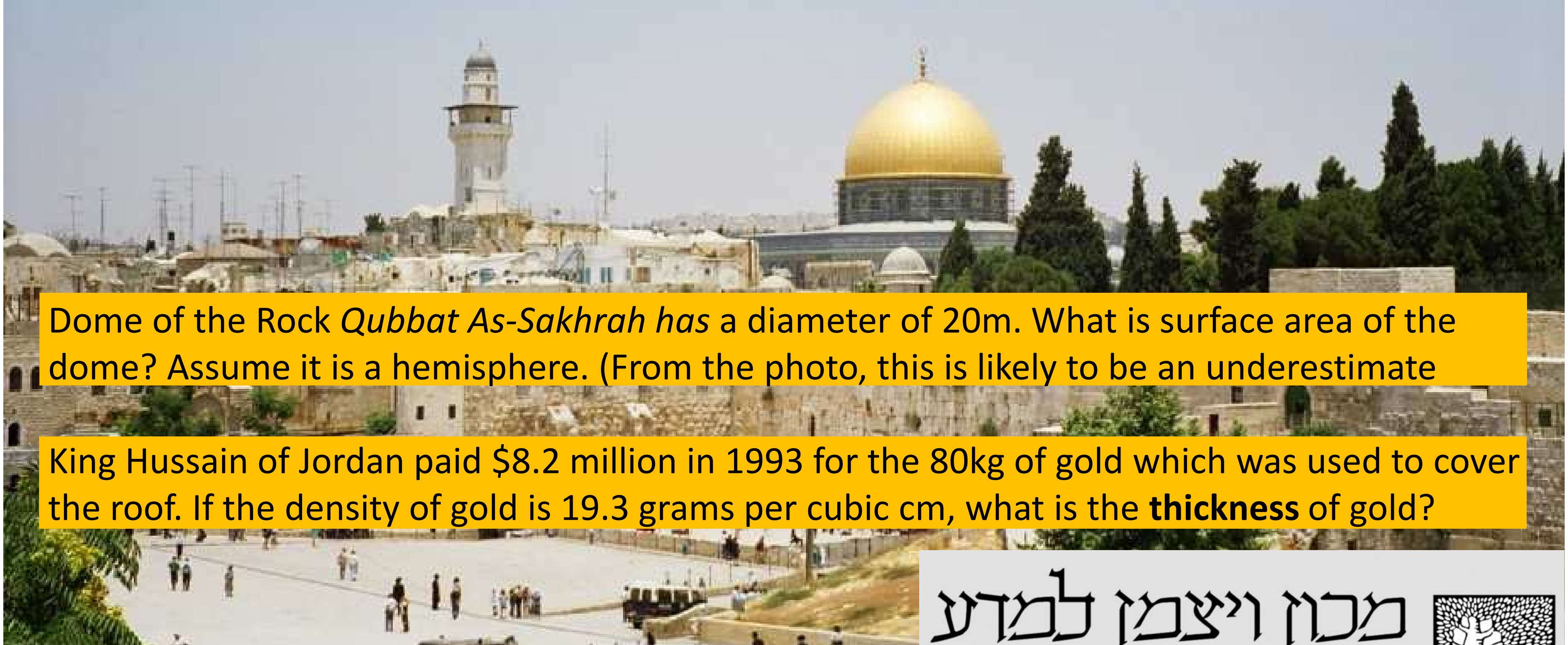
IOW area is approximately $\frac{1}{2}\times 21\times 37 = \boxed{390\text{km}^2}$

[According to Google, the 'official' area is 380km^2]

$$390\text{km}^2 = 390\times(1000\text{m})^2 = 3.9\times10^8\,\text{m}^2$$

$$\frac{3.9\times10^8\,\text{m}^2}{0.5\text{m}^2} = 7.8\times10^8$$

$$\frac{7.8\times10^8}{7.046\times10^9} = \boxed{11.1\%}$$



Dome of the Rock *Qubbat As-Sakhrah has* a diameter of 20m. What is surface area of the dome? Assume it is a hemisphere. (From the photo, this is likely to be an underestimate

King Hussain of Jordan paid $8.2 million in 1993 for the 80kg of gold which was used to cover the roof. If the density of gold is 19.3 grams per cubic cm, what is the **thickness** of gold?

מכון ויצמן למדע
WEIZMANN INSTITUTE OF SCIENCE

Dome surface area is $A = \tfrac{1}{2} \times 4\pi R^2$

$$R = 10\text{m}$$

$$A = 2\pi \times 100 = \boxed{628.3\text{m}^2}$$

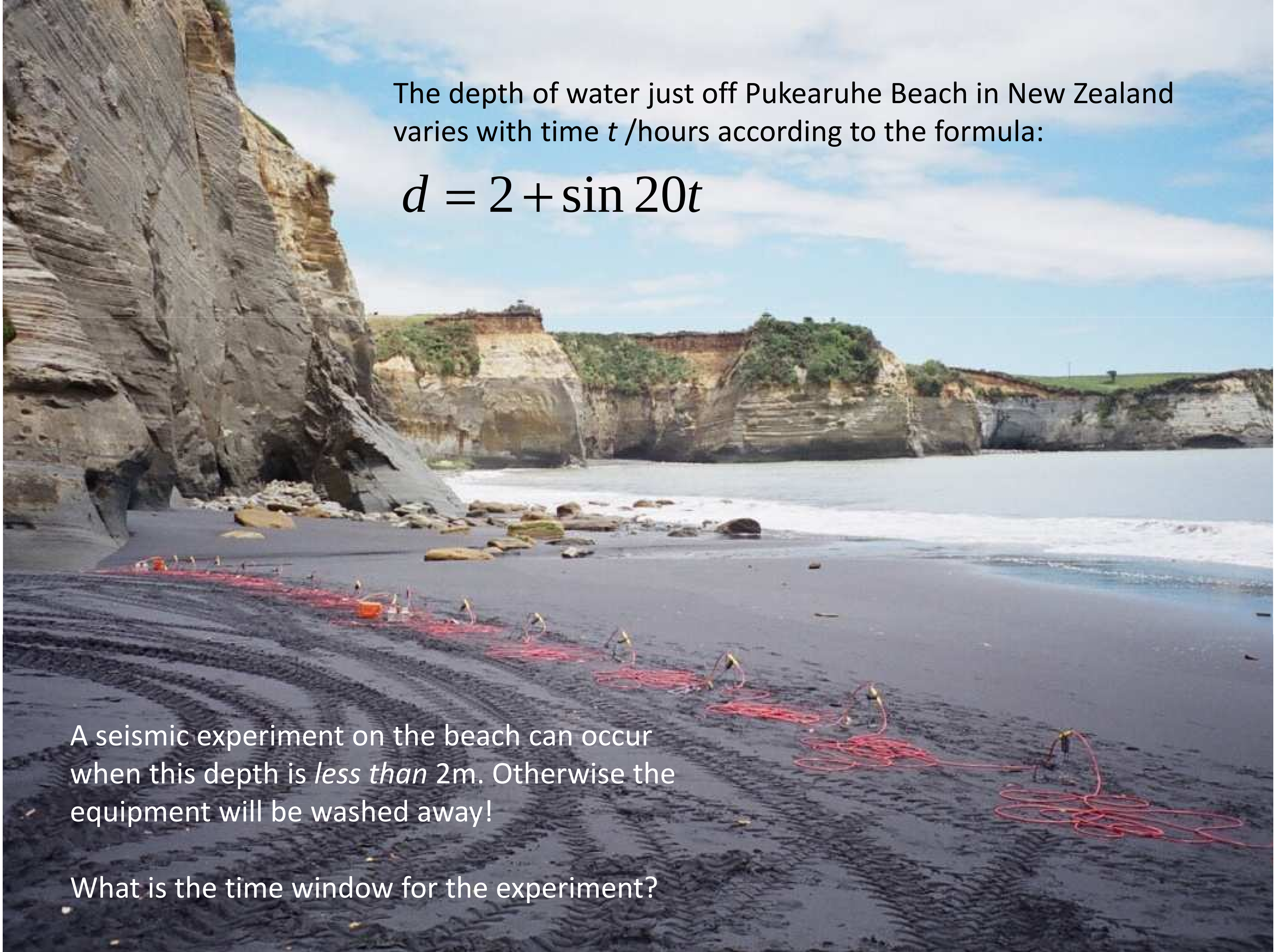
$$19.3\text{g/cm}^3 = \frac{19.3 \times 10^{-3}\text{kg}}{\left(10^{-2}\text{m}\right)^3} = 1.93 \times 10^4\,\text{kg/m}^3$$

Volume of gold is $V_{\text{Au}} = \dfrac{80\text{kg}}{1.93 \times 10^4\,\text{kg/m}^3} = 4.15 \times 10^{-3}\,\text{m}^3$

Thickness of gold is $t = \dfrac{4.15 \times 10^{-3}\,\text{m}^3}{628.3\text{m}^2} = 6.60 \times 10^{-6}\,\text{m}$

$$t = \boxed{6.6\mu\text{m}}$$

[According to Google it is 2.3μm, indicating the hemispherical area is an underestimate of the true area]



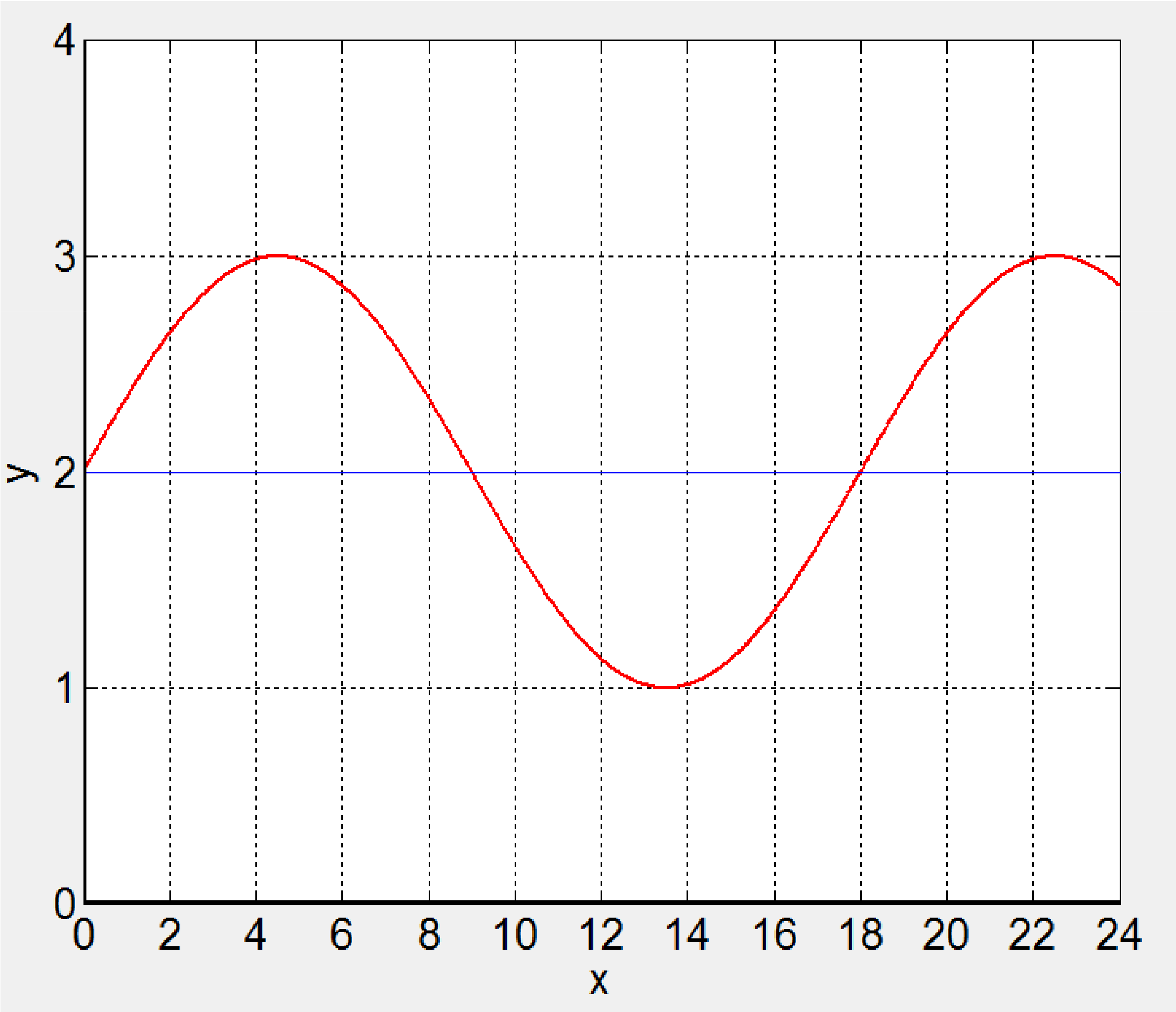
The depth of water just off Pukearuhe Beach in New Zealand varies with time t /hours according to the formula:

$$d = 2 + \sin 20t$$

A seismic experiment on the beach can occur when this depth is *less than* 2m. Otherwise the equipment will be washed away!

What is the time window for the experiment?

$$d = 2 + \sin 20t$$



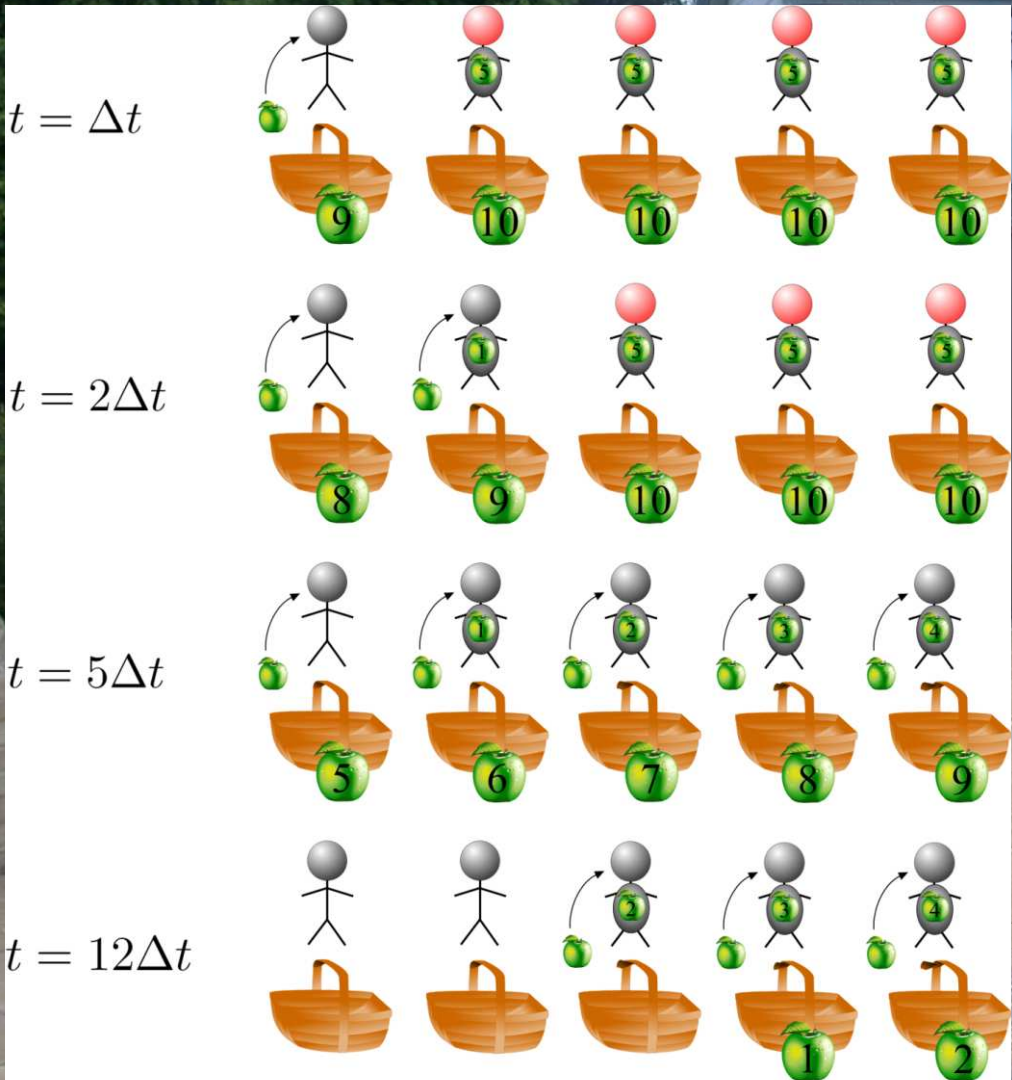
One period T hours of the tide is when 20T = 360°

Therefore T = 18 hours

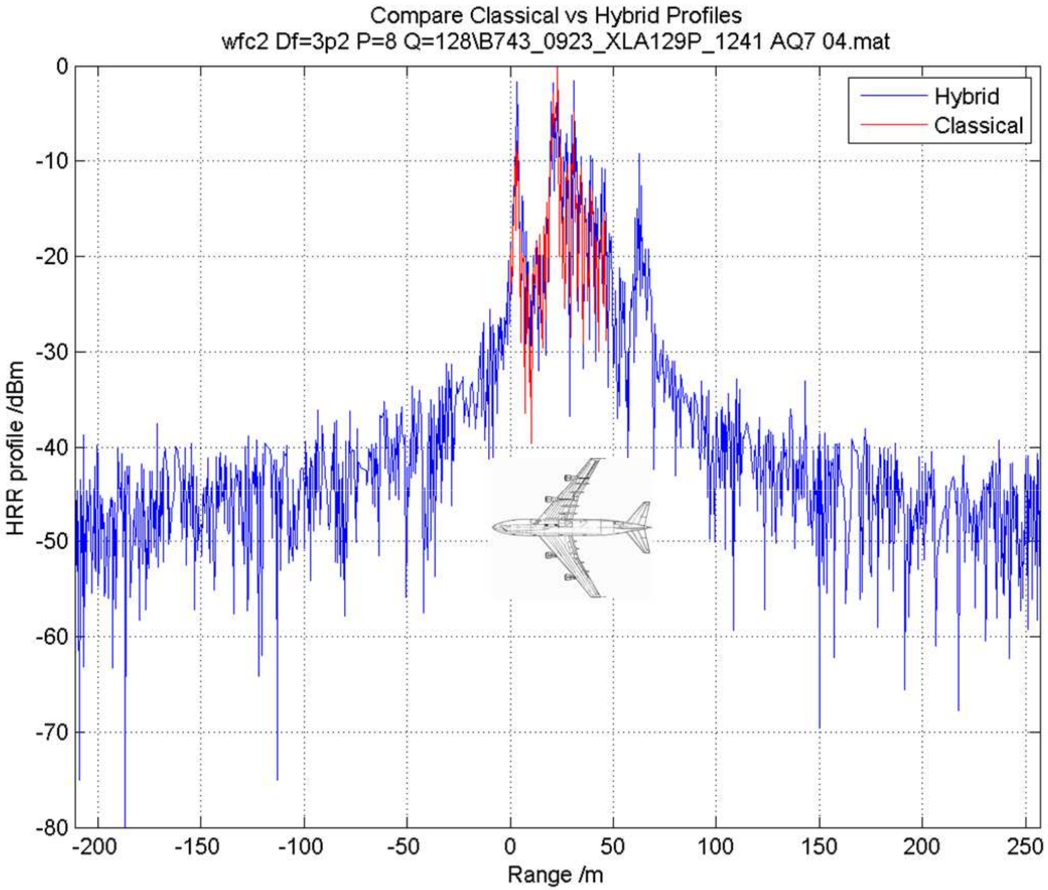
Time window for the experiment is:

0900 till 1800

BP Institute. Cambridge University



'Apples & baskets' model of precipitation and dissolution reactions in porous media



The *resolution* of a radar which transmits over frequency range of Δf is

$$\delta R = \frac{c}{2\Delta f}$$

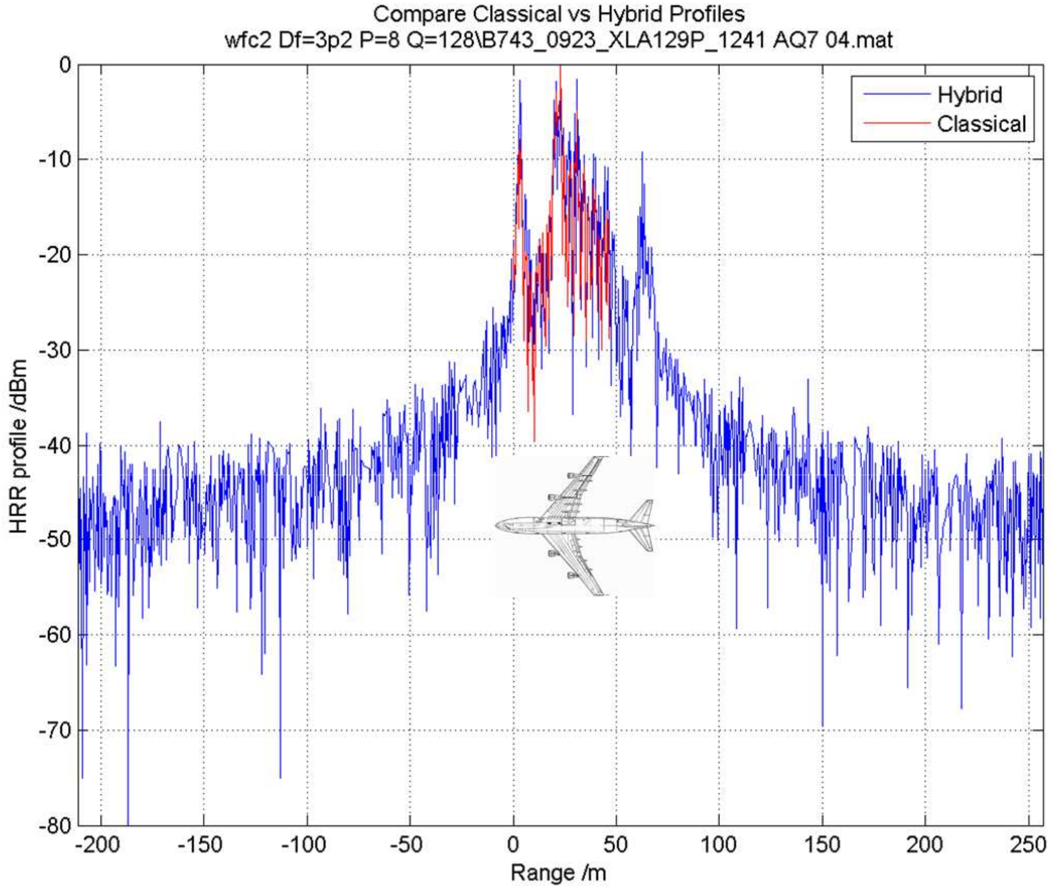
What is the resolution in metres if
Δf = 200 x 10^6 Hz?
[The speed of light c = 2.998 x 10^8 ms^{-1}]

$$\delta R = \frac{c}{2\Delta f}$$

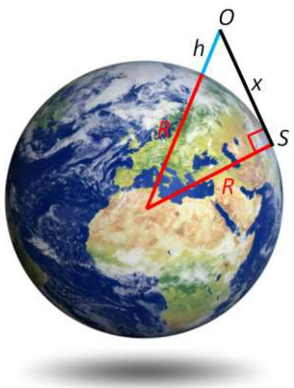
$$1\text{Hz} = 1\text{s}^{-1}$$

$$\delta R = \frac{2.998\times10^{8}\,\text{ms}^{-1}}{2\times200\times10^{6}\,\text{s}^{-1}}$$

$$\boxed{\delta R = 0.75\text{m}}$$



This means the radar could *resolve* aircraft features such as length, position of engines, tailfin etc!



Radius of the Earth $R = 6.378 \times 10^6$ m

Distance to the horizon is approximately

$$d = \sqrt{2 \times \tfrac{4}{3} Rh}$$

If radar height h = 30m, how far away is the horizon?

http://www.dailymail.co.uk/sciencetech/article-1233054/HMS-Dauntless-How-Britains-new-1bn-super-ship-isnt-working-order.html

Radius of the Earth   R = 6.378 x 10^6 m

Distance to the horizon is approximately

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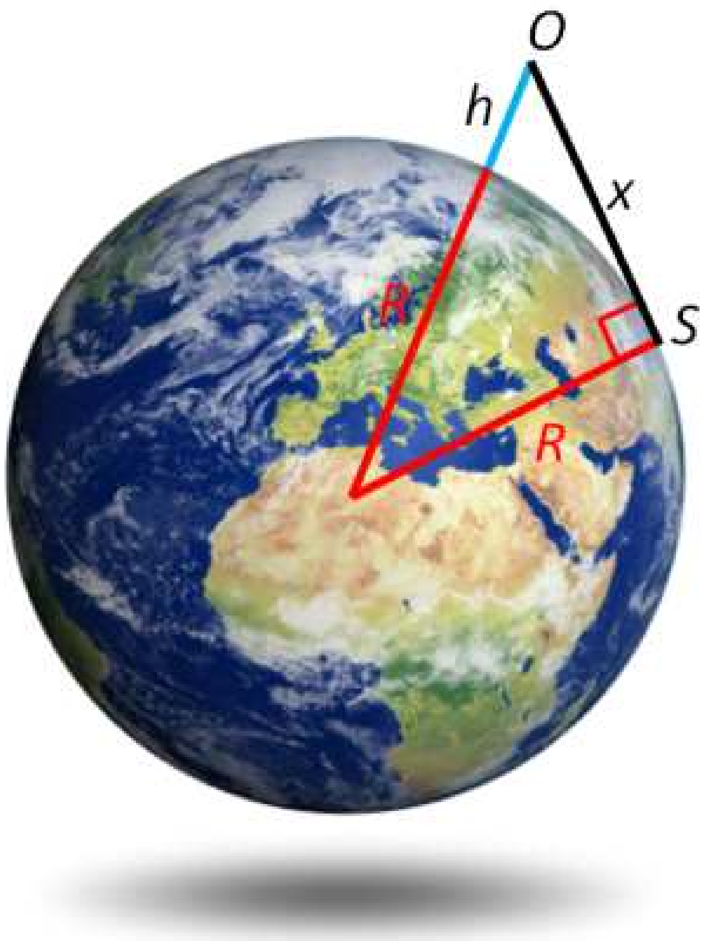
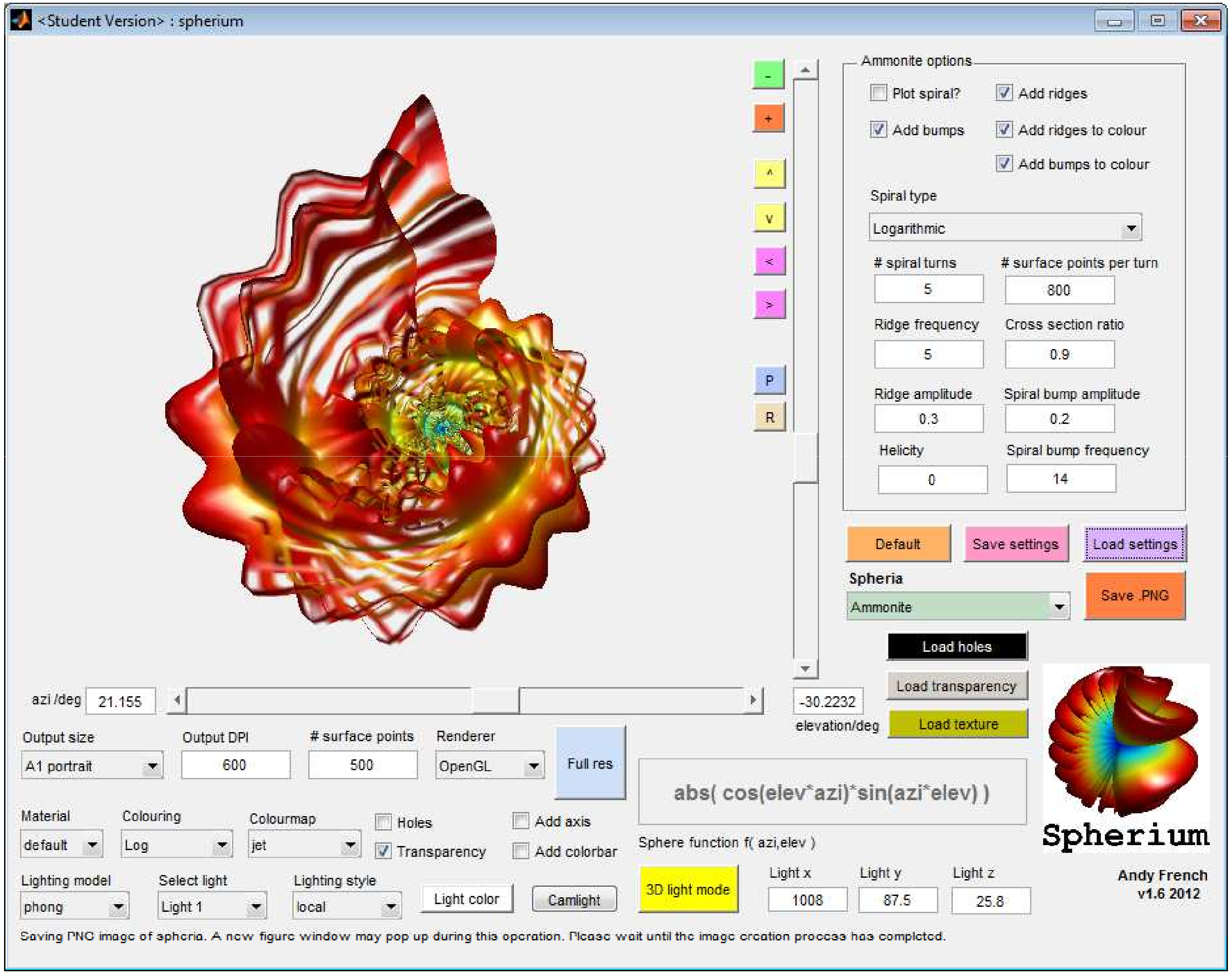
If radar height h = 30m, how far away is the horizon?

$$d = \sqrt{2 \times \tfrac{4}{3} \times 6.378 \times 10^6 \times 30} \quad \text{m}$$

$$\boxed{d = 22.6\text{km}}$$






```
p=0;
for n=1:12
    for m=1:n
        p = p + m;
    end
end
```

What is p?

What has this number got to do with a popular festive carol?

progsoc

Thursdays. 1600-1745.

Science School computer room.

The total number of presents in the carol "The Twelve Days of Christmas" is:

1 +
1 + 2 +
1 + 2 + 3 +
1 + 2 + 3 + 4 +
1 + 2 + 3 + 4 + 5 +
1 + 2 + 3 + 4 + 5 + 6 +
1 + 2 + 3 + 4 + 5 + 6 + 7 +
1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 +
1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 +
1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 +
1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 +
1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10 + 11 + 12

= 364

There is actually a formula for this type of sum. If *n* is the 'number of days of Christmas' and *p* is the total number of presents

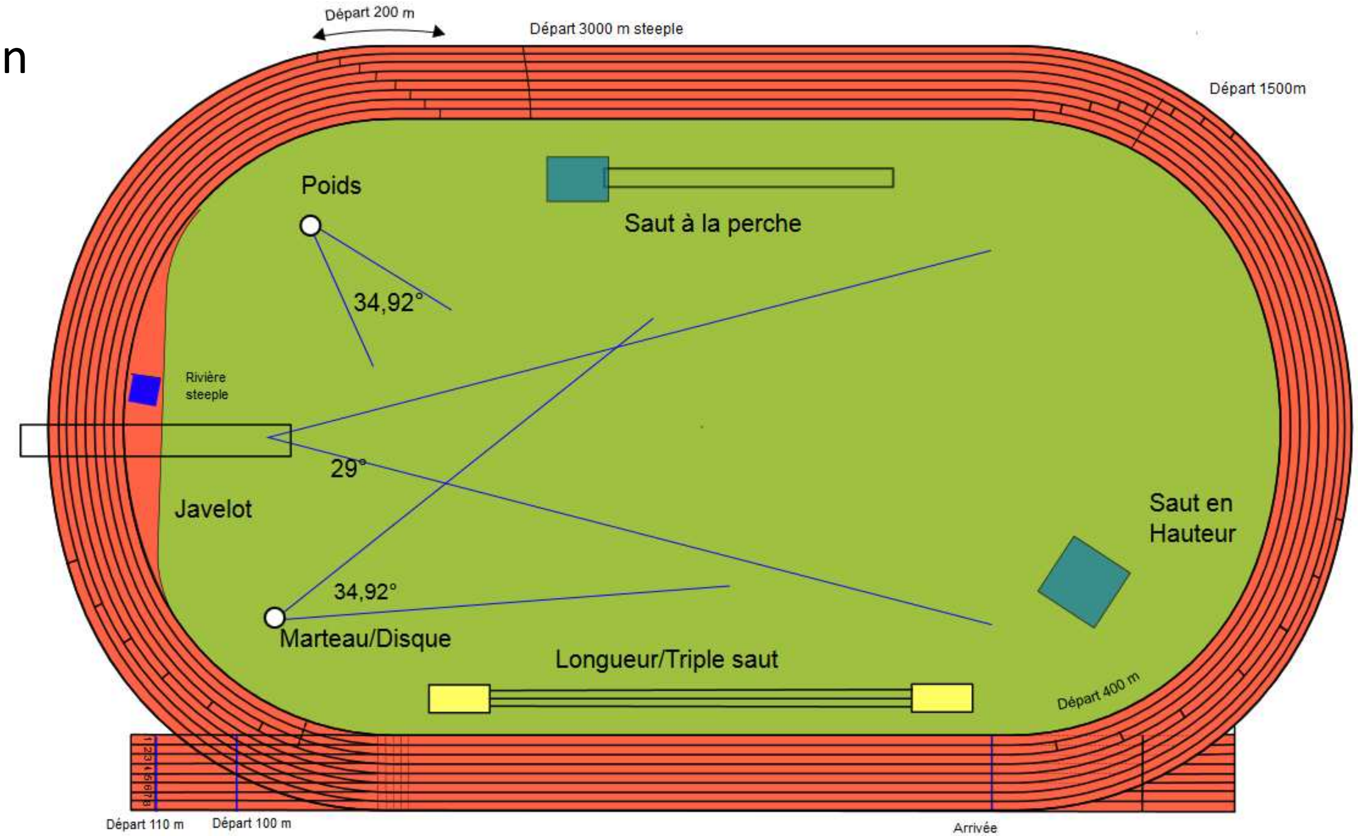
$$p = \tfrac{1}{6} n(n+1)(n+2)$$

e.g. (1/6) x 12 x 13 x 14 = 364

Note if Christmas *lasted all year*

p = (1/6) x 365 x 366 x 367 = 8,171,255 presents!

How far behind Michael Johnson would a 400m runner be if he ran 50.0s?



Michael Johnson covers 400m in 43.18s at World Record pace (set on 26th August 1999, Seville and still holding in Dec 2013)

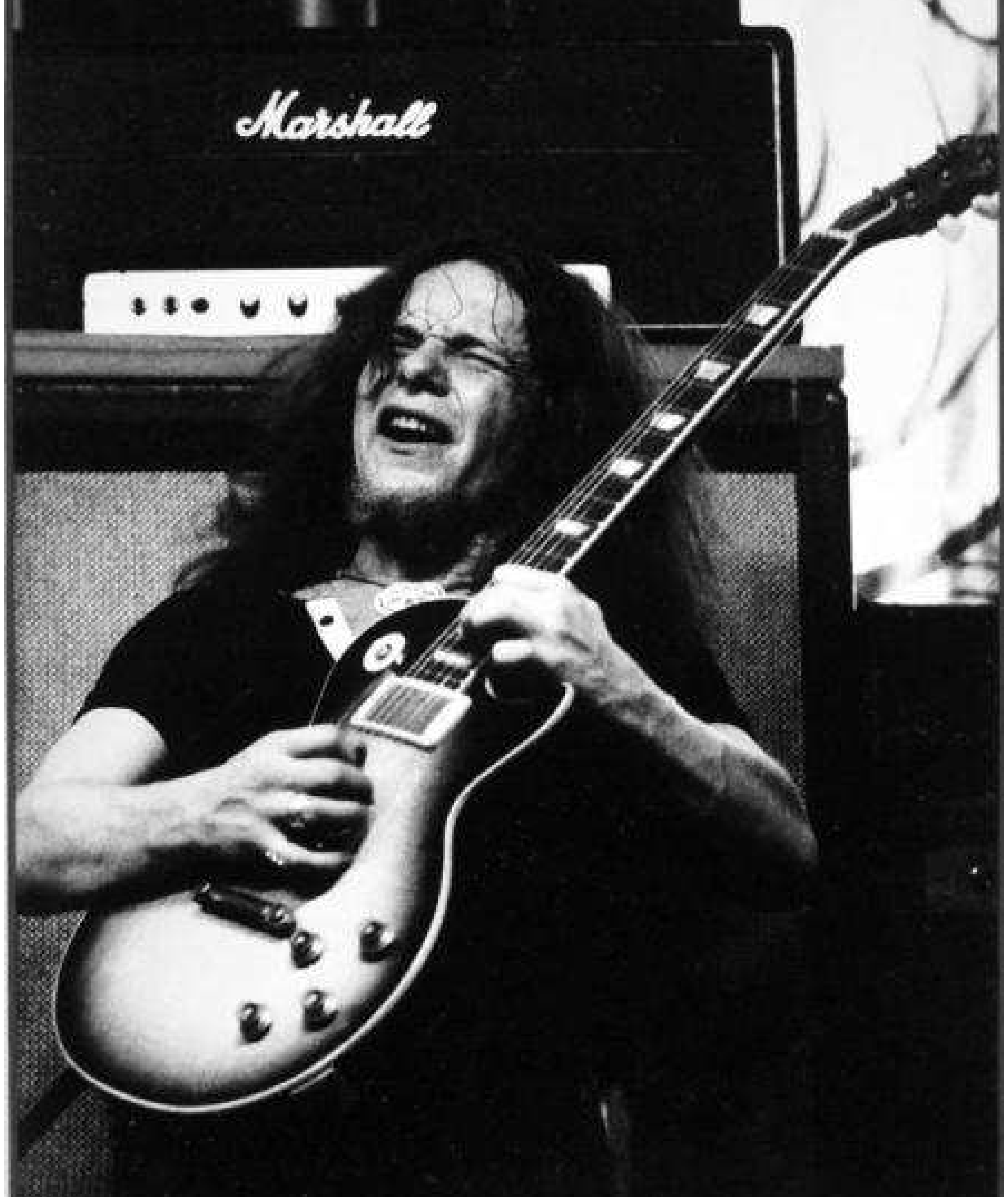
The other athlete covers the same distance in 50s at top speed, therefore he runs at an average speed of

$400m / 50.0s = 8\ ms^{-1}$

In 43.18s he will have covered 43.18 x 8 = 345.44m, so will be

54.56m behind Michael Johnson!

Paul Kossoff (1950-1976)



What are the frequency ratios between the notes D, E and G?

Unison (C)	$2^{\frac{0}{12}} = 1$
Minor second (C#)	$2^{\frac{1}{12}} = \sqrt[12]{2}$
Major second (D)	$2^{\frac{2}{12}} = \sqrt[6]{2}$
Minor third (D#)	$2^{\frac{3}{12}} = \sqrt[4]{2}$
Major third (E)	$2^{\frac{4}{12}} = \sqrt[3]{2}$
Perfect fourth (F)	$2^{\frac{5}{12}} = \sqrt[12]{32}$
Diminished fifth (F#)	$2^{\frac{6}{12}} = \sqrt{2}$
Perfect fifth (G)	$2^{\frac{7}{12}} = \sqrt[12]{128}$
Minor sixth (G#)	$2^{\frac{8}{12}} = \sqrt[3]{4}$
Major sixth (A)	$2^{\frac{9}{12}} = \sqrt[4]{8}$
Minor seventh (A#)	$2^{\frac{10}{12}} = \sqrt[6]{32}$
Major seventh (B)	$2^{\frac{11}{12}} = \sqrt[12]{2048}$
Octave (C)	$2^{\frac{12}{12}} = 2$

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Octave (C)	$2^{\frac{12}{12}} = 2$

$$f_D = 2^{\frac{2}{12}} f_C$$

$$f_E = 2^{\frac{4}{12}} f_C$$

$$f_G = 2^{\frac{7}{12}} f_C$$

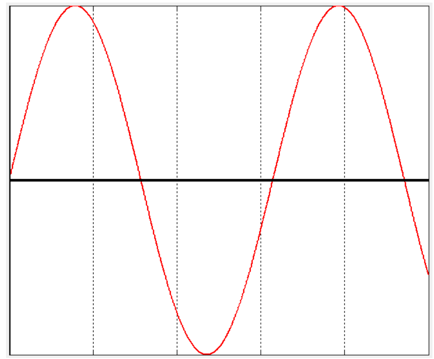
$$f_D : f_E : f_G$$

$$= 2^{\frac{2}{12}} : 2^{\frac{4}{12}} : 2^{\frac{7}{12}}$$

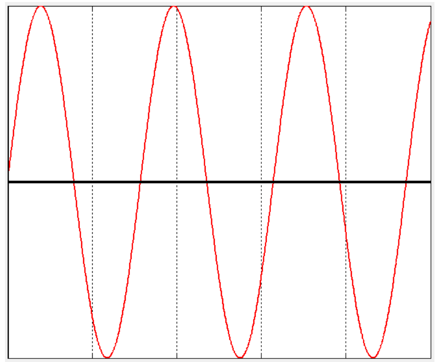
$$= 1 : 2^{\frac{2}{12}} : 2^{\frac{5}{12}}$$

$$= 1 \quad : \quad 1.122 \quad : \quad 1.335$$

C



C + one octave



time

South face of
Annapurna 1, Nepal

The height of Annapurna 1 is 8091m.

Base camp is at 4130m. If the summit is at an elevation of 30 degrees, how far away is the face? (You may assume it is effectively vertical).

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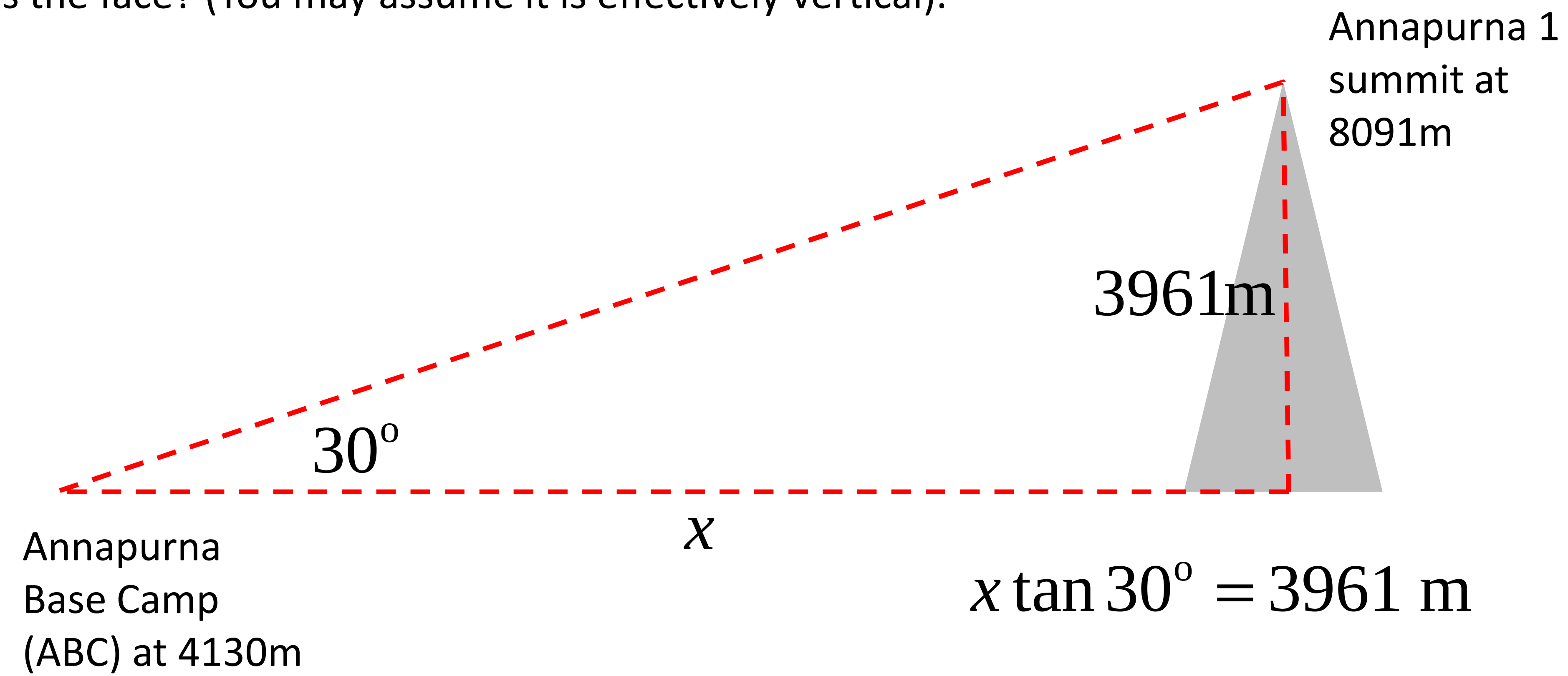


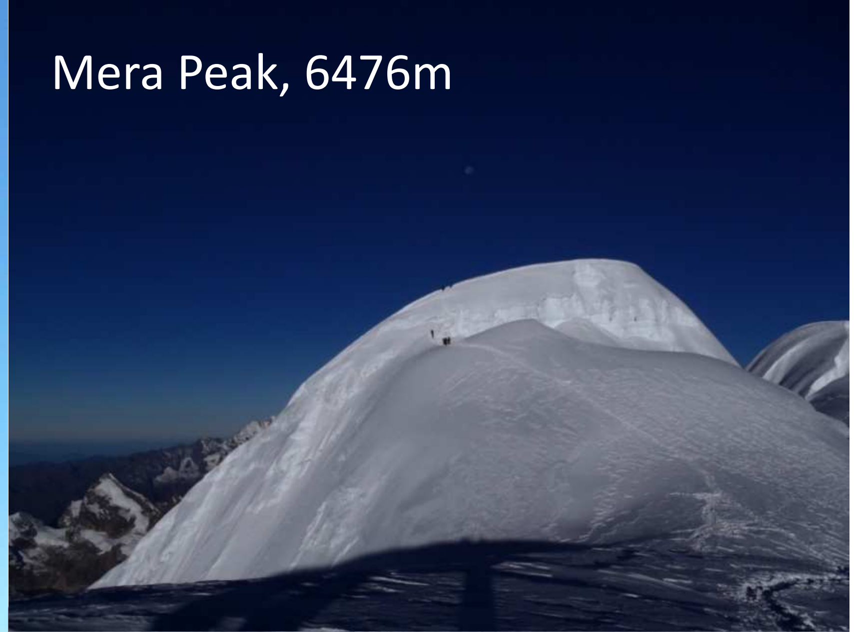
$$x \tan 30^{o} = 3961 \text{ m}$$

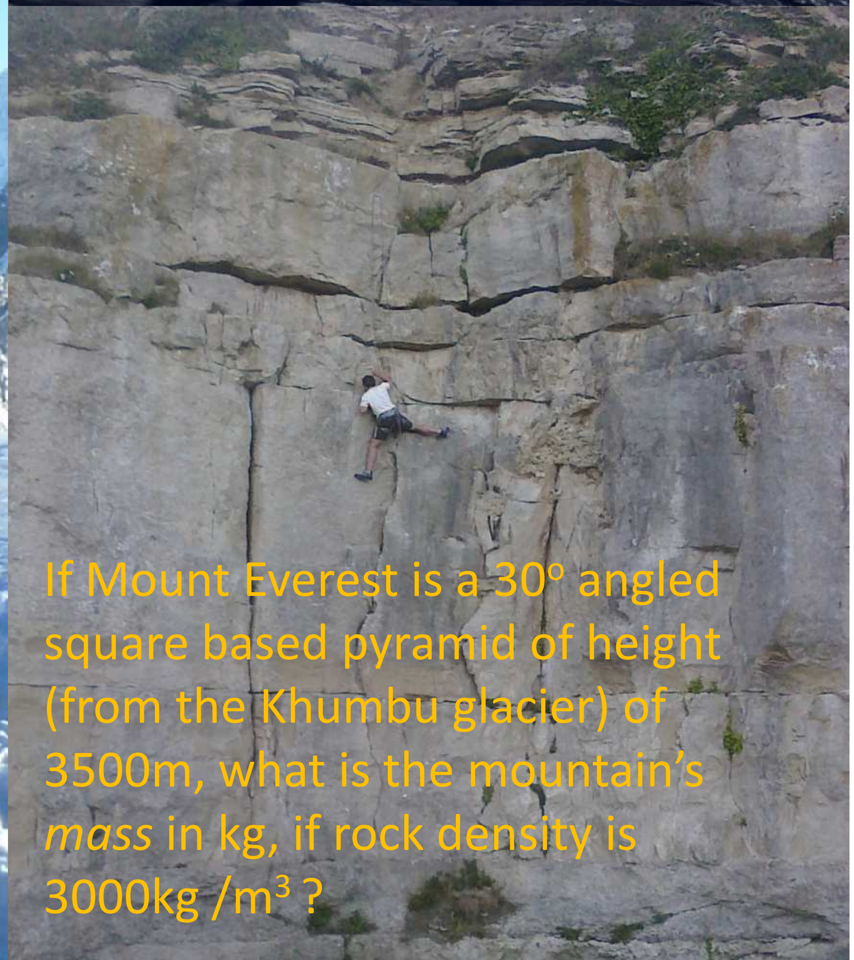
$$\frac{x}{\sqrt{3}} = 3961 \text{ m}$$

$$x = \sqrt{3} \times 3961 \text{ m}$$

$$x = 6.9\text{km}$$

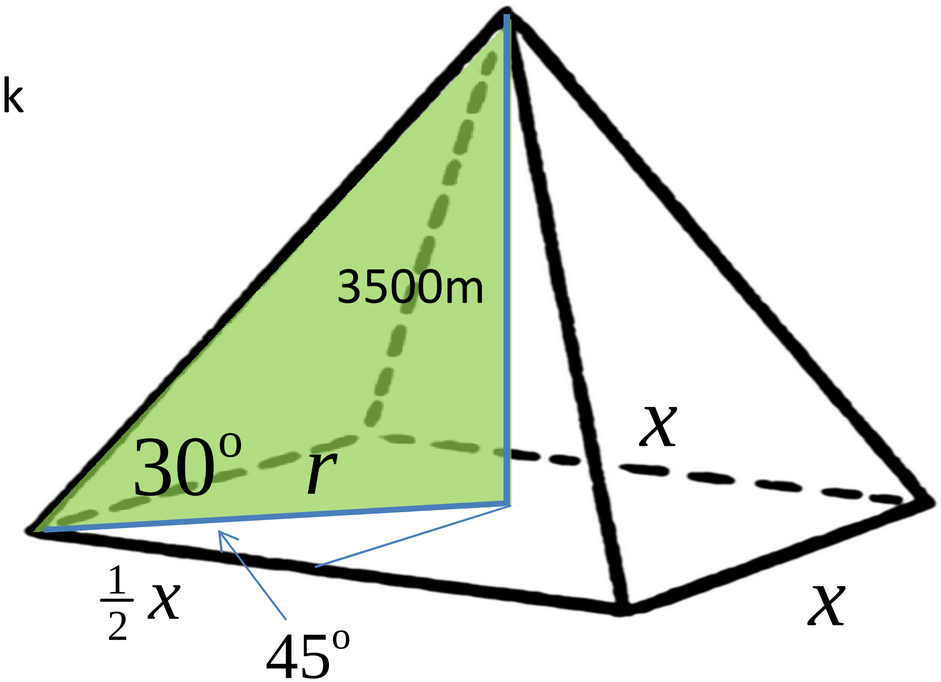
Maurice Herzog and Louis Lachenal, of a French expedition led by Maurice Herzog (including Lionel Terray, Gaston Rébuffat, Marcel Ichac, Jean Couzy, Marcel Schatz, Jacques Oudot, Francis de Noyelle), reached the summit on 3 June 1950.





If Mount Everest is a 30° angled square based pyramid of height (from the Khumbu glacier) of 3500m, what is the mountain's *mass* in kg, if rock density is 3000kg /m^3 ?

If Mount Everest is a 30^o angled square based pyramid of height (from the Khumbu glacier) of 3500m, what is the mountain's *mass* in kg, if rock density is 3000kg /m^3 ?



$$3500 = r\tan 30^o$$

$$3500 = r\tfrac{1}{\sqrt{3}}$$

$$r = 3500\sqrt{3}$$

Volume of a pyramid is 1/3 x base area x perpendicular height

$$\tfrac{1}{2}x = r\cos 45^o$$

$$x = \frac{2r}{\sqrt{2}} = r\sqrt{2}$$

$$x = 3500\sqrt{3}\times\sqrt{2}$$

$$x = 3500\sqrt{6}$$

$$V = \tfrac{1}{3}x^2 h$$

$$V = \tfrac{1}{3}\times 3500^2\times 6\times 3500$$

$$V = 2\times 3500^3 \text{ m}^3$$

$$M = 3000\,\text{kgm}^{-3}\times 2\times 3500^3 \text{ m}^3$$

$$M = 2.57\times 10^{14}\text{ kg}$$


Grisedale tarn, Lake District


George the Bear. Mallory Challenge 2013, Scafell Pike


Indus river, near Basgo


Campsite near the Matho La, Ladakh.

Winchester College / Lotus Flower Trust Ladakh 2013
with the Nuns of Saboo Ayu, near Leh.