Mathematics 3820H – Mathematics from medieval to modern times
TRENT UNIVERSITY, Fall 2014

Assignment #3
Due on Wednesday, 15 October, 2014.

The Persian polymath Omar al-Khayyami, best known nowadays as a poet, developed geometric techniques for finding the positive real roots of cubic and quartic equations. In modern terminology, his method for solving cubics can be described as follows, using modern notation and Cartesian coordinates:

> To solve the cubic equation $x^3 + ax^2 + b^2x + b^2c = 0$, intersect the hyperbola $y = \dfrac{bc}{x} + b$ with the circle $\left(x + \frac{1}{2}(a+c)\right)^2 + y^2 = \frac{1}{4}(a-c)^2$ and find the point of intersection other than $(-c, 0)$.

1. Verify that al-Khayyami's method for solving cubic equations actually does find positive real roots, if such exist. *[5]*

I couldn't find a freely available translation of al-Khayyami's work on algebra into English, but there is one into French [1] if anyone wishes to look it up.

2. Describe the principal attempts before 1500 A.D. to explain how rainbows are formed. What role did the attempts to explain rainbows have in the development of the scientific method and the role of mathematics in science? *[5]*

REFERENCE

1. *L'algèbre d'Omar Alkhayyammi*, trans. by F. Woepcke, Paris, 1851. (Arabic with French Translation.) Available online (pdf) at:
`http://www.wilbourhall.org/pdfs/algebraOmarAlkhayyami.pdf`

Lobachevsky alone has looked on Beauty bare.
She curves in here, she curves in here. She curves out there.
Her parallel clefts come together to tease
In un-callipygianous-wise;
With fewer than one hundred eighty degrees
Her glorious triangle lies.
Her double-trumpet symmetry Riemann did not court –
His tastes to simpler-curvedness, the buxom Teuton sort!
An ellipse is fine for as far as it goes,
But modesty, away!
If I'm going to see Beauty without her clothes
Give me hyperbolas any old day.

The world is curves, I've heard it said,
And straightway in it nothing lies.
This then my wish, before I'm dead:
To look through Lobachevsky's eyes.

Roger Zelazny, from his novel *Doorways in the Sand.*