Alternative Assessment Methods in Mathematics

J.A.C. Weideman
Applied Mathematics
University of Stellenbosch
South Africa
http://dip.sun.ac.za/ weideman

The mathematics grader's dilemma

b) $y = 0$

$$g/r^2 \ln\left(1 - \frac{rx}{v\cos\theta}\right) + \frac{rx}{v\cos\theta}\left(g/r + v\sin\theta\right) = 0$$

$$g/r^2\left(-\frac{rx}{v\cos\theta} - \frac{1}{2}\left(\frac{rx}{v\cos\theta}\right)^2 - \frac{1}{3}\left(\frac{rx}{v\cos\theta}\right)^3\right) + x/v\cos\theta\left(g/r + v\sin\theta\right) = 0$$

ignorer.

$$-\frac{gx}{v\cos\theta} - \frac{gx^2}{2v^2\cos^2\theta} - \frac{grx^3}{3v^3\cos^3\theta} + \frac{gx}{v\cos\theta} + x\tan\theta = 0$$

$$x\tan\theta - \frac{g}{2v^2\cos^2\theta}x^2 = 0$$

$$x\left(\tan\pi/3 - \frac{9.8}{2(400^2)\cos^2\pi/3}x\right) = 0$$

$$x\left(\sqrt{3} - 0.0001225\,x\right) = 0$$

$$\sqrt{3} - 0.0001225x = 0$$

$$-0.0001225x = -\sqrt{3}$$

R = x = 14 139.19 centrede. X

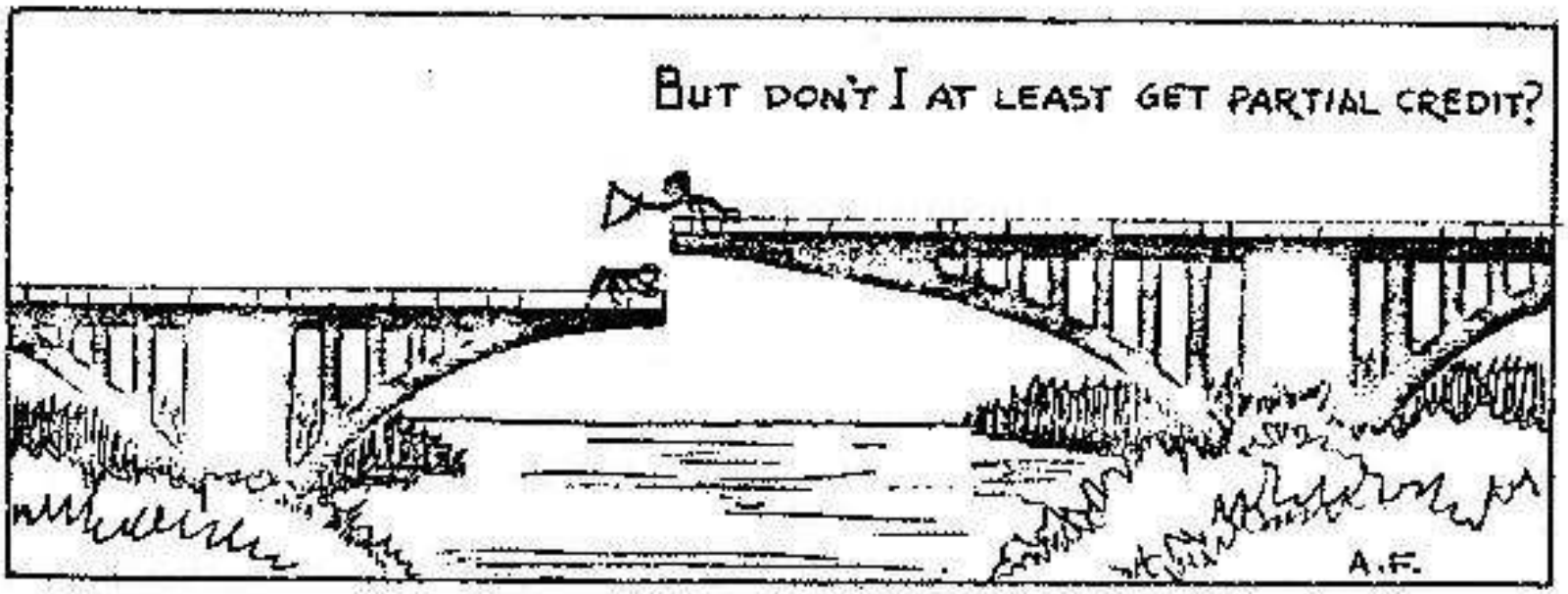
1/3

question 13, My answers are incorrect but are there no marks for the work to get to the wrong answer.

"question 13, My answers are incorrect but there are no marks for the work to get to the wrong answer."

Indeed.

(Thanks to Dr. Karin Hunter, Applied Mathematics, US)



"But don't I at least get partial credit?"

Some alternative assessment ideas:

1. Multiple choice/short answer problems
2. Computer projects
3. Writing intensive courses

1. Multiple choice/short answer problems

What it's not:

A device for quick marking (well not principally anyway)

What it is:

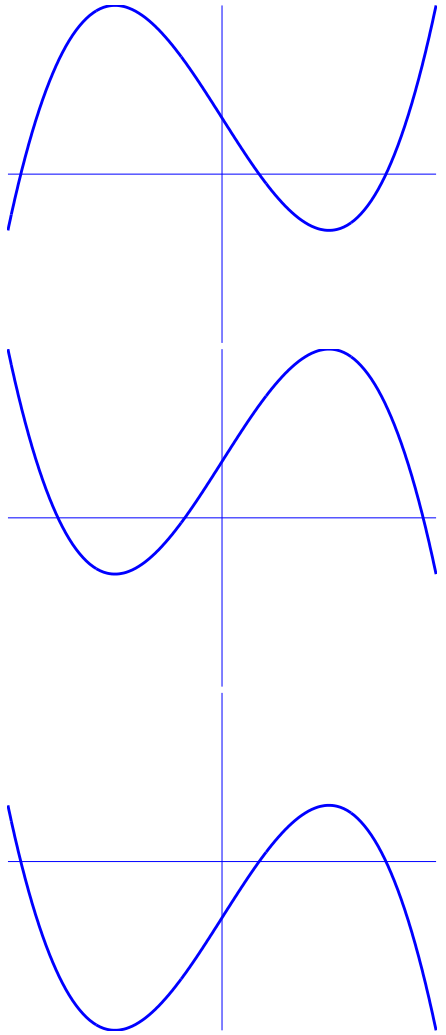
A device for testing knowlegde in an alternative way, complementary to the plug-and-chug activities of traditional assessment methods

Example 1: Match each function with its graph.

$$y = -x^3 + 3x - 1$$

$$y = -x^3 + 3x + 1$$

$$y = x^3 - 3x + 1$$



Example 2: Compute $\int_0^1 \sqrt{1-x^2}\,dx$

(a) 0 (b) $\frac{1}{8}\pi$ (c) $\frac{1}{4}\pi$ (d) $\frac{1}{2}\pi$ (d) π

The way not to do it: plug & chug

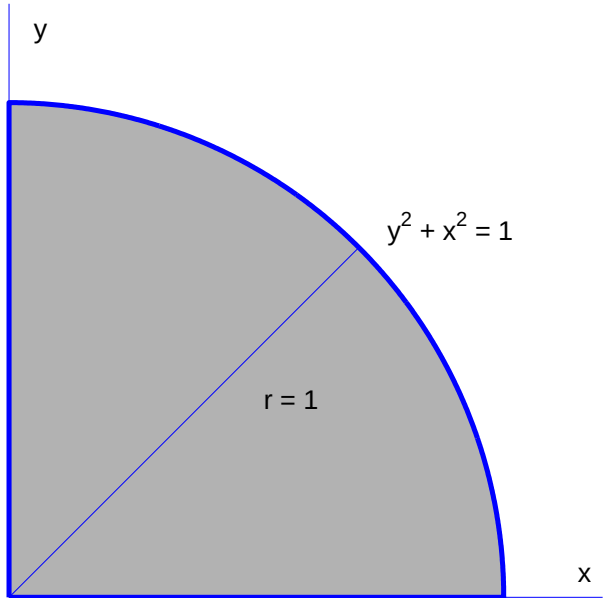
Put $x = \sin\theta \implies dx = \cos\theta\, d\theta,$

x	0	1
θ	0	$\frac{1}{2}\pi$

Then
$$\begin{aligned}
\int_0^1 \sqrt{1-x^2}\, dx &= \int_0^{\pi/2} \sqrt{1-\sin^2\theta}\big(\cos\theta\, d\theta\big) \\
&= \int_0^{\pi/2} \cos^2\theta\, d\theta \\
&= \frac{1}{2}\int_0^{\pi/2} \Big(1+\cos 2\theta\Big)\, d\theta \\
&= \frac{1}{2}\Big[\theta + \frac{1}{2}\sin 2\theta\Big]_0^{\pi/2} \\
&= \frac{1}{4}\pi \implies \text{(c)}
\end{aligned}$$

The way to do it: geometric interpretation

$\int_0^1 \sqrt{1-x^2}\,dx =$ area under the graph of $y = \sqrt{1-x^2}$ on $0 \le x \le 1$:



Area of $\frac{1}{4}$ circle of radius $1 = \frac{1}{4}\pi$

2. Computer Projects

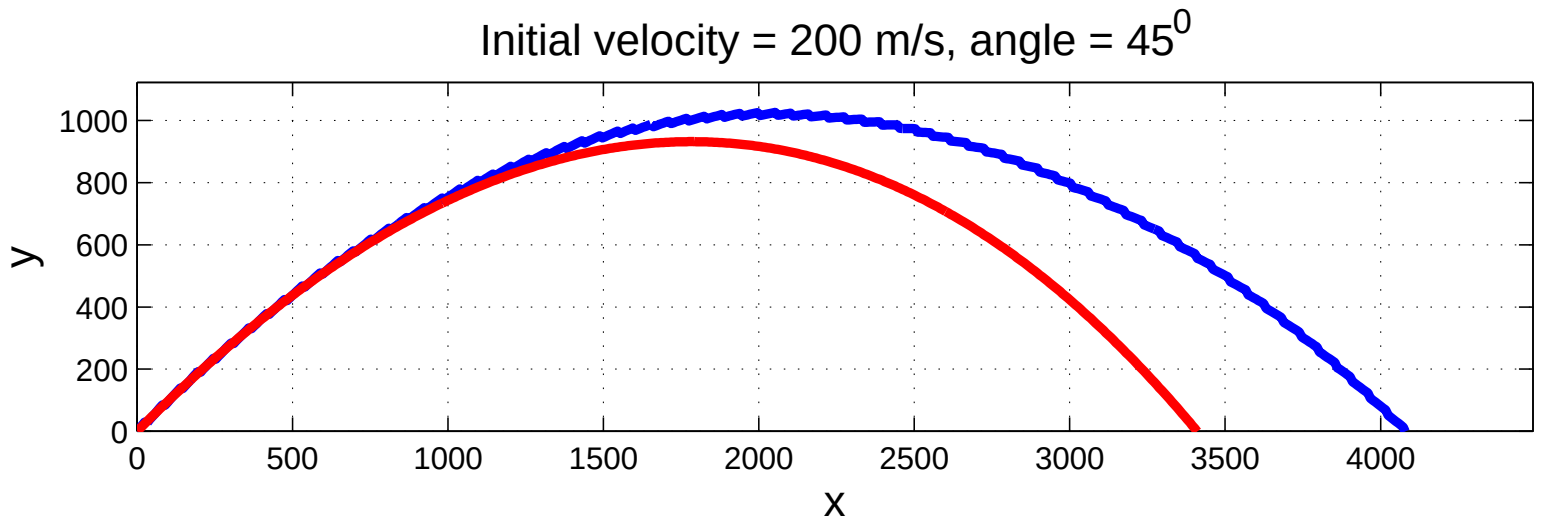
What it's not:

A device for testing programming skills
(unless this happens to be the course in programming!)

What it is:

An alternative demonstration of acquired skills: "You truly understand a concept only when you can implement it on a computer."

Example: Projectile motion



- With no wind resistance trajectory can be obtained with elementary techniques
- With realistic models for wind resistance computer simulation is needed

Entire MATLAB code for simulation

```
V = input('Aanvanklike spoed = ? ');

theta = input('Aanvanklike hoek = ? ');

z0 = [0; 0; V*cos(theta); V*sin(theta)];  % Aanvangsvektor

f = inline('[z(3); z(4); 0; -9.8]','t','z');  % Regterkant

[t,z] = ode45(f,[0 T],z0);     % Los die DV op

x = z(:,1); y = z(:,2);        % Haal die (x,y)-koordinate uit

plot(x,y,'r-');                % Stip die baan
```

3. Writing Intensive Courses (WIC)

What it's not:

An assessment of grammar, punctuation, spelling, or style.

What it is:

An alternative demonstration of acquired skills: "You truly understand a concept only when you can explain it to someone else."

Typical WIC activity

Take Theorem XXX and rewrite it such that the average (first/second/third) year student will understand it. Make the following simplifications . . .