Merit Teaching-Class Activity Spring 2016

This is a class activity for Math 199 which is a Merit Section for Math 285 - Introduction to Differential Equations. The duration of the activity is 1 hour and 50 minutes, including a 15 minutes break.

The activity is intended to stimulate student's ability to reason in teams over non-trivial mathematical problems. The activity is structured around five main principles, outline below:
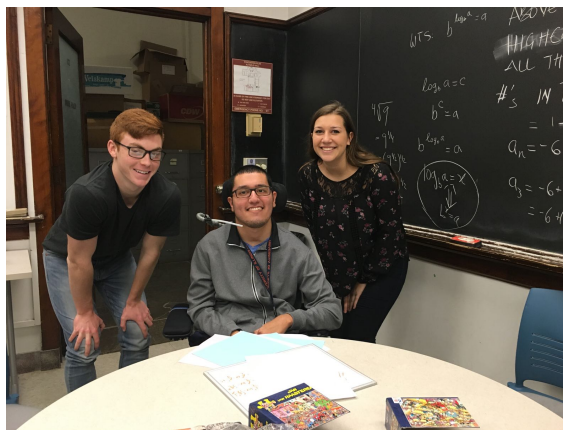
(1) The TA (myself) prepares a set of mathematical problems relevant to the course. The problems are divided into topics according to the structure of the material covered in the lectures. Problems are further associated a difficulty level and color-coded accordingly. Each problem awards a certain number of points, if solved, in alignment with its difficulty level. The adopted color-code is the following: green (5 points), yellow (10 points), and red (15 points).

(2) Students work in groups of 3 or 4. Each group picks a problem in turn.

(3) A group can skip a question after at least 5 minutes thinking.

(4) A group can get help from another group. In this case each group receives half of the points.

(5) The members of the group(s) with more points at the end of the activity receive symbolic prizes like small games and puzzles. Also the participation of all the students is awarded with homemade cookies (hopefully they taste accordingly!).

An example of three problems for the topic "Exact Equations" is reported below. In the example, one problem for each difficulty level is displayed, with corresponding number of points.

TOPIC	POINTS
Exact Equations	5

Let $M(x, y) + N(x, y)\frac{dy}{dx} = 0$ be an exact differential equation.

What conditions must $M(x, y)$ and $N(x, y)$ satisfy ?

TOPIC	POINTS
Exact Equations	10

Verify that the given differential equation is exact, then solve it:

$$(\cos x + \ln y)dx + \left(\frac{x}{y} + e^y\right)dy = 0$$

TOPIC	POINTS
Exact Equations	15

1. Find a general solution to the exact differential equation:
$$M(x, y) + N(x, y)\frac{dy}{dx} = 0$$
2. Find the integrating factors that transform the following non-exact differential equations into exact differential equations:
   - $6xy + (4y + 9x^2)\frac{dy}{dx} = 0$
   - $y(x + y + 1) + (x + 2y)\frac{dy}{dx} = 0$

FIGURE 1. Sample problems for the topic "Exact Equations".

The following picture[1] was taken at the end of a class in Spring 2016, one of the days in which we performed the described activity. The students in the picture are the members of the winning team for that day. As a symbolic prize, they were given a set of small jigsaw puzzles. They literally cut the box of the prize to share it among them (visible in the foreground).

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[1]The students have given explicit consent for the use of this picture.