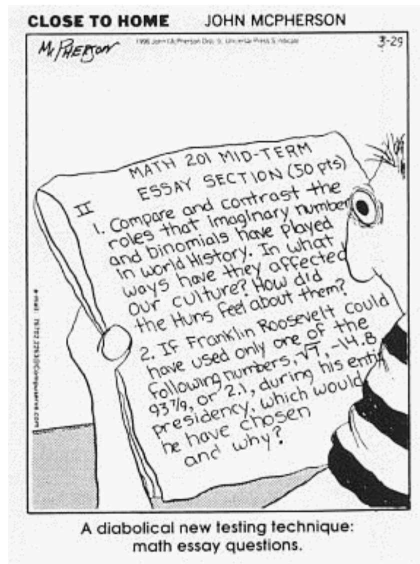
November 16, 2016 Physics 131 Prof. E. F. Redish

- **Theme Music:**
  Billy Cotton
  How'm I Doin'?

- **Cartoon:**
  John McPherson
  Close to Home



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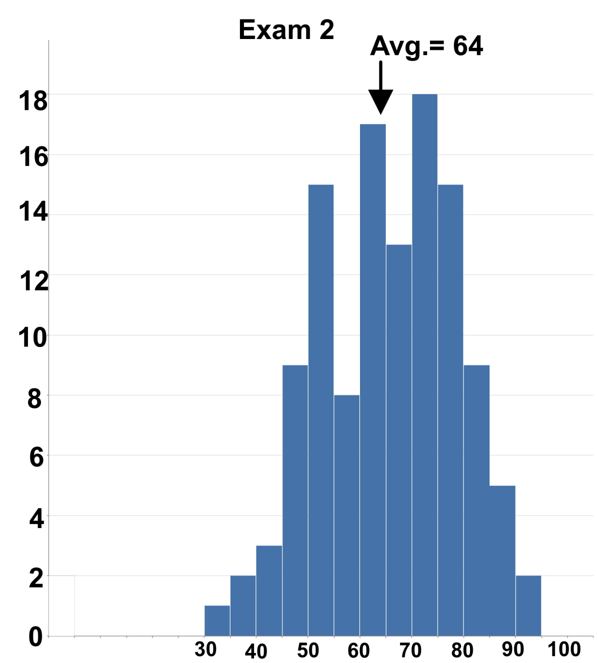
A ≥ 75
75 > B ≥ 60
60 > C ≥ 45
45 > D ≥ 35



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Success on individual problems

	#1	#2	#3	#4	#5
Pct Correct	65%	49%	76%	75%	71%

Principles for #1

- Coulomb's law $\vec{F}^{elec}_{A\to B} = \frac{k_C Q_A Q_B}{r^2_{AB}} \hat{r}_{A\to B}$
- Adding vectors and basic trig
- Newton 3 $\vec{F}^{type}_{A\to B} = -\vec{F}^{type}_{B\to A}$
- Definition of electric field $\vec{E}(\text{at position of } q) = \frac{\vec{F}_{\text{acting on } q}}{q}$

Results on Problem #1

	1.1	1.2	1.3	1.4	
A	3%	4%	17%	**84%**	16%
B	1%	**40%**	5%	1%	18%
C	0%	29%	9%	3%	0%
D	2%	12%	15%	0%	0%
E	**95%**	7%	16%	6%	20%
F	0%	4%	**28%**	1%	0%
G	0%	0%	3%	3%	0%
AE	1%				25%
BE					**22%**

Principles for #2

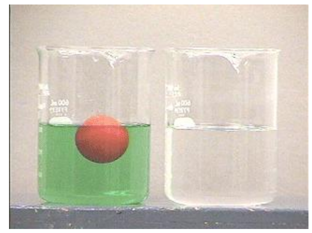
- Force arising from pressure $\vec{F}_{\text{on } A} = p\vec{A}$
- Pressure increase with depth

$$p = p_0 + \rho_{fluid} g d$$

- Archimedes' principle
  - The buoyant force on an object imbedded in a fluid = the weight of the fluid displaced by the object. (It's what the fluid around the object can hold up.)

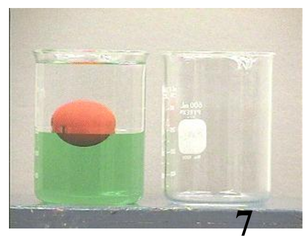
A ball floats in a beaker of water. The ball sinks in a beaker of mineral spirits. The mineral spirit will float above the water when poured slowly on top of water.

If the ball is floating on the water 2/3 of the way under the water, what will happen to the ball when mineral spirits is slowly poured on top of the water?



Relative to the top of the water,

A. The ball will go down.
B. The ball will go up.
C. The ball will stay at the same level.



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Results on problem #2

	2.1	2.2	2.3	2.4		2.5
A	0%	91%	69%	31%	0	42%
B	13%	3%	4%	18%	1	3%
C	78%	6%	27%	49%	2	4%
D	3%	0%	0%	3%	3	4%
E	4%				4	7%
					5	40%

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Principles for #3

- Diffusion governed by Fick's Law

$$\langle r^2 \rangle = 2nD\Delta t \qquad n = \text{ \# of dimensions}$$

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Sample essay

In this unit, we were studying buoyant forces and there was a question that challenged me. There were two objects suspended in water, however, one object was a little bit lower than the other. The question asked how does the buoyant forces compare between the two? I originally though the buoyant force of the higher object was greater than the other. But I remembered Archimedes' principle stated that volume only matters when measuring buoyant force, not weight or mass. Therefore the buoyant forces between the two are the same.

Sample essay

I made and error when determining the force a block submerged completely in water feel from the water above it acting on it and the force it feels from the water below pushing up on it. I simply looked at the block, noticed that it was positioned cloer to the bottom of the tank than it was to the top and thought that since there's more water molecules above the block than below, the force of water molecules on the block above it is greater than the force of water molecules pushing up, That was my one-step thinking error, but if I had just used the principles that pressure increases with depth and that F = pA so force increases with pressure, then I would have known that the force of the water molecules acting on the block from below is always greater than the force of water molecules from above regardless of position.

Sample essay

.In class, one of Newton's laws that we have learned is that two objects exert equal and opposite forces on each other.... So for problem 1 on this test, I knew that one I figured out how Q interacted with the dipole, specifically, the force the dipole exeted on Q, I knew by this principle that the force Q exerted on the dipole had to be equal in magnitude but opposite in direction. This prevented me from making a 1-step thinking error that the force Q exerted on the dipole was equal to the movement of the dipole after these two objects interacted.

Principles for #5

- Momentum definition $\vec{p} = m\vec{v}$
- Conservation of momentum condition:
  - Momentum of a system is conserved if all external forces acting on the objects in the system balance.
- Conservation of momentum law

$$\vec{p}_A^{\,i} + \vec{p}_B^{\,i} = \vec{p}_A^{\,f} + \vec{p}_B^{\,f}$$

$$\Delta\vec{p}_A = -\Delta\vec{p}_B$$

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