NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
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Presidentｓ Message

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Hello to all OAPT members.

Since we were last together in Sudbury, May 2005, your executive has undertaken a number of projects on behalf of OAPT. The beginning of the New Year is a good time to give you a report of the activities so far.

1. The conference 2006

The annual conference has been moved to the Perimeter Institute in Waterloo. Damian Pope of PI is organizing the conference as part of the outreach program of the Institute.

The title of our annual conference this year is: "**Innovative Teaching Strategies for Modern Physics**."

Two themes have been chosen:

1. Quantum Physics and Relativity
2. Authentic Inquiry

The Perimeter Institute is contributing at least one speaker to the lineup, and there are a number of modern physics education specialists on the agenda. As always, we are interested in having your participation (as a talk, or presentation) in an effort to make this conference a memorable one. If you would like to address one of the topics below, please contact me.

* Teaching exemplary courses in quantum/relativity

* Experimenting and demonstrating Q/R principles

* Effective use of media, simulations, etc for Q/R

* Theorists and engineers who can work with teachers to locate fruitful starting points

We have contacted the Photonics Institute for a possible set of demos/teaching strategies, and we will have some outstanding astronomers who use quantum based imaging techniques. Anyone interested in participating in the efforts of the conference committee is welcome and asked to contact Jim Ross.

2. Conference 2007, 2008 and beyond

In order to avoid the last minute rushing, we have begun to lay down the groundwork for conferences one, two and more years in advance. We are still talking of Kingston for 2007 (either RMC or Queens) and Ryerson is interested in hosting 2008. If we can settle upon the themes for these conferences this year, we can work much more effectively at securing top-notch speakers and presenters.

Once again, please contact me if you wish to become active on one or more of these committees.

3. Ministry of Education Review

Early in 2005, OAPT executive members had heard of a planned MoE physics curriculum review to begin in Sept. 2005. OAPT sent a letter to the MoE at that time, indicating an interest in participating. We did receive a reply indicating receipt of our letter, and advising us to wait for further notice. When no notice had arrived in September, other messages were sent. By November, we had been contacted by the MoE, but the review was already well underway.

We made contact with Maureen Callan in late November 2005, and began to prepare a submission at that time. I received a number of valuable contributions from Rolly, Paul, Vida and Elzbieta. With only weeks to go, our submission obviously could not be as thorough as we would like.

When we met with Maureen Callan in December 2005, we were able to engage in a very wide and frank discussion of the review process. It appears that the MoE dropped the ball on us. They had received our letters, to be sure, but they had no records of OAPT having been a registered educational organization. In fact, OAPT had been fully recognized years ago, and had been active participants in other MoE curriculum initiatives in the past.

In February, the Curriculum and Assessment Policy Branch of the Ontario Ministry of Education notified us that they have renewed our membership. We are now back on the list, and will be invited to participate in the next physics curriculum meeting on May 12, 2006.

John Caranci will organize and coordinate OAPT's contribution to the MoE physics review. He plans to consult with members more extensively. His report is once again going to be quite quick (Feb., 2006) but there will be another opportunity to participate in Sept., 2006.

4. Newsletter

Paul Passafiume has done a great job of preparing and distributing the newsletter. The new format is pleasing to all, and the column format appears to be well received. The newsletter is poised to grow. If we maintain the existing columns, we can add to the format as new people come aboard.

5. Membership List and Tracking

At the present time, Ernie McFarland and Carol Croft at U Guelph have been maintaining the membership list. As our membership grows, that task grows as well. It's important to keep close contact with the members as they drop in and drop out, change schools or residences, change emails, and so on. This is the time to make some major changes to the organization of the membership database. For example, it would be very useful to have one database containing Ontario's secondary schools (about 900 of them) so that we know which of the schools have OAPT members (numbering about 400) and which to not. A relational database with those capabilities would support our other organizational projects.

5. Web Site

Rolly Meisel has done an outstanding job maintaining and improving upon the web site. We have some money for a major overhaul, and the executive committee believes that is the most effective way to use the cash. The plans include

* our own domain name, and independent hosting

* a web site built upon an appropriate database that controls conference registration, and records

* physics contest registration, communication

* photo contest registration, communication

We are, of course, concerned about membership privacy. The number of ID's and passwords that could access this information would be very tightly limited. We would consult with the larger membership on appropriate ways of maintaining security of that information.

In closing

There are, as usual, a number of very essential projects running this year, for the benefit of the whole OAPT organization. Diana has the photo contest well in hand, Terry is putting the physics contest on the tracks, and the world looks great.

Thanks for all of your contributions!

Jim Ross

The Case for Modern Physics

Dr. Damian Pope
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On a frosty December day in Murray Hill, New Jersey in 1947, two scientists gathered in their lab to show their boss a device they had just built. It amplified electrical signals and, after much effort, they had just got it working. John Bardeen and Walter Brattain were very proud of their achievements. Their boss was impressed.

In weeks that followed, the new invention was given a name, the *transistor*. At the time, everyone thought it would be of some use, but no one predicted just how big it would eventually become.

As the years passed, more and more engineers and technicians began using transistors in various electronic devices. Today, 59 years later, they are everywhere.

Think of your cell phone, your computer or your students' IPODs. Each of them contains thousands upon thousands of tiny transistors jammed into minute circuits. Worldwide, 10^{18} transistors are manufactured annually.

Transistors are like tiny electronic switches. Send a current through one part of them and a larger current flows elsewhere ('ON' mode). Without the initial current, the larger one is absent ('OFF' mode).

Arguably, transistors form the backbone of the multi-billion dollar electronics industry. They are an important part of modern life and have billions of dollars of economic impact annually.

Both Brattain and Bardeen had strong backgrounds in physics. But, what particular sort of physics guided them as they struggled to build the first transistor? Was it Newtonian physics? No. This set of theories predicts that the transistor is a physical impossibility as it should fall apart within a split second due to electrons emitting radiation upon accelerating.

Instead, Brattain and Bardeen relied significantly on the recently developed theory of quantum physics. In particular, they employed quantum models of how many, many electrons within solids behaved. Without these models, they may not have been able to build their prototype. They would have lacked a fundamental understanding of the materials they were dealing with.

This story is just one of many examples that illustrate of the immense practicality of modern physics. Today, in 2006, such physics is an integral part of our daily lives.

Presumably, one of our goals as teachers is to prepare students for the real, day-to-day world. One important aspect of this world is modern physics. And as emerging technologies such as quantum computers, quantum teleporters and quantum secret codes (the last of which is already a commercial reality) develop more and more, the significance of relativity and quantum physics will only grow.

Given this, whilst also acknowledging the importance of first giving students a solid foundation in Newtonian physics, isn't it desirable that we ensure that they are adequately exposed to modern physics in high school?

I believe that one can make a good case to support this notion.

And I invite you to join me at this year's OAPT conference at Perimeter Institute in Waterloo to further explore modern physics at the high school level, along with innovative teaching strategies for *all* topics, modern or otherwise.

I hope to see in you here in late May.

Digital Physics

Exploring the Work-Energy Theorem

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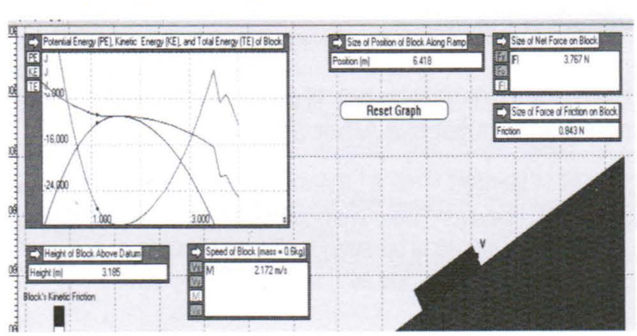
Hello everyone, and welcome to another edition of Digital Physics! These words come to you at a particularly busy time for us all – the dreaded exams! May they find, and serve you well! In this column, as promised, we'll take a look how we can lead our students to a functional understanding of the subtle difference between the Law of Conservation of Energy, and the Work-Energy Theorem. Once again we'll solicit the power of Interactive Physics 2000 as a means of assistance along our journey. All set? Here we go!

As we all know, the Law of Conservation of Energy states something like this: the total mechanical energy of a system remains constant unless non-conservative forces act to increase or decrease it through the mechanism of work. Mathematically we might write: $E_i + W_{i \to f} = E_f$ (1), where E_i is the total energy of the system in its initial state, E_f is the total energy of the system in its final state and $W_{i \to f}$ is the amount of energy that is transferred to or from the system by non-conservative forces as it moves from its initial to final state. Now, what about the Work-Energy Theorem – what is it all about, and does it differ substantially from the Law of Conservation of Energy? Well, of course we know that the Work-Energy theorem states something like this: the total kinetic energy of a system remains constant unless a net force acts to increase or decrease it through the mechanism of work. Mathematically, we might write this as: $E_{ki} + W_{i \to f} = E_{kf}$ (2), where E_{ki} is the total kinetic energy of the system in its initial state, E_{kf} is the total kinetic energy of the system in its final state, and $W_{i \to f}$ is the amount of kinetic energy that has been transferred to or from the system as work done by the net force. Essentially the Work-Energy Theorem is just a statement of the conservation of kinetic energy. When we frame this sort of discussion for our students it seems (for us) to be fairly straight forward, but for many of them it is not. Much of this discomfort stems from difference between the two work terms in each of equations (1) and (2). Ratifying this difficultly is possible by examining (using Work-Energy Theorem) the derivation of gravitational potential energy of, say, a cart coasting up a frictionless ramp (this clarifies the difference between conservative and non-conservative forces). Given how little time we have in which to teach these ideas, this option is not very practical.

Another possibility is to give the students some practice with this concept (following its introduction) using IP2000. Unfortunately there was no "canned" script that would enable me to do this with my class, so I had to write one of my own (not an easy task). I am by no means an expert on writing IP scripts, but I do have some experience in the area and can tell you this: the software is hard to program, the manual is even more elusive and the whole experience can just about put you in the clink. *However*, once you have a simulation that actually works the results can be fantastic and very rewarding. Students get a lot out of it – much more than you might at first think given uncooperative nature of the software. The simulation I made is simple enough: a block of set mass and initial speed slides up a ramp. The script measures block speed, position, height above datum, net force and frictional force. Although initially set to zero, the coefficient of sliding friction may be adjusted to reasonable values (weird things start happening beyond this!).

Now, here's how I work things. I'll have the kids set up in small groups huddled around a computer. We have five computers in our classroom which usually means at least five students to a computer. I'll have the students run the simulation and stop it at some arbitrary point in time as the block slides up the ramp. They will then use the information displayed by the simulation to determine the speed of the block in its final position. This is done using both the Law of Conservation of Energy, and the Work-Energy Theorem. The answers obtained can be verified with the output of the simulation. At this stage it is worth noting that, at least with this simulation, wild things begin to happen if the block is stopped too near to the top of the ramp. This likely indicates a limitation of the software, and can be avoided by stopping things farther down the ramp.

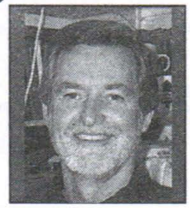
Included below is a sample screen capture from the simulation that I use. It has been cropped to fit into this article, but the essential information is there. This simulation also plots the energy curves as functions of time, which is a neat little visual that may bring some clarity to the math.



As always, I'm eager to see how some of these ideas might work for others. If you'd like to try them, let me know and I'll send you the simulation and any work sheets that go along with it. Feel free to email me at the above address.

Until we meet again!

The Demonstration Corner



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The Word's Simplest Motor

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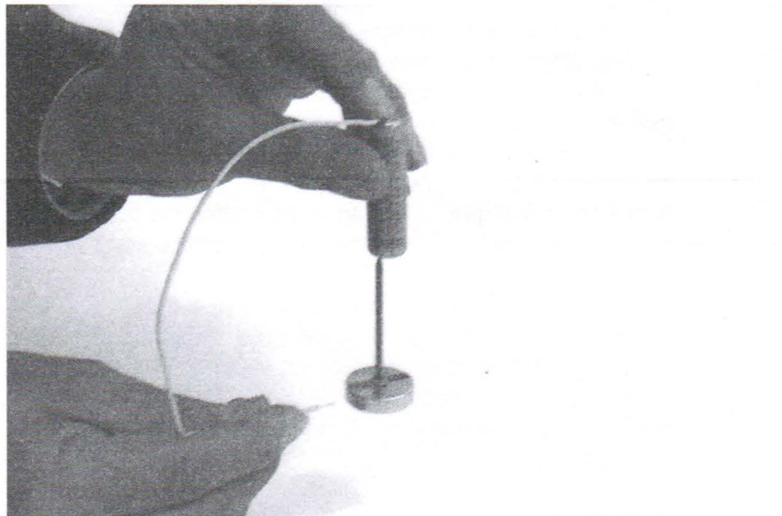
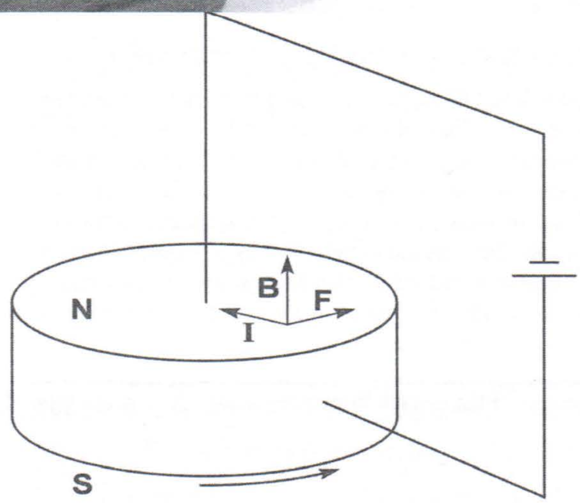


In the December 2004 issue of *The Physics Teacher,* Christopher Chiaverina described a motor consisting of four components: a battery, a cylindrical rare earth magnet, a small piece of copper wire, and a steel nail. Since I know that many of our members do not have ready access to this journal, I have essentially reproduced his article here.

The picture on the right shows the motor that we built at the University of Toronto. The left hand holds the battery and the forefinger holds one end of the wire against the positive end of the battery. The magnet sticks to the head of the nail and the tip of the magnetized nail is attracted to the ferromagnetic bottom of the battery. The right hand touches the other end of the wire to the side of the magnet. That's it! You'll be amazed at how quickly the cylindrical magnet spins.



It's easy to understand how the motor (technically called a homopolar motor) works by referring to the schematic diagram on the right. Current flows through the magnet and along its surface and the charge carriers experience a Lorentz force since they are moving in a magnetic field. The direction of the force $\vec{F}$ which determines the sense of rotation is given by the right hand rule or by the direction of the cross product $\vec{I} \times \vec{B}$. Of course, one can reverse the sense of rotation by simply flipping over either the battery or the magnet.

Rare earth magnets are readily available from any scientific supplier like Arbor Scientific and, for many of you, they are available locally at Lee Valley Tools. Get one soon and impress your students!

Grade 12 Physics Photo Contest:
In SPH4U category there are maximum 10 entries per school, in SPH4C category max 15 entries per school. Although the deadline to mail in your entries is between April 3 and May 1, students ending their semester one in January may want to prepare their photos now! See www.oapt.ca for the last year's winning entries.