Ontario Association of Physics Teachers

NEWSLETTER

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Winter Meeting - Orlando - Report

Bill Konrad - Section Representative

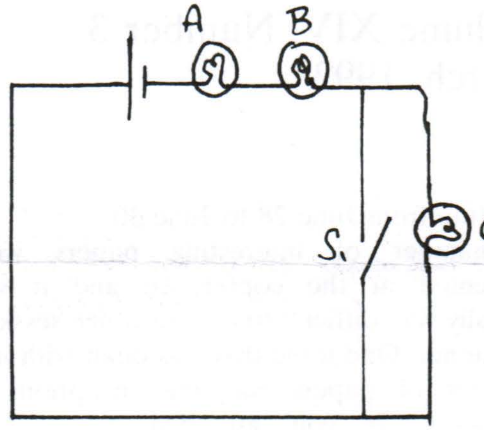
Sunny Orlando in Florida was the site for this year's winter meeting of the American Association of Physics Teachers which was convened from January 4 to January 9, 1992. As your newly appointed section representative I represented the Ontario Association of Physics Teachers at this conference. I was one of approximately 1100 delegates present for the six day event. There was a healthy mixture of university, college, and high school physics instructors.

Although attending a conference in Florida in the middle of winter might seem like a fantasy for most Ontario physics teachers, the cost actually compares favourably with a conference in downtown Toronto. Consider the following factors; a registration fee of $100, a hotel rate of $60 per room (no change in rate for two, three, or four people in the room), and a flight for $300. Although these prices are in US funds, a conference in Florida is not necessarily that much more expensive than one of the larger conferences in Ontario held in a posh downtown hotel.

One attractive feature of the conference is the two solid days of workshops that precede the actual sessions. This years' delegates could choose from a total of 29 workshops which were either half day or full day sessions. I selected the full day workshop entitled "Light and Color/Sound and Music". This workshop was filled with practical suggestions that could readily be utilized in the grade 12 physics course. I will share some of these at our conference to be held at Ryerson Polytechnic Institute from June 28 to June 30.

A number of interesting papers were presented at the conference and it was actually very difficult to choose which sessions to attend. One topic that was dealt with in a number of papers was misconceptions in physics. If you attended the OAPT conference in Windsor in June of 1990 you may recall Ernie McFarland's presentation on "Misconceptions in Physics". Ernie illustrated a number of misconceptions that first year university students bring to their course. In the United States a number of research projects have actually investigated the topic of concept formation and misconceptions in a systematic way. The March issue of the "Physics Teacher" will feature a major article on this topic written by some of the individuals who presented at the conference. I have also contacted some of the teachers and professors who presented at Orlando and hope to get material from them which can be shared at our own conference in June. To give you a specific example I would like to summarize a presentation given by Eric Mazur, a physics professor at Harvard University. He stated (and other presentations also emphasized) that research has shown that we must change our teaching methods if we are to help students grasp fundamental concepts. Mazur stated that he was beginning to recognize that too often physics stresses mathematical problem solving at the cost of concept formation. Students become very proficient at solving problems similar to those solved in class but in actual fact may not understand the concepts involved very well at all. He illustrated this hypothesis by giving a specific example. He gave the following problem to his students on their final examination thinking that they would find it very easy.

Consider the circuit shown below:



What would happen to the following if the switch S_1 is closed?

- the brightness of bulbs A, B, and C
- the current through each bulb and the total current in the circuit
- the effective resistance of the circuit
- the power dissipated by A, B, and C
- the total power dissipated by the circuit

Much to Mazur's dismay his students performed very poorly on this question. The average mark was about 20%. Remember that these are physics students at Harvard.

Mazur also indicated that by all conventional measurements (student comments, formal reviews, etc.) he was seen as an excellent professor and the ability of his students to solve conventional problems was quite good. You would also agree that the question above could be asked at the grade 12 physics level in Ontario.

As a result of the poor performance of his students on solving a conceptual problem on the final examination Mazur changed his teaching style. Although he still lectures students in a conventional lecture room he has introduced an element of cooperative learning into his presentation. Part way through his lecture he will pause and give students a conceptual problem like the one shown above. The question is usually in multiple choice format. He then asks them to record their answer. He also asks them to indicate the degree of confidence with which they are responding. The choices in this case are: very sure, not sure, or just guessing. Students are then given a specific period of time, such as a few minutes, to discuss their answer and reasoning with another student sitting close to them in the lecture theatre. After this consultation they again record the answer to the question as well as their degree of confidence. The mark sense cards are then collected. He has been able to track the progress of concept formation. Explaining their reasoning to a peer and listening to the explanation of a peer has improved the ability of these Harvard students to improve their understanding of fundamental physics concepts.

Another presentation given by a team from the University of Massachusetts described a program in which undergraduate science and engineering majors, enroled in an introductory physics course, were required to write qualitative strategies for solving problems prior to actually solving them. A substantial portion of the mark for a solution on a test or examination was given for the description of the strategy. Students were expected to indicate factors such as the following:

- the principle being used (e.g. energy conservation)
- assumptions made
- why the principle being used was legitimate for the situation at hand.

As you can imagine there was some initial resistance from students asked to use this approach. However, by the end of the course students showed increased ability to analyze problems based on principles.

Some time at the June conference will be spent on this fascinating topic of concept formation by physics students. If there is sufficient interest it could become a major focus for a future OAPT coference.

June Conference

By now, all members should have received a colourful poster advertising the 1992 conference at **Ryerson Polytechnical Institute, June 28, 29 30.** The theme of the conference is **Physics and the Arts** and the keynote speaker will be Ken Laws, an authority on the physics of dance. A secondary theme is **Teaching Concepts in Physics** and contributed papers are invited. (See call for papers.)

Features of the Conference

- Registration fee $50 for members
- Residence accommodation $45 per night, singles only
- Chelsea Inn or Ibis Hotel nearby. $65 to $80, double
- Parking $10 per day (24 hours)
- Meals available at residence cafeteria, breakfast about $3, lunch $4 - 5
- Monday evening buffet $25, followed by presentation from Ken Laws
- Sunday workshops:
  (1) Ryerson's physics labs will be open for active participation, complete with demonstraters, lab outlines and computers for data reduction.
  (2) Lasers, photonics & fibre optics at CATE
  (3) Wave optics, Fourier transforms and spatial filtering at CATE
- Tours of High-tech graphics: typography or video
- Theatre tickets for Phantom, etc. may be obtained from Fred Hainsworth if you contact him as soon as possible.

Registration forms will be included in the May newsletter. Alternatively, you may write, telephone or FAX Fred Hainsworth at the following address:

OAPT Conference,
c/o Fred Hainsworth,
Ryerson Polytechnical Institute,
350 Victoria Street,
Toronto, Ontario, M5B 2K3
FAX (416) 979-5308
Tel. (416) 970-5079

Call For Papers

Contributed papers are hereby solicited on any topic of interest to physics teaching, especially those addressing one of the two themes of the conference. Presenters should specifically request a 15 or 30 minute time period. Strict adherence to the final time schedule will be maintained. Please specify any special requirements for AV. Your favorite demonstration (5 min) is always welcome.

Presentations of a marketing nature are not normally accepted. Assignment of a conference time slot is the decision of the conference managers. Exhibit booths will be across the hall from the main lecture theatre. Poster areas in the hall (coffee break area) can be arranged.

Abstracts should be sent to Fred Hainsworth at Ryerson Polytechnical Institute.

Physics Cinema Classics

A collection of your favorite physics films is available on three video disks for $425 U.S. if you order before April 8, 1992. The topics are Mechanics I, Mechanics II and Heat, Waves I, Waves II & Electricity & Magnetism, Conservation Laws, Angular Momentum & Modern Physics. Contact:

AAPT,
University of Nebraska,
110 Ferguson Hall,
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Newsletter Editor Required

We need a volunteer to take on the position of Newsletter Editor as of September, 1992.

The **OAPT newsletter** is published four times a year by the Ontario Section of the American Association of Physics Teachers.

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THE DEMONSTRATION CORNER

PARALLAX AND IMAGES

by

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(a) Parallax

Parallax is the apparent motion of one object with reference to a second object caused by a change in position of the viewer. Involve the class in the following way to introduce this concept.

Have each student extend his/her right arm horizontally to arms length with the thumb pointing upward. Then extend her/his left arm to half arms length with the left thumb pointing downward. With one eye open, have the student align the thumbs. Tell them to move their heads to the left and then to the right and describe what they see. When the head is moved to the left, the near thumb will appear to move to the right against the background of the far thumb.

Introduce the definition of parallax. Then ask students to repeat the process as they move the nearer thumb closer and closer to the far thumb. Establish that, when the two thumbs are at the same position with reference to the eye (but one above the other), there will be no apparent shifting of two thumbs with reference to one another when the head is moved from side to side.

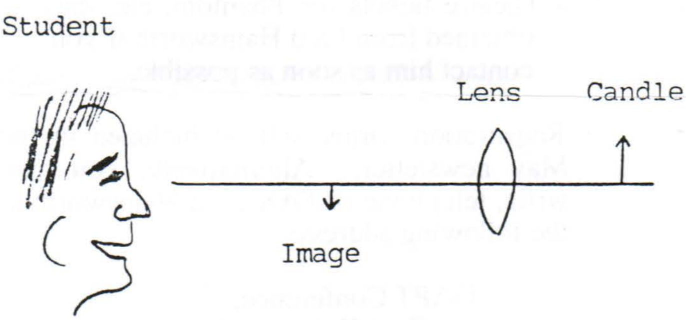
(b) Zero-parallax and Virtual Images

The method of zero-parallax can be used to locate virtual and real images formed by mirrors and lenses. To demonstrate the method of zero-parallax for plane mirrors, place a candle about 20 cm in from of a large pane of clean glass. The virtual image of the candle will appear behind the plane mirror (glass). Use a finder candle the same size and shape as the object candle to locate the image. Begin with the finder candle behind the glass and off to the side of the image, but position it closer to the glass than the virtual image. Have a student sitting on the right side of the class tell you how far to move the finder candle parallel to the glass until the finder candle and the virtual image coincide. Then have a student sitting on the left side of the class tell you how far to move the finder candle back and forth perpendicular to the glass until the finder candle and the virtual image coincide from this location. Continue the process until the finder candle and the virtual image coincide from both locations. The finder candle and the virtual image must then be at the same location because there is zero-parallax between the two. Have students walk slowly across the back of the room to verify that the finder candle and the virtual image do not shift with reference to each other as they move.

(c) Seeing a Real Image Suspended in Space

Students know how to locate the real image formed by a converging mirror or lens by "catching" it on a paper screen. But when they remove the screen and look at the real image from some distance from the lens or mirror, they think they see the image in the instrument rather than inverted in space between their eye and the instrument. To help them visualize the suspended inverted image, and to illustrate the method of zero-parallax for locating real images, proceed as follows.

Position the student along the principal axis of the optical bench system as shown. "Catch" the real image formed by the mirror or lens on a small paper screen. Have the student look at the image on the paper screen from the side of the screen opposite the instrument. Shift the screen up and down until half the image is caught on the screen and half is suspended in space. Have the student look at both parts of the image and move his/her head from side to side to see that the half of the image caught on the paper screen and the half suspended in space do not shift with reference to each other. Then slowly remove the screen completely. The student will see an inverted real image suspended in space between the eye and the instrument, not "in the instrument."



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Submissions describing demonstrations will be gladly received by the column editor.
