SAMPLE / EXEMPLAIRE

CANADIAN ASSOCIATION OF PHYSICISTS

PROFESSIONAL PRACTICE EXAMINATION

GENERAL INSTRUCTIONS

You are expected to answer each question and you should allot roughly equal time to each. Each question has equal weighting, but at least a reasonable attempt at each question is required in order to receive a passing grade. Please be sure to write legibly and to limit each answer to about 2 sheets of lined 8.5x11" paper. The intent of the examination is not to test knowledge of physics or of science generally, but rather to test various aspects of communication, as well as the ability to apply physicists' modes of thought in an unusual situation, and to verify an appreciation of ethical matters. In general, there is no correct answer to any question. What is important is how you go about answering them.

QUESTION 1. *Objective*: *This question attempts to test three things. First, it evaluates whether you can write properly formatted, comprehensible English with reasonably precise syntax, grammar and spelling. Second, it assesses your ability to organize your thoughts in a logical, comprehensible, believable and reasonably precise manner. Finally, it tests your capability to interpret the content or significance of technical matters to a non-technical but reasonably intelligent audience, at a level of sophistication and clarity appropriate for that audience.and in a way which matches the communication to the abilities and background of the listener or reader.*

Write a clear explanation of one of the following physics-related topics. Your explanation should be suitable for an intelligent, interested layperson. It should explain the substance of the topic and briefly outline its significance to the public.

1. The theory of special relativity
2. Laser cooling
3. The 'standard model' of subatomic physics

QUESTION 2. *Objective: This question looks for a reasonable understanding of the physicist's role in (and obligations to) the public and society, to the profession and the discipline, to clients and employers, to colleagues and subordinates, and to others with whom you may have a professional or business relationship.*

Consider the following fictional situation, and indicate the ethical considerations in favour of and/or against the three suggested courses of action in terms of your responsibilities to the various parties involved. On balance, which course would you recommend and why? (Remember, there may be no correct answer to this question). If you wish, you may add (and support) a course of action of your own devising.

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You are in charge of a small team of physicists and chemists in an externally-funded, independent research institute. Your team is studying fundamental questions of chemical reaction kinetics using ultra-fast laser techniques, and there are no immediate practical applications. One of your employees, X, is a member of a visible minority group and has a three-year appointment. In 6 months, he is due for a review before an employment review committee, which may lead to permanent employment. Based on his hard work and innovative approaches, you strongly support X's permanent employment. However, you are aware that your own boss (who will be very influential on the committee) would like not to renew X's contract when it comes up for renewal, and quite by accident you recently overheard a phone conversation which made it quite clear that this negative attitude is because X is a member of a visible minority.

X is a highly promising scientist, the first of his family to attend an institution of higher learning, and has been assigned to study one particular group of compounds. Partly because of various set-backs beyond X's control and partly because of the care he has taken, his program is behind schedule. However, he has just managed to complete a series of difficult measurements of an important parameter, measurement of which had been considered impossible by many people. The parameter is in essence determined by the slope of a particular graph which relates X's measured quantities. X writes a paper reporting his measurements. This will be a considerable contribution to the field and (if accepted by a prestigious journal before the review committee meeting) will likely be enough to convince the employment review committee to give X a permanent position. However, submission of the paper must first be approved by your boss, who is aware that its acceptance by the journal will make it hard for him to get rid of X. He rejects the paper, arguing that the key graph does not have enough data points to be believable and that the institute's reputation would therefore suffer. You strongly believe this is a not fair criticism and that it is merely an excuse, but neither is it so obviously unreasonable that you can take the matter to the Director of the institute.

You inform X of the problem. X returns to your office a month later with many more data points. Their position and scatter do not significantly change either the magnitude or the estimated error of the parameter which is being measured. Because you are more familiar with his work than X realizes, you recognize that there was not enough time for him to have carried out the additional measurements, and conclude that some or all of the new data must have been fabricated. However, your boss will not know this, and will be forced to approve the paper if it is submitted to him; this will give just enough time for the paper to be accepted before the employment review.

The employment review committee is not permitted to consider any work which has not been published, and letter publications and the like do not count. The institute's policy on plagiarism, falsified data and the like is clear: it must be reported to the Director at once.

What should you do? Some possible actions are given below, but others may be possible.

1. Immediately 'blow the whistle,' which will certainly destroy X's career.
2. Tell X that you know what he has done, but will not report it so long as he provides real data. Given the time needed to do this, it will almost certainly mean that X will not get a permanent position, as a result of your boss' bias (which you cannot prove).
3. Since there is no change to the final result, turn a blind eye. After all, you only noticed it because you are far more careful than most managers.

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QUESTION 3. Objective: *Academic understanding is the very foundation upon which all success in physics must be based. Nevertheless, for success in most if not all employment sectors, the ability to apply physicists' thought processes to unfamiliar situations is crucial. Such situations include new or existing physics areas in which the candidate may start with little direct knowledge, and unfamiliar areas of science and technology. They also include non-technical situations, such as business or public policy problems. (In all cases, of course, the ethical requirement not to practice beyond the candidate's area of competence must be considered, often by practicing as a member of a team.) This question attempts to measure such capabilities.*

What is important is the way in which you go about answering the question, rather than the final result. Like many situations in real life, there is insufficient information for you to be precise. You will have to make reasonable assumptions. Be sure to show your assumptions, how you arrived at them, and how you did your calculations.

You are director of research for a large manufacturer of bottles and other glassware. Your team has developed a plastic coating which was intended to strengthen all types of bottles. The formulation is excellent, but has a strong brown tinge, meaning it can only be used on brown bottles. Fortunately, your company has 50% of the beer bottle market in N. America, and many beer bottles, of course, are brown. The material is patentable and likely to be difficult to copy by competitors. Increased beer bottle life should enable your company to charge the beer manufacturers extra, although they will also need a financial incentive to adopt the new technology. The costs of applying the coating, and of the coating itself, are negligible. Assuming that (i) that beer bottles have a lifetime of 10 trips now and are presently sold for $0.02 (2 cents) each, (ii) the total incremental costs to your company of producing and distributing a bottle are $0.015 (1.5 cents), and this is not very dependent on volume, (iii) the coating will double the lifetime, and (iv) the costs of collecting bottles for re-use are negligible, how much (to first order) would it be worthwhile for the company to spend to bring the product to market? Remember that any technology takes time to be adopted, and that (because of inflation and interest) a dollar earned N years from now is worth the same as $1/(1.1^N) earned this year (i.e. $0.91 in year 1, $0.83 in year 2, and so on).

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