

A Career in Medical Physics:

A very unbiased opinion why this is
the 'Best Job in the World'...

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Medical Physicist

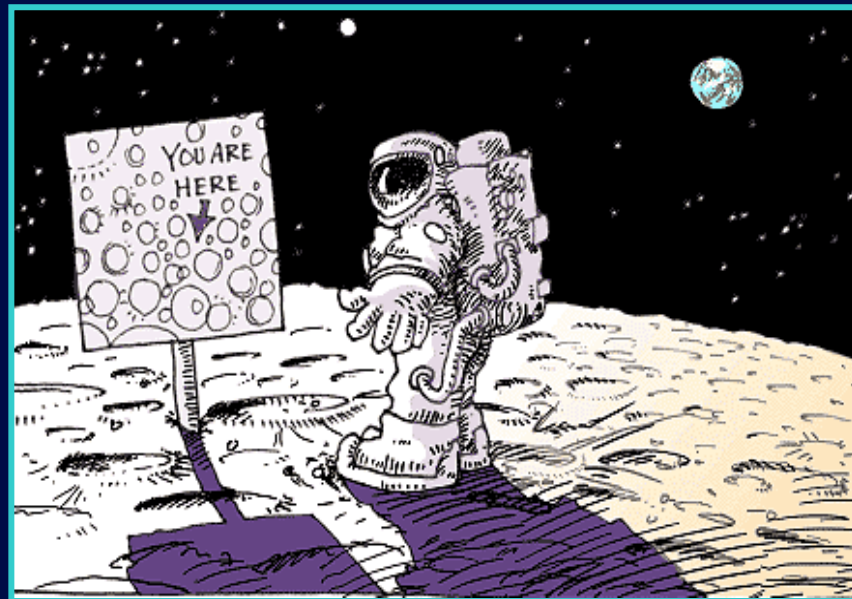
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A Little About Me...

- MSci Physics, University of Strathclyde (2004)
- MSc Medical Physics, University of Aberdeen (2005)
- Medical Physics training, Ninewells Hospital, Dundee (2005-2006)
- Training as MRI Physicist (2006-2008)
- State Registration (2009)

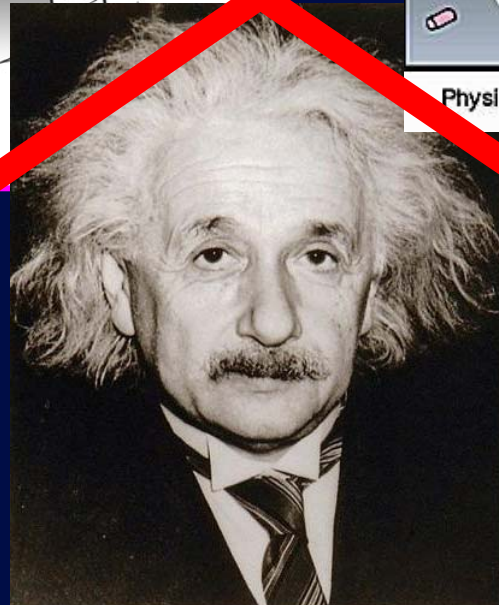
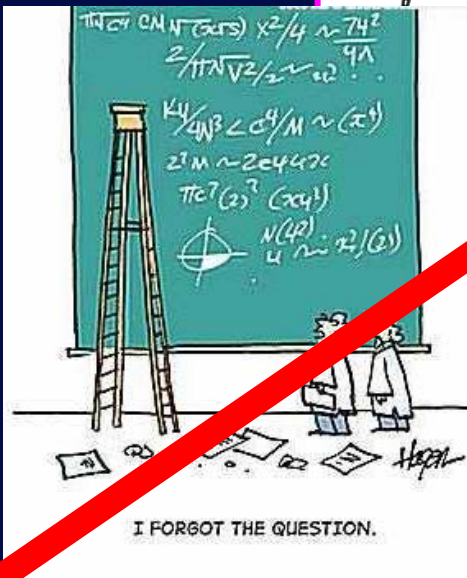
Physics?? Why Physics?



Worlds view of a physicist...



Physicists from a tough neighbourhood.

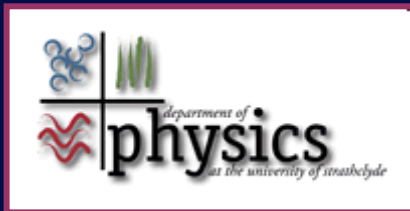


Physics

- Sounds really difficult- but not as hard as you would imagine!
- Covers nearly all areas of life
- Has applications in most areas of life
- Great if you don't know what to do!!

Physics at Strathclyde (official)

- Rated excellent in government-led survey
- One of biggest departments in UK
- 11th in UK for physics (Guardian University Guide)
- 14th friendliest in UK (out of 114!)
- Large postgraduate student population- loads of help!



Physics at Strathclyde

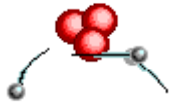
- Large union (one of largest in UK!!): Range of clubs, associations and activity groups
- Lecturers are very friendly and approachable (you will need it in latter years!)
- Emphasis is on teaching you skills such as problem solving etc (rather than leaving you to figure that out!)
- Very wide range of topics taught (astronomy to medical physics, quantum physics to communication skills)
- Ability to carry out industrial placements, placements abroad, flexibility between courses etc

But what will you do???



Charlie didn't know which was harder to work out - quantum physics or his wife's mind.

Nuclear Physics



BRIAN SHUSTER



"Oh, and I suppose it was me who said 'what harm could it be to give the chickens a book on nuclear physics?'"

- Hit sub-atomic particles together and see what happens!
- Very interesting science and technology
- Develop alternative energy sources

- BUT- nuclear physics has a very bad press!

Finance

- Finance sector needs people with mathematical skills- science graduates frequently work in this sector
- Lots of financial modelling and IT involved
- VERY well paid!
- BUT- its very stressful and its only money at the end of the day...



Teaching

- Somebody has to do it!
- Long-term shortage of scientific/maths teaching at all levels of education, so you are unlikely to be unemployed
- Extra incentives for going into science/maths teaching at present
- BUT- means going to school every day for rest of your life!



Research

- An academic career normally requires a PhD
- Develop new ideas
- Research can be presented at conferences
- Teach undergraduate students
- Lots of scope to work abroad

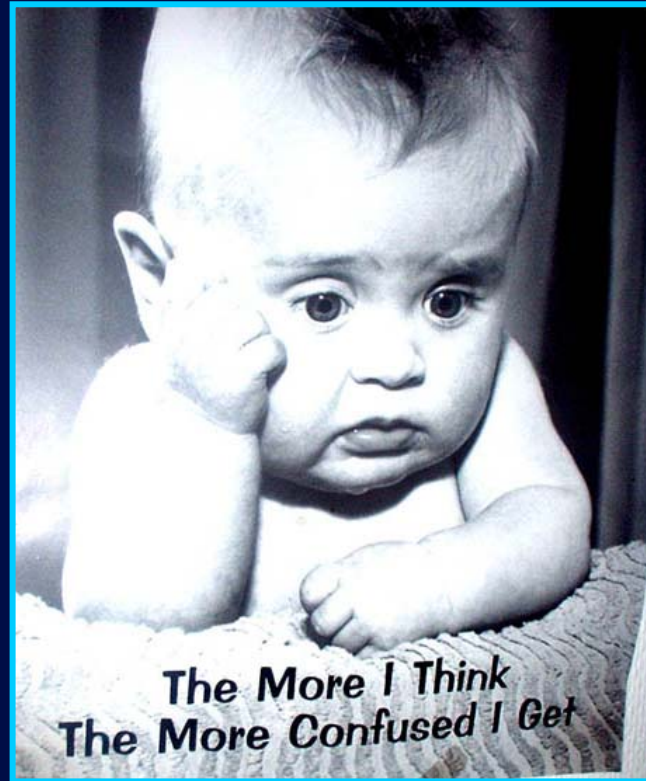


Medical Physics

- Applies basic physics concepts in a clinical setting
- Maintaining hospital equipment, optimising examinations/treatments
- Real impact on patients
- Employed mainly by the NHS (job security?)



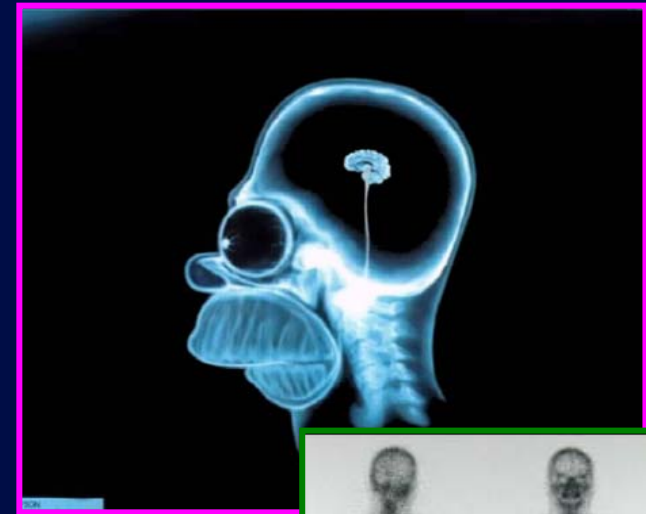
Umm, ok...



...But what is Medical Physics?

Never heard of Medical Physics?

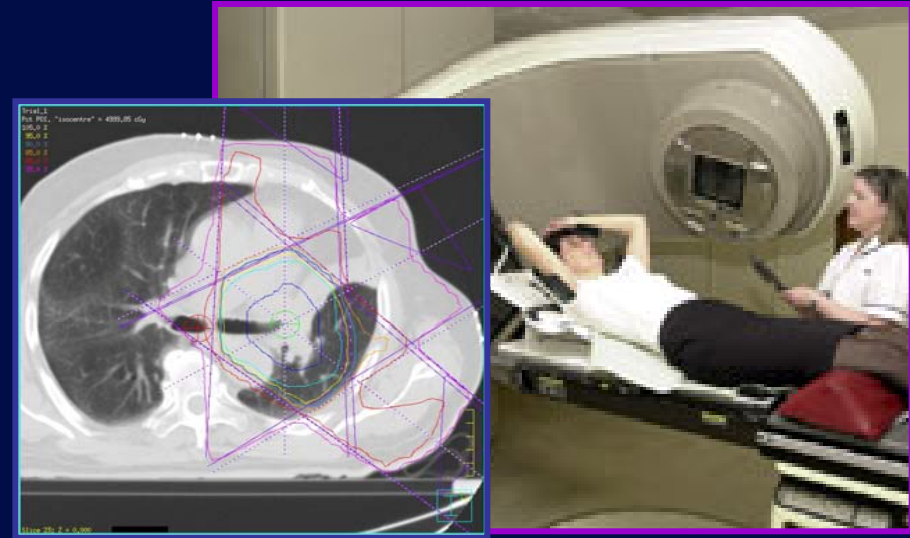
- **X-Rays**: Wilhelm Conrad Roentgen 1895 (Nobel Prize 1901)
- **CT**: Allan M Cormack and Godfrey Newbold Hounsfield (Nobel prize 1979)
- **MRI**: Paul Lauterbur and Peter Mansfield (Nobel prize 2003)
- Radioisotope labelling and detection: Rosalyn Yalow (Nobel Prize 1977) – **PET and Nuclear Medicine**
- Basis of measuring very small voltages- **ECG**
- Particle accelerators- **Radiotherapy**



...Are you Sure?

Radiotherapy

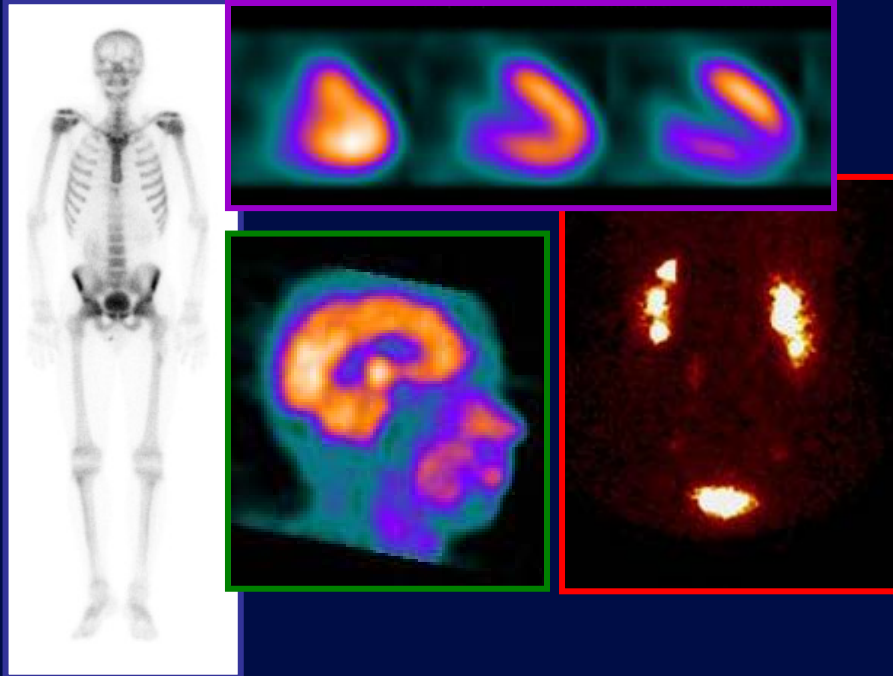
Radiotherapy is the treatment of disease (usually cancer) using very high doses of X-ray or particle radiation.



Medical physicists are involved in:

- planning treatments
- maintaining treatment machines
- developing new types of treatment
- making sure radiation is used safely
- checking the dose given by treatment machines is correct

Nuclear Medicine



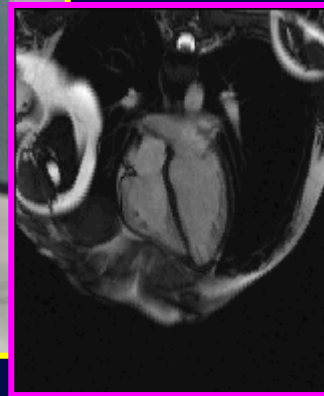
In Nuclear Medicine, radioactive materials are used to obtain images of tissue function. Large radiation doses are also used to treat disease.

Medical physicists are involved in:

- image processing
- assessing the performance and safety of imaging equipment
- working out radiation doses



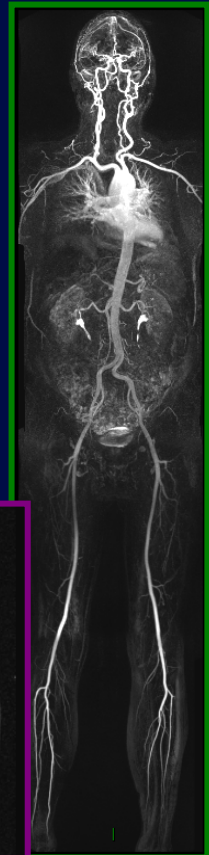
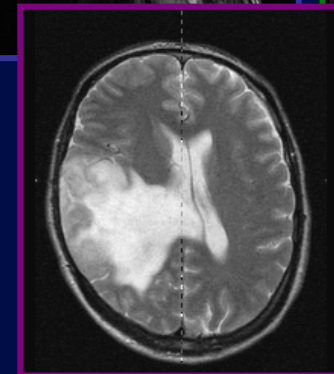
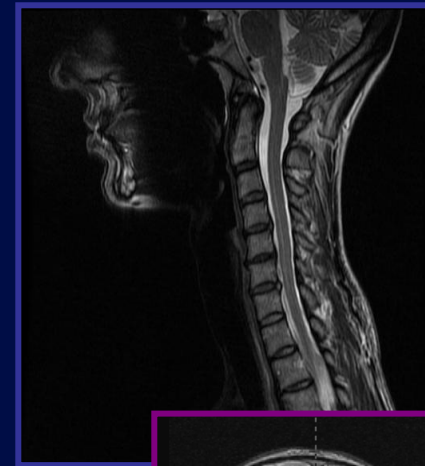
Magnetic Resonance Imaging (MRI)



MRI uses a big strong magnet to image the water in the body (good soft tissue contrast)

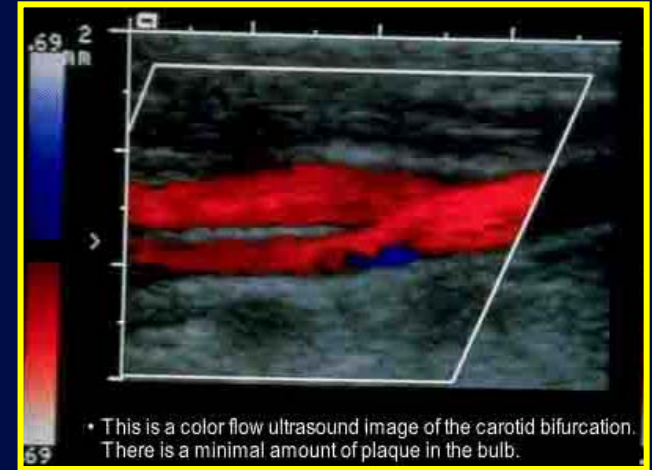
Medical physicists are involved in:

- all aspects of safety training- including checking patient implants
- carrying out quality assurance on equipment
- Analysing patient data for reporting



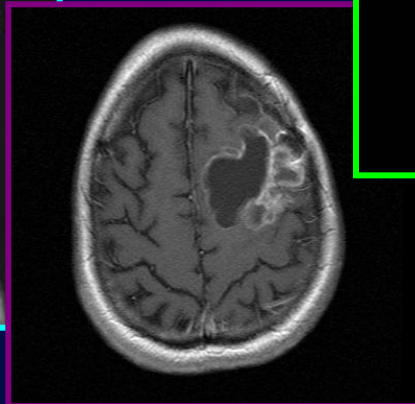
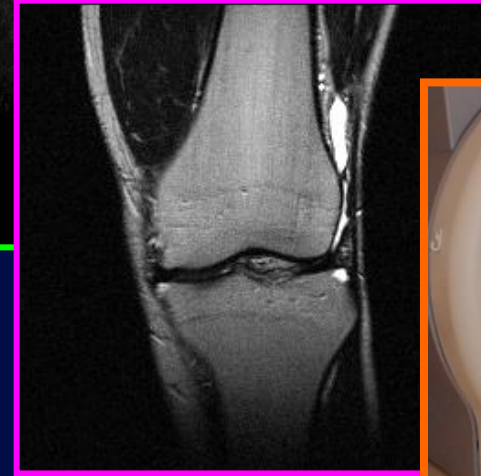
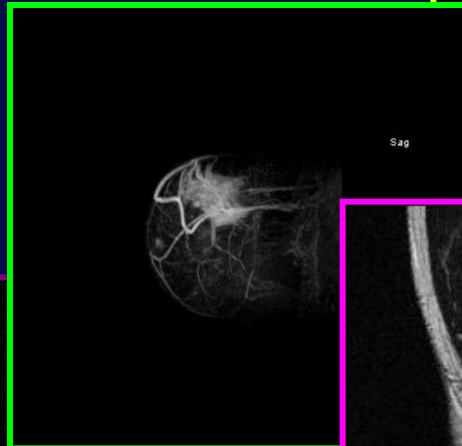
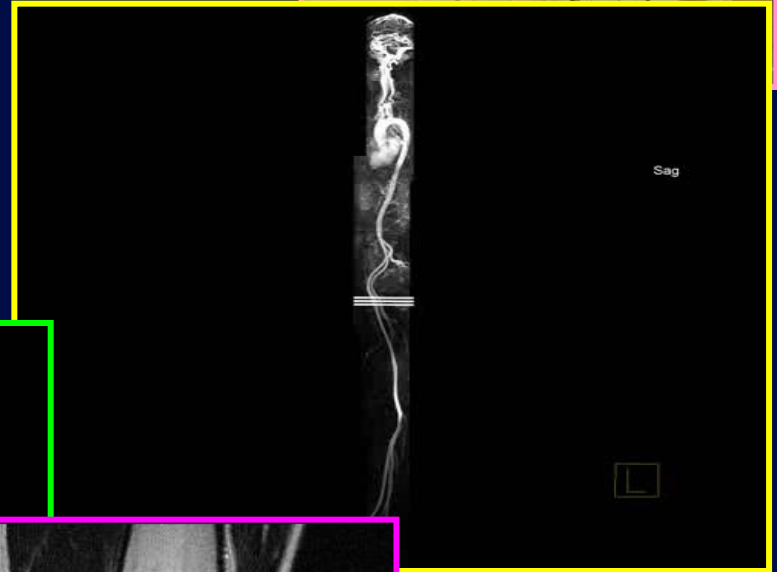
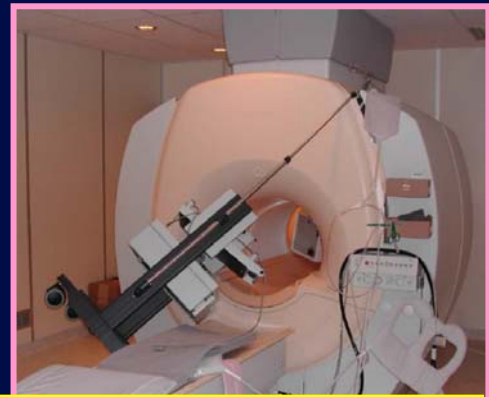
Other Areas of Medical Physics

- Ultrasound
- Radiation Protection
- Physiological Measurement
- Biomedical Engineering*



MRI

- MRI uses a very large magnet ($30,000 \times$ Earth's magnetic field)
- Images the hydrogen atoms (i.e. water) in the body
- Non-ionising radiation (safe)
- Images in any plane (versatile)
- Excellent soft tissue contrast, high resolution



Life as an MRI Physicist

- Carrying out quality assurance checks on MR scanner
- Performing image quality assessments
- Safety checking patient implants
- Teaching clinicians about the basics of MRI
- Giving safety lectures
- Sitting with radiographers while scans performed
- Optimising techniques and protocols
- Performing quantitative analysis for clinical reporting
- Carrying out research to develop clinical service
- Comparing new techniques with existing ones
- Presenting at conferences / Publishing papers
- Trying to raise the profile of Medical Physics

...Trying to make things better

But where is the Physics?

- Understanding the basic quantum mechanics to understand the basis of MRI
- Understanding of the magnetic properties of metals, and how they interact with magnetic fields
- Understanding of physical principles of MRI such that faults with equipment can be diagnosed and repair arranged
- Use of statistics for research
- Ability to 'think on your feet' in often pressured situations, without losing cool
- Figure out solutions to problems
- Ability to analyse situations and determine if there are better ways of doing things
- Ability to manage workload
- Ability to develop ideas and theories and carry out experimental work to backup

Now the serious bit...



Career Path

Several possible routes but in general:

- A-levels/ Highers: Maths, Physics and one other
- Degree: Physical science (3-5 year course)

THEN:

- NHS training scheme: 4 years in total
- Or continue with a PhD and stay in academia
- Or apply for jobs in the medical devices or the biomedical industry
- Medical Physics post-graduate degree (Aberdeen or England)

NHS Training Scheme

- 19 training centres across the UK
- Each centre takes on up to 5 trainees per year
- Scotland takes on 7 trainees per year (5 centres)
- First year is spent studying for a Masters Degree in Medical Physics
- Second year is split into three placements in different hospital departments
- Trainees produce a portfolio for each placement and undergo an oral examination at the end
- The next two years are advanced training

Why Medical Physics? (official guide)

- A rewarding career based around the application of interesting science to a variety of problems.
- An opportunity to:
 - Make a difference to people's lives
 - Work with cutting edge technology
 - Research and develop new techniques and methods
 - Work throughout the UK with options to travel and work abroad.
- It is a rapidly expanding area with good future career opportunities.

Why Medical Physics?

(my, personal and unbiased, thoughts)

- Real feeling of contributing to other peoples lives (with no blood involved)
- Work with patients, surgeons, doctors, scientists and big bits of equipment
- Research is encouraged- able to attend conferences
- No two days are the same
- Rewarding, exciting and the pay is ok!
- Best Job in the World...?

PHEW!

So to Summarise...



A Physics Degree

- ‘Degree that opens doors’ – *cliché but true!*
- Applications in most areas of life- good choice to keep your options open
- Teaches lessons used in most areas of life- i.e. problem solving, thinking on your feet etc.
- Only way you can do Medical Physics (‘Best Job in the World’)

BUT DON'T WORRY:

- It wont make you a ‘geek’, it will make you ‘quirky’

Useful Links


- www.ipem.ac.uk
- www.medicalphysicist.net
- www.prospects.ac.uk
- www.nhscareers.nhs.uk

If all else fails...


- shelley.waugh@nhs.net

PRESENTS
**BEING A
 PHYSICS
 UNDERGRADUATE
 IN
 10
 EASY STEPS**

1. RECIEVE YOUR
 ASSIGNMENT

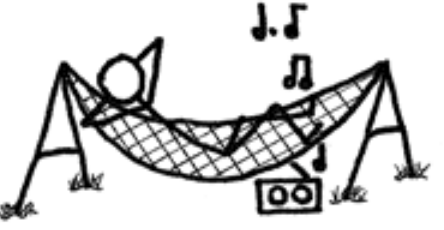
RING 

UHG, I CAN'T BELIEVE HE ASSIGNED HOMEWORK DUE THE SAME DAY AS THE TEST.




HW-18 due Tues
 Chapter 21
 Problems 21,
 34, 57, 67

2. IGNORE THE
 ASSIGNMENT ALL WEEK. IT'S
 ONLY FOUR PROBLEMS.



3. REALIZE SUNDAY NIGHT THAT
 EACH PROBLEM WILL TAKE NO
 FEWER THAN 20 HOURS. PANIC!

A train leaves Boston at velocity $v=0.95c$ along a track parallel to the x-axis and passing through the origin. A conducting sphere with polarization $p=py$, located with its center on the y axis and a distance d from the origin is rotating at angular velocity ω along the y-axis. If each car of the train is a cylinder of length L and radius R , with a charge density $\rho=Ae^{m-\rho^{1/2}}$, find the force on the train from the conducting sphere. What is it if the system is immersed in a dielectric κ ? Solve the problem three different ways.



4. READ FIRST PROBLEM AND
 THE SECTION TO WHICH THE
 PROBLEM RELATES.



5. REALIZE THAT YOU HAVE NO
 IDEA WHAT YOU JUST READ.
 READ IT ALL AGAIN.



6. SPEND THREE HOURS TRYING
 TO GET UP THE PROBLEM ONLY
 TO REALIZE THAT YOU END UP
 WITH AN UNINTEGRATABLE
 INTEGRAL. ALSO, YOU FORGOT A
 NEGATIVE SIGN

$$\psi = A\psi_0 = \sqrt{\frac{m\omega}{\pi\hbar}} e^{-\sqrt{\frac{m\omega}{\hbar}} \frac{x^2}{2}}$$

$$\langle x \rangle = \int_{-\infty}^{\infty} \psi^* x \psi dx$$

$$= \int_{-\infty}^{\infty} \sqrt{\frac{m\omega}{\pi\hbar}} x e^{-\sqrt{\frac{m\omega}{\hbar}} x^2} dx$$

$$=$$

7. COMPARE ANSWERS IN THE
 MORNING. NOT ONLY ARE
 THEY COMPLETELY
 DIFFERENT, BUT YOU FORGOT
 ANOTHER NEGATIVE SIGN.

$$\vec{B} = \frac{\mu_0}{4\pi} \left\{ \frac{-2Q\omega d}{R^3} \hat{z} \right\}$$

$$\vec{v} = R\omega \sin\theta \hat{\phi}$$

$$\vec{r} = R(\sin\theta \cos\theta \hat{i} + \sin\theta \sin\theta \hat{j} + \cos\theta \hat{k})$$

$$\vec{B} = \frac{-Q\omega d}{4\pi R^3} \hat{z}$$


$$\vec{B} = \frac{\mu_0}{4\pi} \left\{ \frac{2Q\omega d}{R^3} \hat{z} \right\}$$

$$\vec{v} = R\omega \sin\theta \hat{\phi}$$


$$\vec{r} = R(\sin\theta \cos\theta \hat{i} + \sin\theta \sin\theta \hat{j} + \cos\theta \hat{k})$$

$$\vec{B} = \frac{\mu_0}{4\pi} \left\{ \frac{2Q\omega d}{R^3} \hat{z} \right\}$$

8. SPEND THE NEXT THREE
 HOURS (HAVING TO SKIP A
 CLASS IN THE PROCESS) ON
 FIXING YOUR HOMEWORK.
 CORRECT THE LAST MISSING
 NEGATIVE SIGN 30 SECONDS
 BEFORE CLASS STARTS.




9. BE OVERJOYED WHEN YOUR
 HOMEWORK IS RETURNED
 THREE WEEKS LATER. YOU
 GOT THE HIGHEST GRADE IN
 THE CLASS!



10. SALVAGE WHAT LITTLE SELF
 ESTEEM YOU HAVE LEFT BY
 MAKING FUN OF PEOPLE IN THE
 "LESSER MAJORS."

WHY DON'T ENGINEERING
 MAJORS EVER MAKE JOKES
 ABOUT PHYSICISTS?

WHY
 DON'T
 THEY?



BECAUSE THEY NEED
 SOMEONE TO HELP THEM
 WITH THEIR HOMEWORK!

