

1 Introduction

This is the second annual undergraduate physics challenge organised by the Institute of Physics (IOP) and universities in the Northwest of England (the “challenge”). The challenge is open to teams of 3 to 5 students in the First year of a physics course at a Northwest university (the “university”).

Teams should produce a device to convert thermal energy to mechanical energy from a given heat source to raise a mass to achieve the greatest gravitational potential energy. The heat source will be up to 1 litre of just boiled water (i.e. 100°C) which will be provided. Teams can choose their own test payload and distance moved through, but it must be removable for measurement. No other energy input may be used for lifting, electrical power for measurement and/or sensors only is permitted.

On their poster, teams should be able to discuss the theoretical and experimental efficiency.

The challenge is directly linked to the IOP graduate skills criteria for accreditation.

2 General Challenge Rules

- a) The challenge is open to students in their first year on undergraduate physics courses at the universities.
- b) Each university can enter up to two teams of 3-5 students.
- c) There are no restrictions on how the challenge is run within the university; it can be embedded into a unit/module or run as an extra curricula activity – see Appendix for details
- d) Registration for the challenge will close at midnight on 31 January 2016
- e) The budget for each team is GBP 30 – see Appendix for calculation of costs, and rules on salvaging
- f) The teams should make available to the judges a list of items purchased and their costs, but need only include the total cost on their poster
- g) The organising committee may change the rules if necessary to ensure health and safety – if students are in any doubt, they should ask their local academic representative
- h) Rules specific to this year’s challenge are set out in the appendices.

3 Judging (general)

The teams will be judged in three ways:

- A Poster and stand session, designed to test the team’s ability to showcase their work in a commercial environment. Three judges will each score the teams.
- A peer review element, whereby each team will rank their three best designs.
- A competition element, in which the projects will be judged on measurable objective criteria.

- Students will also be asked to give a 5 minute presentation to all attendees at the start of the competition event. Although the presentations are not a formal part of the marking, they are an opportunity for the teams to impress the judges.

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Marks will be weighted as follows for each component:

Judge 1 (poster and stand session)	20%
Judge 2 (poster and stand session)	20%
Judge 3 (poster and stand session)	20%
Peer review	20%
Measured competition	20%

The marking scheme for each component is given in the appendices.

5 Enforcement of the Rules

- a) The decisions of the panel of judges will be final
- b) Participating universities are responsible for ensuring that the rules are internally adhered to during the design, construction and test stages
- c) Complaints should be lodged directly in writing to the IOP representative of the organizing committee
- d) Final score cards will be kept by the committee and checked by the judges before announcement of the winner and runner-up. The score card is given in Appendix D.

6 Prizes

The prizes will be divided as follows:

- First prize – GBP 250
- Second prize - GBP 100

Certificates of recognition will be awarded to all students and the winning team.

7 General

By entering the challenge, all participants shall be deemed to have accepted all the rules, including, but not limited to, those set out in this General section.

IOP's decision on the prize winners is final and no correspondence will be entered into. IOP shall be entitled to use any outcome of the challenge as it sees fit going forward, without the need for obtaining the consent of any of the participants.

All entrants must be over 18 and have the right to enter.

IOP can change or withdraw these terms and conditions without notice and can refuse any entry.

No entries are allowed from IOP employees or anyone connected with the challenge, including their immediate families.

All valid entries have an equal chance of winning.

As not all countries in the world accept the legality of competitions, it is the sole responsibility of each non-UK based entrant to ensure that they are not breaching any laws of their country of residence by submitting an entry. IOP will not be held responsible for any entrant entering any part of the challenge unlawfully. If in any doubt, the entrant should check with the relevant authorities in their country.

IOP can use winners' names and images for promotion, including on any third party website IOP may use for advertising.

Personal data will be processed in accordance with the Data Protection Act 1998.

BY ENTERING THE CHALLENGE, ENTRANTS RELEASE AND HOLD IOP HARMLESS FROM AND AGAINST ANY AND ALL LOSSES, DAMAGES, RIGHTS, CLAIMS, AND ACTIONS OF ANY KIND ARISING IN WHOLE OR IN PART, DIRECTLY OR INDIRECTLY, FROM THE CHALLENGE OR PARTICIPATION IN THE ACTIVITIES, INCLUDING WITHOUT LIMITATION, ACCESS TO ANY MATERIALS, ANY FRAUD OR ATTEMPTED FRAUD, MISTAKE, DATA LOSS, DATA CORRUPTION, TECHNOLOGICAL OR HUMAN ERROR OR MALFUNCTIONS, OR RESULTING DIRECTLY OR INDIRECTLY, FROM ADMINISTRATION OF THE CHALLENGE, ACCEPTANCE, POSSESSION, USE OR MISUSE OF ANY PRIZE AWARDED IN CONNECTION WITH THE CHALLENGE, INCLUDING WITHOUT LIMITATION, PERSONAL INJURY, DEATH, AND/OR PROPERTY DAMAGE, AS WELL AS CLAIMS BASED ON PUBLICITY RIGHTS, DEFAMATION, AND/OR INVASION OF PRIVACY, ALL SO FAR AS THE LAW ALLOWS.

IOP awards cash prizes in the form of a cheque in the name of the prize winner. Any other arrangement will be at its discretion.

Any tax payable as a result of a prize being awarded or received will be the responsibility of the winner. Winners should seek independent financial advice prior to accepting a prize if this is a concern.

Prizes will be despatched to the winners via the UK mail service, unless otherwise stated. IOP will not be liable for any prizes that are lost, delayed, or damaged in the post for reasons beyond its reasonable control.

Terms governed by English law.

Appendix A: Technical details of the challenge.

Teams should produce a device to convert thermal energy to mechanical energy from a given heat source to raise a mass to achieve the greatest gravitational potential energy. The heat source will be up to 1 litre of just boiled water (i.e. 100°C) which will be provided. Teams can choose their own test payload and distance moved through, but it must be removable for measurement. No other energy input may be used for lifting, although electrical power for measurement and/or sensors only is permitted. Energy for lifting is restricted to water between zero and 100 °C.

On their poster, teams should be able to discuss the theoretical and experimental efficiency.

Appendix B: Timings for projects

To ensure consistency between teams, lab work on projects should not start until January, but teams may be briefed before Christmas so they can start some research.

While some departments may have a restricted number of lab sessions available, it would help for fairness for the students going forward to the final to be able to work on their projects until Easter, in their own time if necessary.

Where projects are run “extra-curricula”, departments will need to make arrangements for students’ lab time and to ensure health and safety.

Appendix C: Budget and costings

Each team has a budget of £30 to make their device. A list of all costs should be made available to the judges, but only the total need be included on the poster. The budget includes items supplied by the departments.

Salvaged materials but not fabricated components may be used, and should be listed in costings (along with where it came from) with their indicative value, but need not be included within the budget if genuine scrap. The judges’ decision as to what constitutes salvage and scrap is final.

The test mass is not included within the budget.

Appendix D: Final challenge day

The final challenge will be held at the University of Central Lancashire (UCLan) on 27 April 2016.

Indicative timings are as follows:

10.30 Setup

11.00 Presentations

12.30 judging and lunch

13.30 Competition

14.30 Presentations/wrap up

15.00 Depart

Appendix E Guidelines for Presentation (not judged)

Although the presentations are not a formal part of the marking, they are an opportunity for the teams to impress the judges.

The presentation should be no longer than 5 minutes in length, there will be an additional 5 minutes for questions and changeover.

The presentation will not be judged, the format for this will be individual to each team, it is suggested that you talk about the highlight and the low lights of undertaking the challenge. Powerpoint presentation facilities will be available.

Appendix F Poster and Stand Session

The poster is designed to test the team's ability to showcase their work in a commercial environment:

- a) Each team will produce one A1 poster in portrait format. It should clearly display the logos of the team's university and of the IOP.
- b) Students should include their efficiency calculations and analysis on their posters.
- c) Students should not detail full costings for their device on their poster, but a final figure should be given.
- d) Teams should make available to the judges a list of items purchased and their costs.
- e) Students should take consideration of the judging criteria provided below when designing their posters.

The stand is designed to test the team's demonstration skills:

- a) Each team will be given a table alongside their poster board to set up their device.
- b) Students should expect to present to the judges for around 5 minutes, with a further 2 minutes for questioning.
- c) Students should take consideration of the judging criteria below when designing their presentations.

During the poster and stand session, judges will be able to see the projects work. Each team will present their work by means of a poster and a formal demonstration. The judges will ask questions based on what they have been presented with.

The judging criteria for the poster and stand session are as follows:

- Clear formatting, poster design, including compliance with formatting.
- Device design, and innovative use of budget
- Optimization of variables to achieve maximum work-done
- Technical knowledge facilitated through answers to judges questions.
- Understanding of the underpinning physics demonstrated

Judges will rank the poster and stand sessions and these rankings will be applied using the formula given in Appendix J

Appendix G Peer Review

There will be a peer review element to the challenge. During the poster and stand session, the other teams will vote for their top three designs using the following form:

Team Voting:

Our team have voted for the following best designs:

1st

2nd

3rd

The teams will be given the following points

1st 3 points awarded

2nd 2 points awarded

3rd 1 point awarded

Points will be collected for all teams and then ranked according to the points awarded.

Appendix H Competition element

The devices will be judged on the maximum work generated

Each of the projects will be ranked according to the objective criteria chosen for the challenge.

The final percentage for each team will be calculated using the following formula (for 20% weighting element)

$$\% = 20 \left[1 - \frac{(n - 1)}{(N)} \right]$$

Where n is the ranking position, and N is the number of teams.