# What is the International Physics Olympiad (IPhO)?

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# Introduction

"In recognition of the growing significance of physics in all fields of science and technology, and in the general education of young people, and with the aim of enhancing the development of international contacts in the field of school education in physics, an annual physics competition has been organized for secondary school students. The competition is called the International Physics Olympiad and is a competition between individuals."

The International Physics Olympiad (IPhO) is the highest physics competition for high school students.

# Introduction

It is one of the international science Olympiads.

The first competition was held in 1967 in Poland.

Each country may send one national team.

One national team consists of five students and two team leaders.

The students must be under the age of 20 by 30$^{th}$ June in the year of the competition to compete (upper age limit).

Is there a lower age limit?

The team leaders must have a background in university physics.

What does a team leader do?

# Introduction

Physics have both theoretical and practical aspects.

Students are expected to apply what they know to new situations, critically and creatively.

- Theoretical examination (solve 3 structured problems in 5 hours)
- Experimental examination (perform 2 experiments in 5 hours)

What is the expected level of IPhO problems?

- IPhO syllabus ≈ first year undergraduate physics.
- Pre-university: STPM, IB, A-levels, Asasi Pintar UKM, UEC.
- Mathematical background: calculus.
- Experimental skills: measurement, data analysis, error analysis.
- Time management.

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# Introduction

Timetable of competition:

**1. Programme of IPhO 2015**

| Day and Date | For Contestants | For Leaders |
|---|---|---|
| Saturday, July 4 | Arrival (Check-in after 14:00 hrs) and Registration | |
| Sunday, July 5 | Registration (08:00 hrs) and Opening Ceremony (16:00 - 19:00 hrs) | |
| Monday, July 6 | Excursion | Experiment Discussion |
| Tuesday, July 7 | Experiment Examination | Excursion |
| Wednesday, July 8 | Excursion | Theory Discussion |
| Thursday, July 9 | Theory Examination | Excursion |
| Friday, July 10 | Excursion | Excursion |
| Saturday, July 11 | Excursion | Moderation and IB meeting |
| Sunday, July 12 | Closing Ceremony (10:00 - 13:00 hrs) and Departure | |
| Monday, July 13 | Departure (Check-out before 12:00 hrs) | |

# Introduction

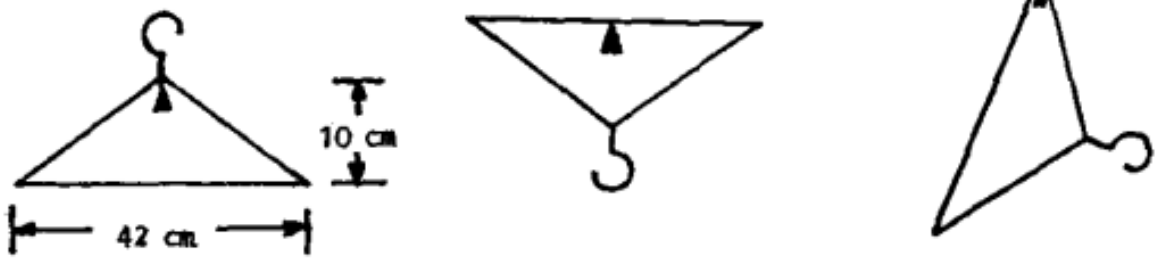
Sample theoretical problem:

**Problem 2: Oscillating coat hanger**

A (suitably made) wire coat hanger can perform small amplitude oscillations in the plane of the figure around the equilibrium positions shown. In positions a) and b) the long side is horizontal. The other two sides have equal length. The period of oscillation is the same in all cases.

What is the location of the center of mass, and how long is the period?

a) b) c)



# Introduction

## Sample experimental problem:

**Diffraction due to Helical Structure**[1] (Total marks: 10)

**Introduction**

The X-ray diffraction image of DNA (Fig. 1) taken in Rosalind Franklin's laboratory, famously known as "Photo 51", became the basis of the discovery of the double helical structure of DNA by Watson and Crick in 1952. This experiment will help you understand diffraction patterns due to helical structures using visible light.

**Objective**

To determine geometrical parameters of helical structures using diffraction.

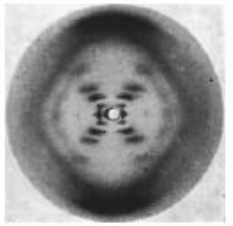


Figure 1: Photo 51

**Theory**

A laser beam of wavelength $\lambda$, falling normally on a cylindrical wire of diameter $a$, is diffracted in the direction perpendicular to the wire. The resulting intensity pattern as observed on a screen is shown in Fig. 7.

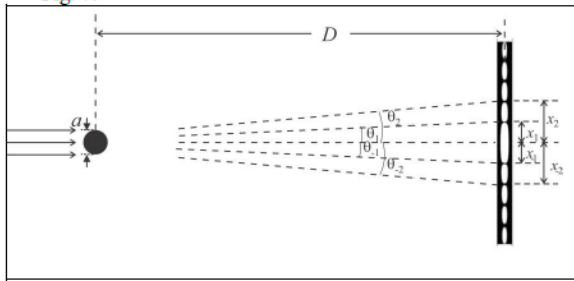



Figure 7: Schematic of the diffraction pattern due to single cylindrical wire of diameter $a$.

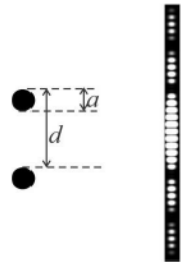



Figure 8: Schematic of diffraction pattern due to two cylindrical wires

The intensity distribution as a function of angle $\theta$ with the incident direction is given by

$$I(\theta) = I(0)\left[\frac{\sin\beta}{\beta}\right]^2 \quad \text{where } \beta = \frac{\pi a \sin\theta}{\lambda}$$

The central spot is bright and for other angles, when $\sin\beta$ ($\beta \neq 0$) is zero, the intensity vanishes. Thus the intensity distribution has $n^{\text{th}}$ minimum at the angle $\theta_n$, given by

$$\sin\theta_n = \pm n\frac{\lambda}{a} \qquad n = 1, 2, 3, 4, 5 \ldots.$$

Here $\pm$ refers to both sides of the central spot ($\theta = 0$).

The diffraction pattern due to two parallel identical wires kept at a distance $d$ from each other (Fig. 8) is a combination of two patterns (diffraction due to a single wire and interference due to two wires). The resultant intensity distribution is given by,

$$I(\theta) = I(0)\cos^2\delta\left[\frac{\sin\beta}{\beta}\right]^2$$

where $\delta = \frac{\pi d \sin\theta}{\lambda}$ and $\beta = \frac{\pi a \sin\theta}{\lambda}$

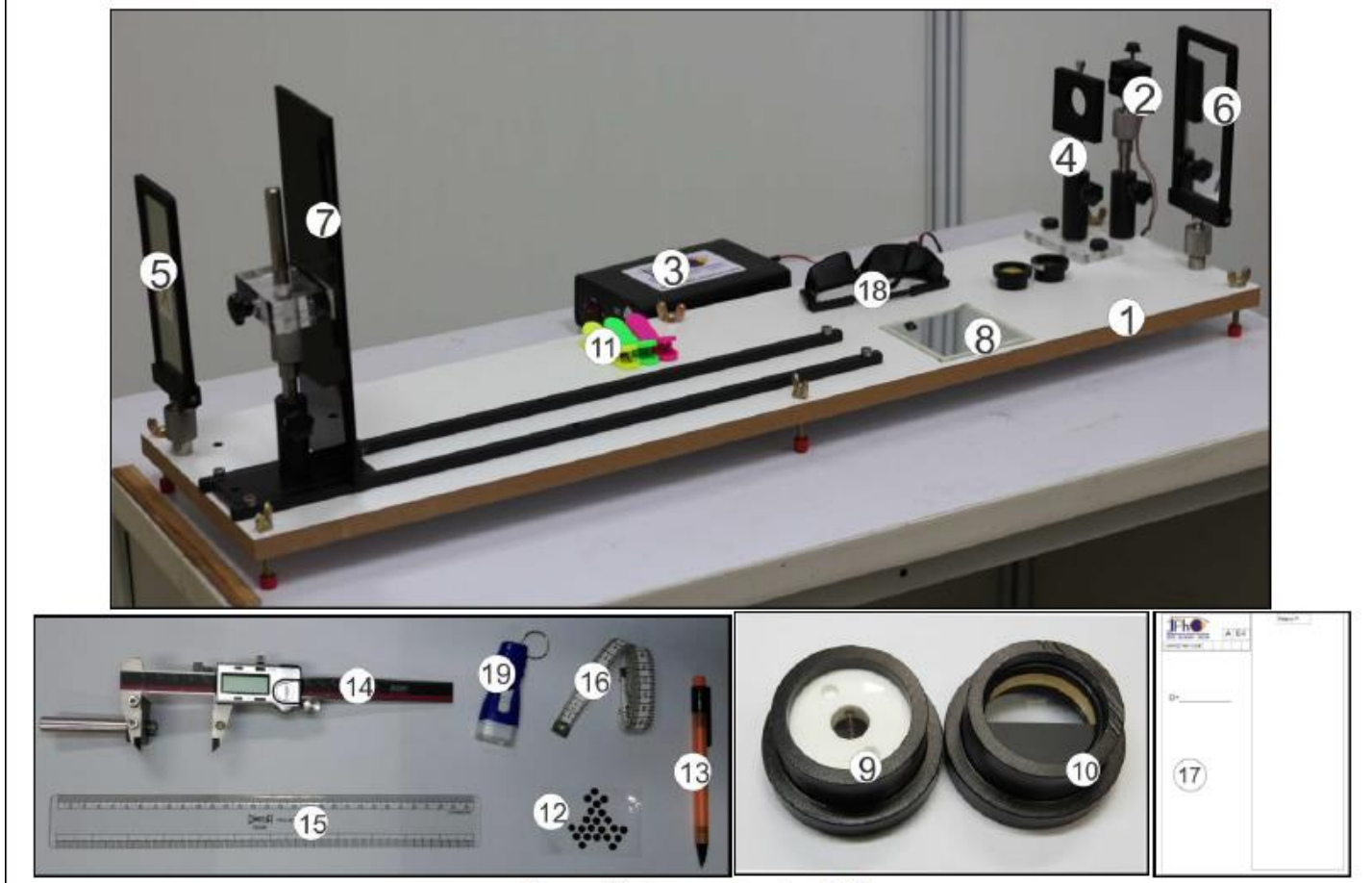


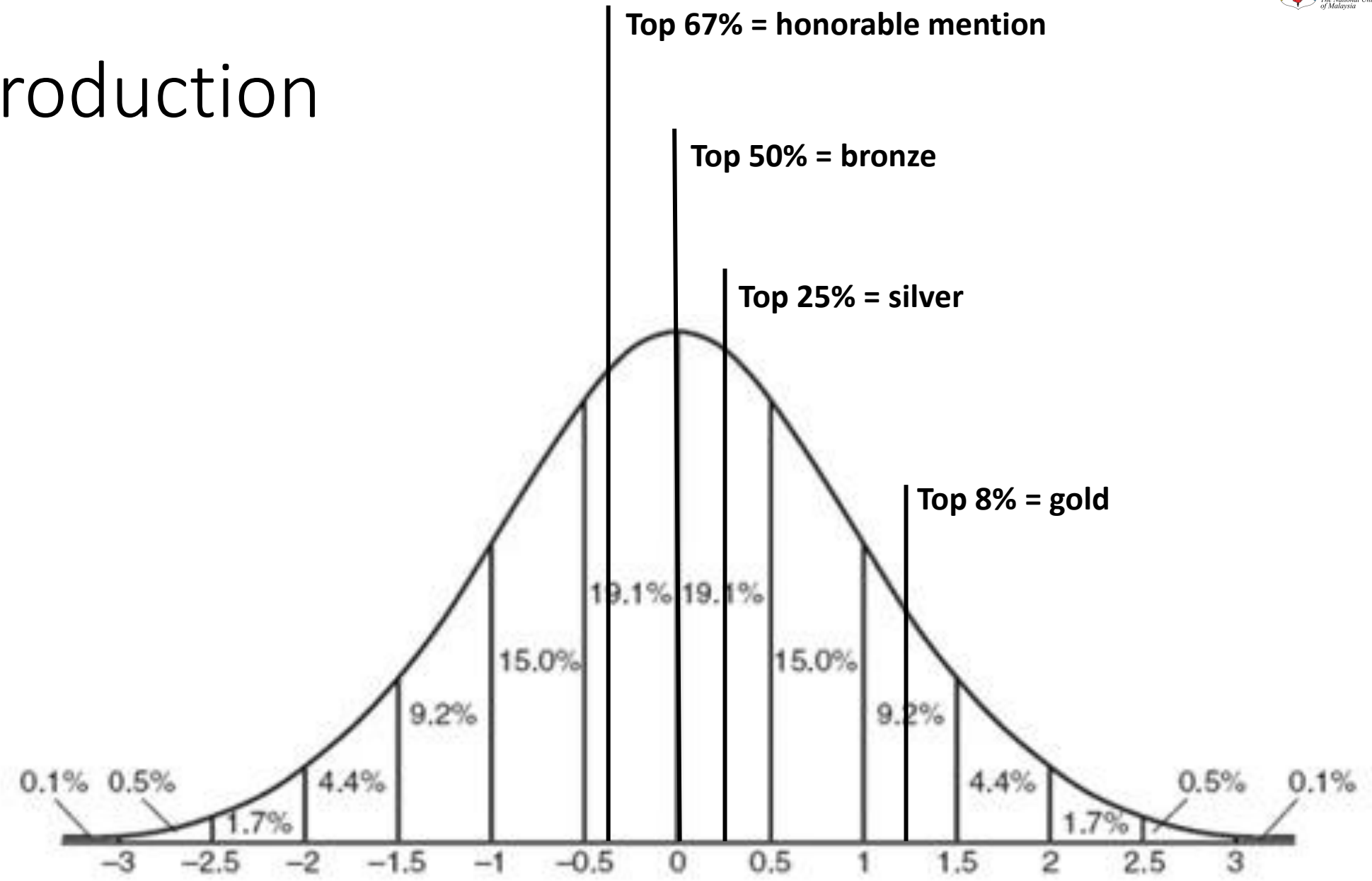

Figure 2: Apparatus for E-I

# Introduction

Comparison between STPM questions and IPhO problems.

| STPM problems | IPhO problems |
|---|---|
| Smaller scope of topics:<br>• No rotation in mechanics.<br>• No special relativity in modern physics. | Broader scope of topics:<br>• Rotation of rigid bodies included.<br>• Special relativity in modern physics. |
| One problem focused on a single topic. | One problem involving many topics.<br>• Radiation and particles from the Sun.<br>• Large Hadron Collider. |
| Algebra is the default, minimal calculus. | Calculus is the default. |
| Practicals are guided, not timed and in groups/pairs. | Practicals are open-ended, timed and individual. |
| Using known formulas to solve old problems. | Using known concepts to solve new problems. |

# Introduction



# Introduction

Apart from the IPhO, there are several regional physics competitions:

- Ibero-American Physics Olympiad (1991)
- Asian Physics Olympiad (2000)
- Gulf Physics Olympiad (2016)
- Northern Baltic Physics Olympiad (2016)
- European Physics Olympiad (2017)
- International Applied Physics Olympiad (2021)

# Malaysia in the IPhO

## Past achievements

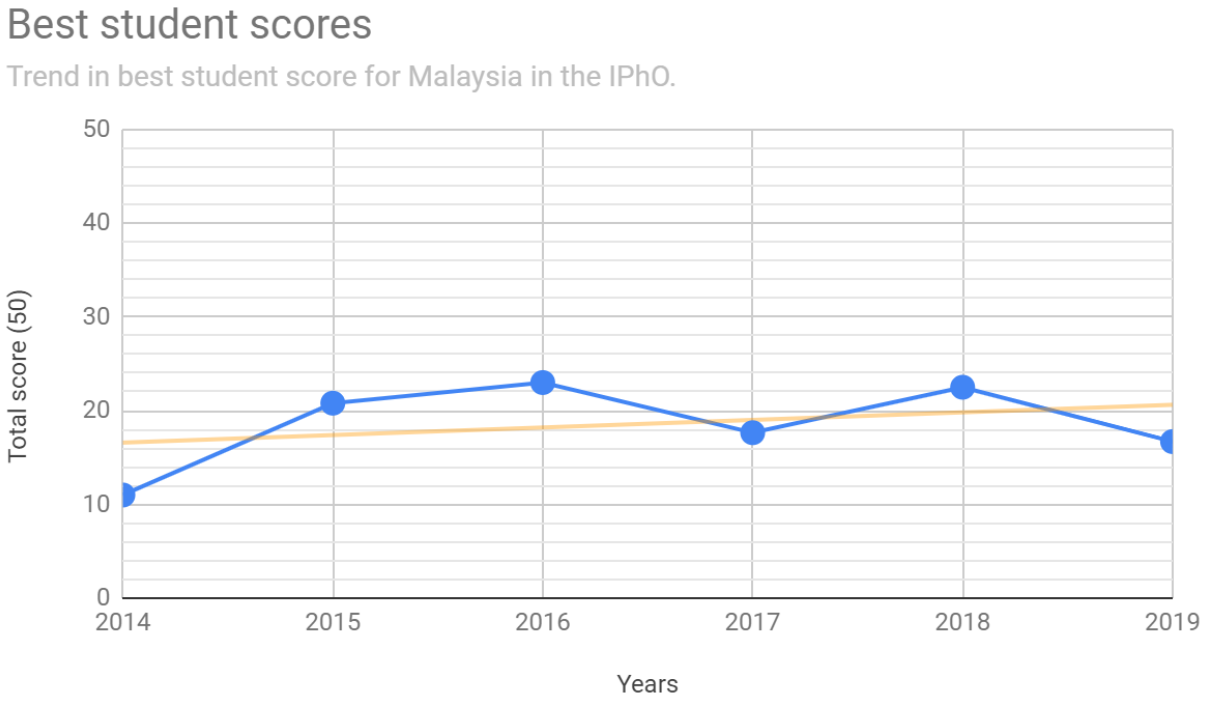

**CHEW KOK WEI**

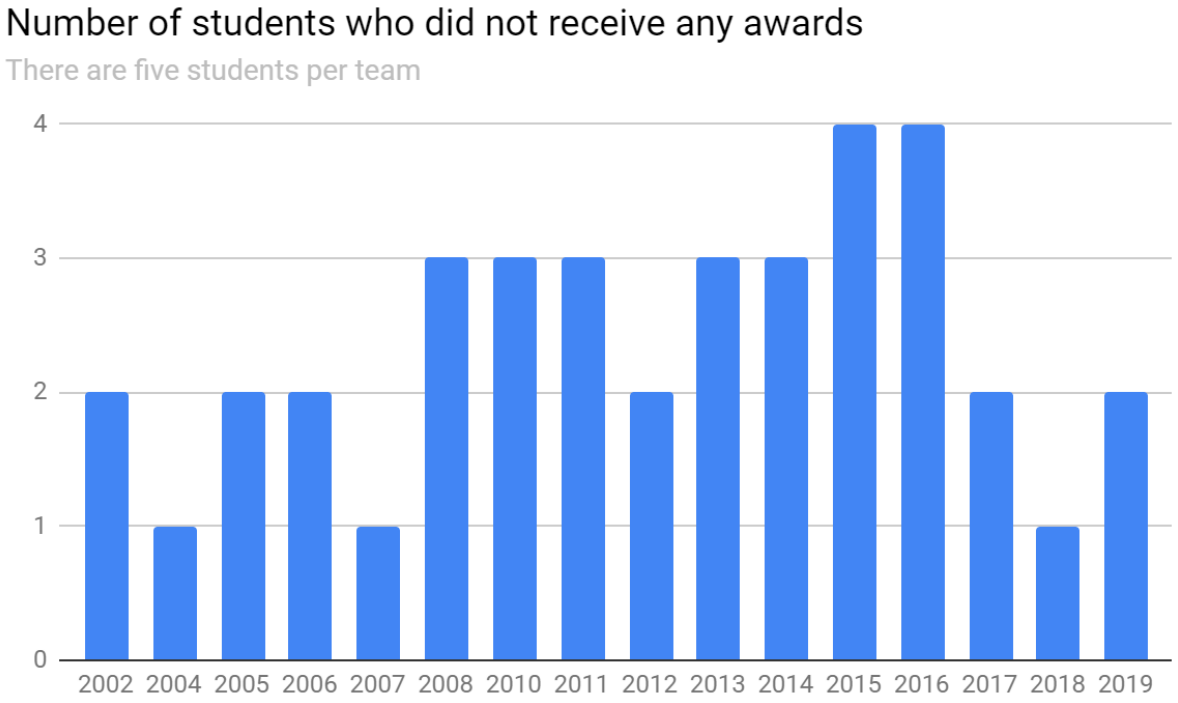
(Chung Ling, Georgetown)

| Year | Host country | GOLD | SILVER | BRONZE | HONORABLE MENTION | TOTAL |
|---|---|---|---|---|---|---|
| 2019 | Latvia* | | | 1 | 2 | 3 |
| 2018 | Portugal | | | 3 | 1 | 4 |
| 2017 | Indonesia | | | 1 | 2 | 3 |
| 2016 | Switzerland | | | 1 | - | 1 |
| 2015 | India | | | - | 1 | 1 |
| 2014 | Kazakhstan | | | - | 2 | 2 |
| 2013 | Denmark | | | 1 | 1 | 2 |
| 2012 | Estonia | | | - | 3 | 3 |
| 2011 | Thailand | 1 | | - | 1 | 2 |
| 2010 | Croatia | | | 1 | 1 | 2 |
| 2008 | Vietnam | | 1 | - | 1 | 2 |
| 2007 | Iran | | | 1 | 3 | 4 |
| 2006 | Singapore | | | 1 | 2 | 3 |
| 2005 | Spain | | | 1 | 2 | 3 |
| 2004 | South Korea | | | - | 4 | 4 |
| 2002 | Indonesia | | | - | 3 | 3 |
| | **Total** | **1** | **1** | **11** | **29** | **42** |

# Malaysia in the IPhO

## Trends

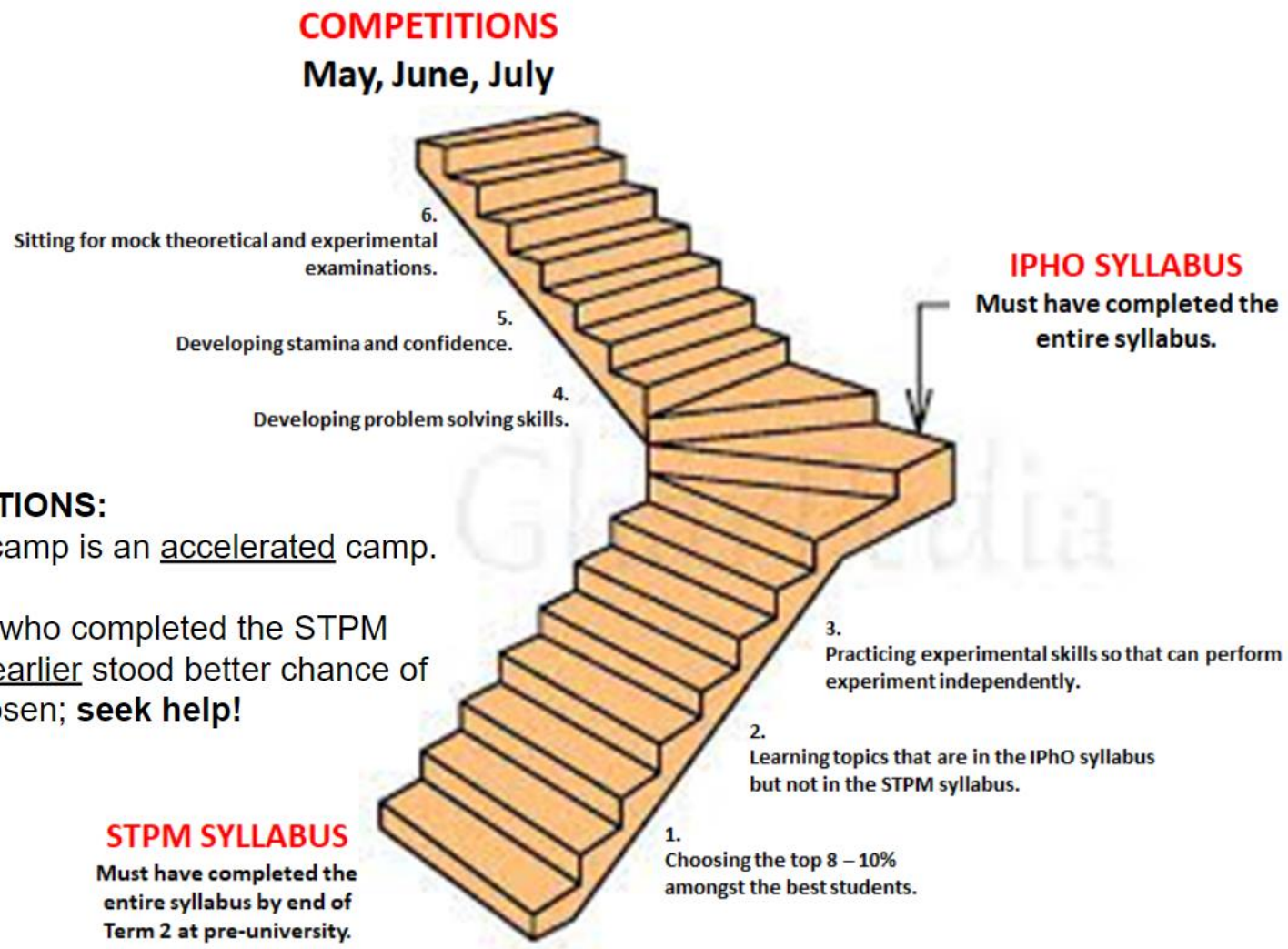


# Malaysia in the IPhO

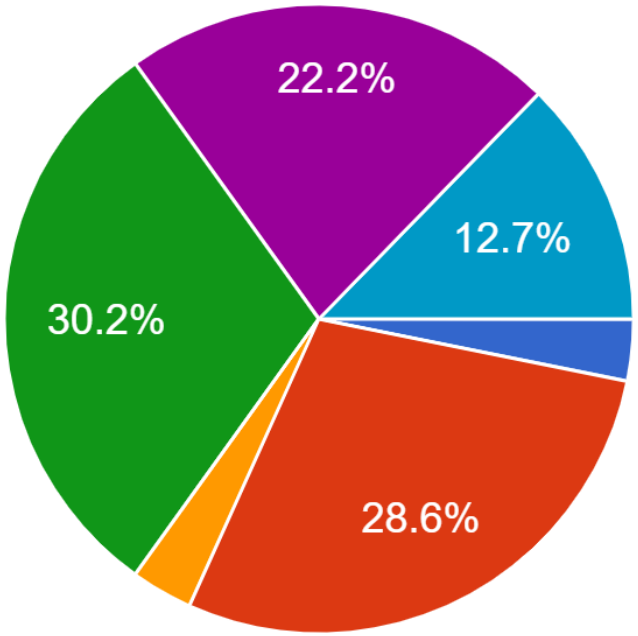
| Jan | Feb | March | April | May | June | July |
|---|---|---|---|---|---|---|
| STAGE 0 | | STAGE 1 | STAGE 2 | STAGE 3 | STAGE 4 | |
| Invitation from host country | Announcement | | | | | |
| Remote training camps | Remote training camps | | | | | |
| | | First test Term 1 topics | | | | |
| | | | Second test Term 2, 3 topics | | | |
| | | | | Online training camps | Online training camps | |
| | | | | EuPhO | | |
| | | | | | Physical training camps | Physical training camps |
| | | | | | | IPhO |

# What happens next?



# Why are you interested to participate in the physics Olympiad?

63 responses




- I want to qualify for the first training camp.
- I want to be selected to represent the country at IPhO this year.
- I want to be selected to represent the country at IPhO next year.
- I want to improve my mastery in physics.
- I want to pursue my interest and passion in physics.
- I want to learn the tips and tricks to pe…