

## What is PeerWise?

PeerWise is a free, online multiple choice question (MCQ) authoring and sharing system. Students create their own questions using the tools in the online repository. Students then answer, rate and comment on their peers' questions, making use of the system's Web2.0-like functionality (such as discussion threads, ratings-based sorting, and the ability to 'follow' authors).



Physics 1B 2010-11

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**Write question**

Write the main text of the question below. Make sure the question is clear and unambiguous, and use language which is professional. Feel free to format the text of your question using the formatting options.

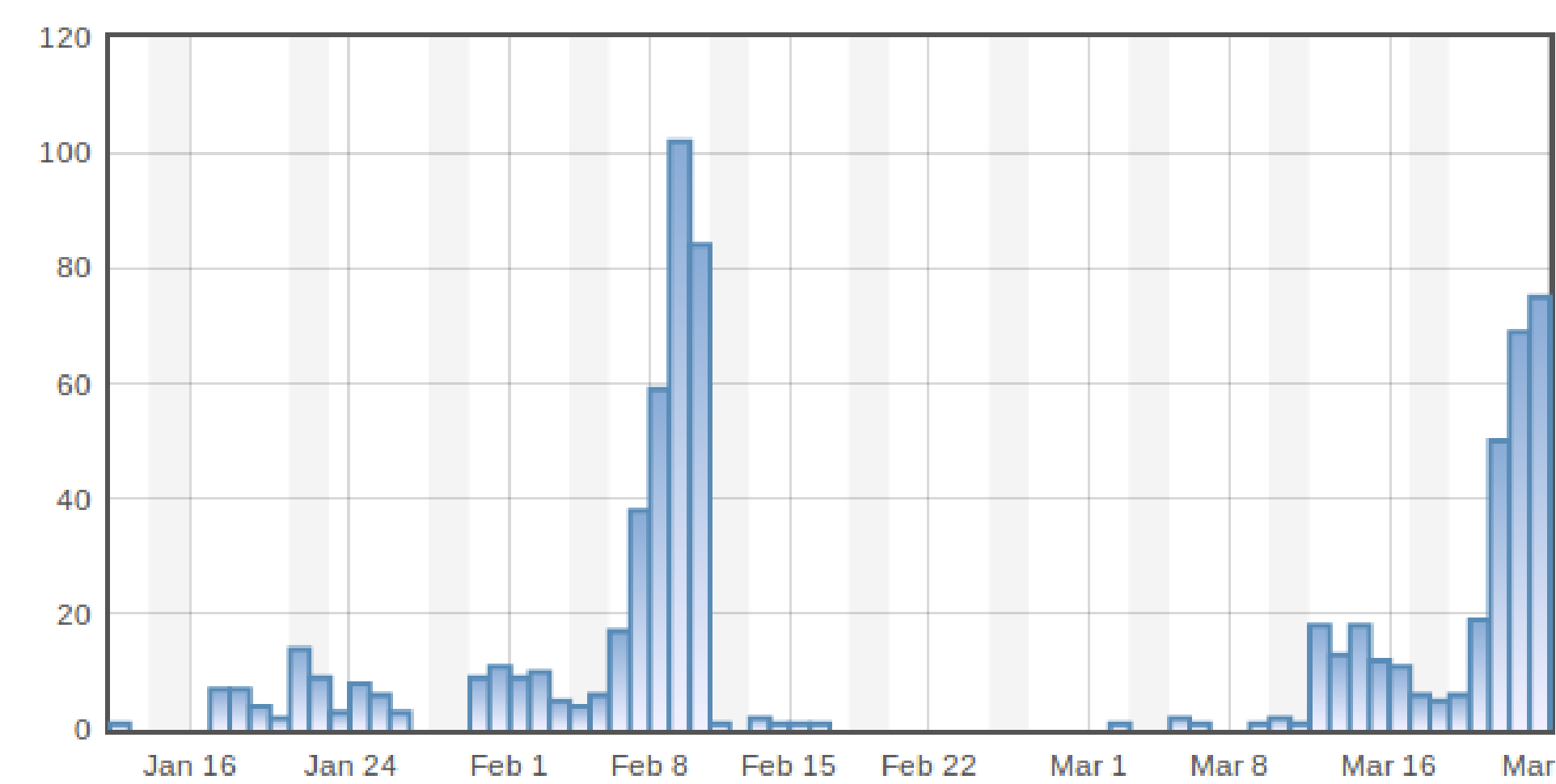
Rich text editor toolbar: Bold, Italic, Underline, Text color, Background color, Bulleted list, Numbered list, Link, Unlink, Undo, Redo, Font family, Font size, Text color, Background color, Bulleted list, Numbered list, Link, Unlink, Undo, Redo.

Click to view	Preview	Question created	Number of answers	Author's answer popular?	Help requests	Most recent comment	Number of comments	Difficulty rating	Overall rating
1	0.10 moles of a gas is contained in a container of volume and	5:09pm, 29 Mar	7	<input checked="" type="checkbox"/>	0	1:00pm, 18 Apr	2	very hard	4.80
2	What is the wavelength of an electron moving with a speed of	6:25pm, 25 Mar	8	<input checked="" type="checkbox"/>	0	5:24pm, 04 Apr	2	very easy	0.50
3	Calculate the energy of one photon of yellow light whose wavelength	6:03pm, 25 Mar	4	...	0	4:17pm, 28 Mar	1	very easy	0.00
4	Electrons generally fit up outside in which order?	4:48pm, 29 Mar	11	<input checked="" type="checkbox"/>	0	12:59pm, 28 Mar	3	very easy	1.56

## How did the students make use of the system?

The figure below illustrates the temporal profile of student submission of questions to the system for the second year Physics class at Glasgow. Two peaks can be seen: these correspond to summative assessment deadlines. There is also lower level engagement prior to the deadlines: this is activity by highly engaged students. We see very similar profiles of student activity in all the classes in which the system was deployed, with students routinely participating to a much greater extent than was mandated by the assessment tasks.

Number of questions contributed per day



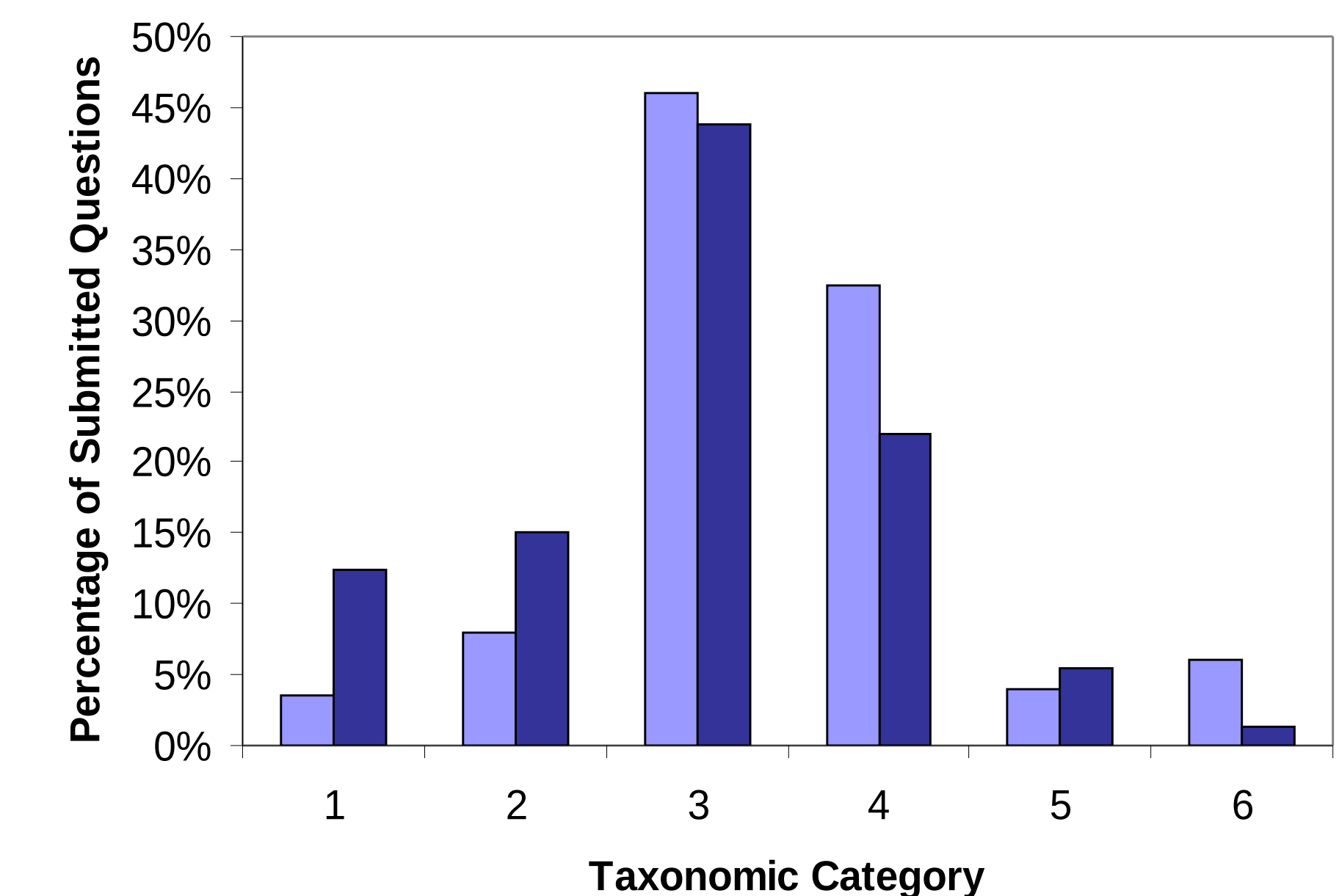
## What standard of questions did they write?

Questions submitted to both first and second semester first year Physics courses at Edinburgh were classified according to the level of sophistication of their content. The classification was conducted using a revised form of Bloom's Taxonomy, identifying 6 cognitive levels as follows:

### Category Description

- 1 Remember, recognise or recall
- 2 Understand, interpret or predict
- 3 Apply, implement or calculate (1-step calcs.)
- 4 Analyse, differentiate or organise (multi-step)
- 5 Evaluate, assess or rank
- 6 Create, combine or produce (synthesise ideas)

The figure shows the distribution of submitted student questions for the first semester course (Newtonian mechanics, light bars) and second semester course (waves and modern physics, dark bars).



There are comparatively few questions in the lowest two taxonomic categories (particularly for the first semester course). Most of the questions require students to go beyond simple factual recall or elementary understanding, A significant proportion of the questions occupy categories 4 and above, requiring students to engage in detailed analysis, solve extended multi-step problems, or to synthesise ideas from more than one area of physics. An example of one such question is shown here.

A block with mass  $m$  is revolving with linear speed  $v_1$  in a circle of radius  $r_1$  on a frictionless horizontal surface. The string is slowly pulled from below until the radius of the circle in which the block is revolving is reduced to  $r_2$ .

What is the value of the work done?

## How and where did we deploy the system?

We deployed PeerWise with first and second year undergraduates, over a number of different classes including Physics, Chemistry and Biology, at the Universities of Edinburgh, Glasgow and Nottingham in the UK. Prior to

**Master Physics by Writing MCQs**

Submit and answer questions on topics in the target region just above the physics you have already mastered.

**Physics Forces in your target region**

Relativity: Newton's Third Law  
Applying Newton's Laws in situations that involve tension

**YOUR CHOSEN TOPIC**

**Tension...** in cords connecting accelerating masses.

**CONCEPT**

**COMMON MISCONCEPTIONS AND ERRORS**

Wrong physics: Tension is greater in the cable on the side of the pulley that has the greatest mass.

Like: Tension is the same on both sides of a pulley.

Wrong math: Confuse sines and cosines.

**DATA**

From wikipedia: max speed = 10m/s, max gradient = 23 degs  
120 people max per car. Guess cars accelerate from rest in 10s  
I estimate masses of car + pulley to be about 8 to 10 tonnes

**Question stem** Halfway car 1, at 10 seconds, accelerates down 23 deg slope. This pulls car 2, which is 100m up the slope. How far does car 2 travel?

**The key (the correct answer)** 23.3 x 10^3 m

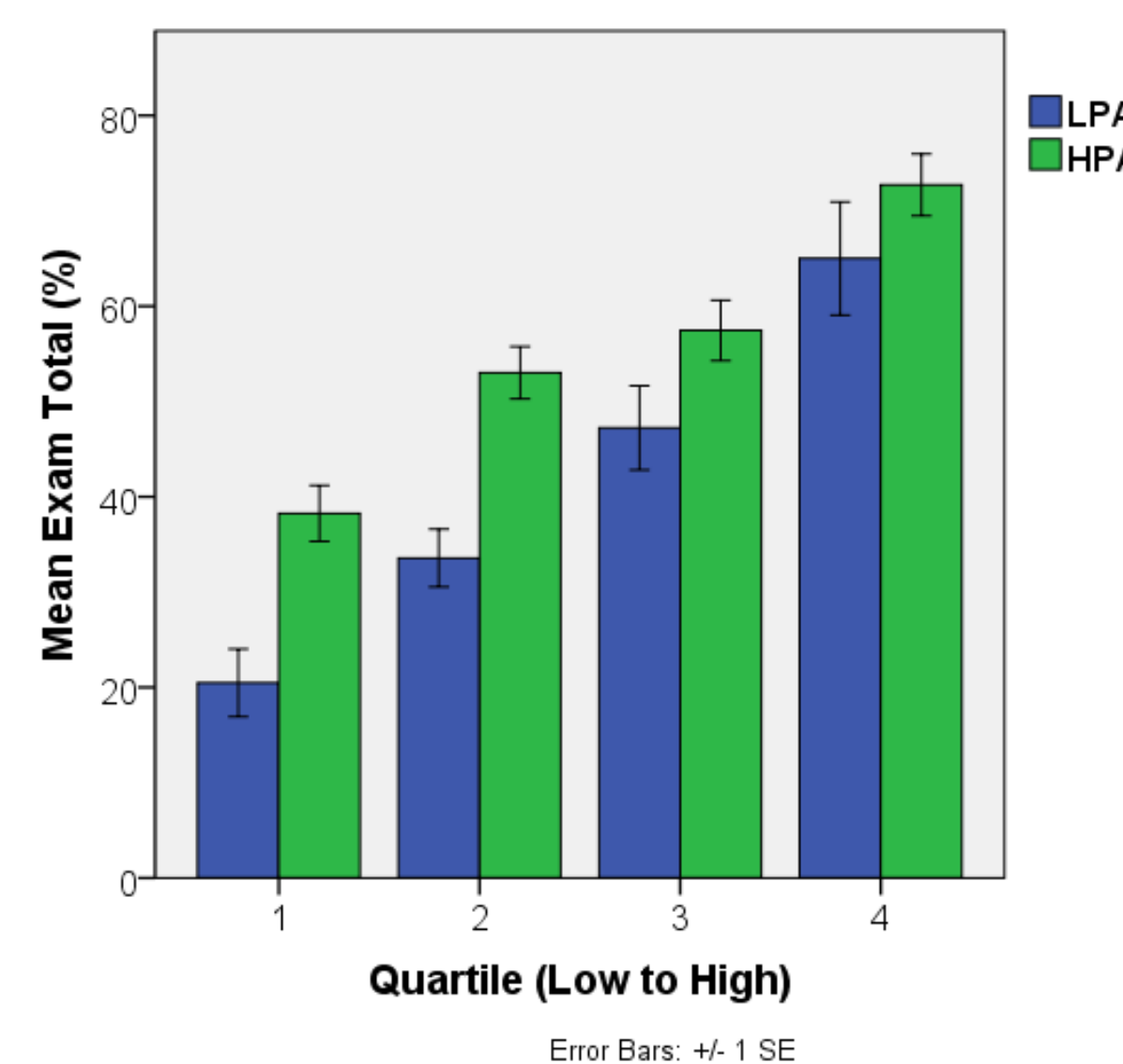
**Explanation** Cable pulls on each of the cars with the same force magnitude, even though cars are accelerating. Car 1 has same acceleration as car 2. Frms but masses are different therefore acceleration forces must be of different magnitude. Key steps, use coordinate system parallel to slope in each case. Draw free body diagram for each car. Find components. Obtain a, then substitute back to get T.

its introduction, we provided scaffolding materials to the students to support their use of the system, targeting cognitive aspects of MCQ design rather than system usage. Specifically, we held interactive sessions addressing good practice for setting effective MCQs, and providing high quality example questions for students to work through in groups. We hypothesise that the example questions 'set the bar' for subsequent good quality student submissions.

## Does using PeerWise influence course result?

Cohort	Number of Students	Mean Exam Score *	Standard Error	p value	Effect Size **
Physics 2	(N=152)				
HPA ***	78	58.1	1.9		
LPA	74	38.0	2.7	<0.001	0.45

\* all scores expressed as percentages  
\*\* Pearson's  $r$   
\*\*\* HPA/LPA denote higher/lower PeerWise activity



Here we illustrate some example course outcomes from the second year Physics class at Glasgow. The figure shows comparisons of final exam scores for students with low (LPA) and high (HPA) PeerWise activity, divided into quartiles according to a pre-test. In all quartiles, HPA students outperform LPA students, with statistically significant differences for students in the lowest two quartiles. Whole class statistics are given in the table.