

Norwegian Olympiad on Astronomy and Astrophysics – Round 1 Statistics

General Statistics

The multiple-choice problem set for Round 1 was sent out to schools in week 42, and the schools had until the end of week 45 to send back their students' attempts. After these three weeks, we received 153 submissions from 25 different schools spread around 8 counties (fylker). Out of the 153 submissions, 29.4% were girls, which is the highest we have had so far.

Figure 1 shows the total score distribution with mean $\mu = 9.31$ and standard deviation $\sigma = 3.66$ for the $n = 153$ students. The maximum possible score was 20, and it wasn't attained by any of the students.

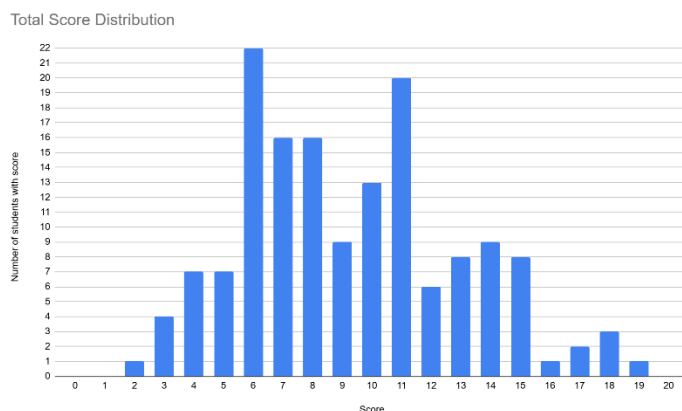


Figure 1: Total Score Distribution for Round 1

We have also looked at the distribution for correct answers to the questions, with its histogram shown in Figure 2. No single question was answered correctly by every student, and we can clearly see some questions that posed a big problem for the students.

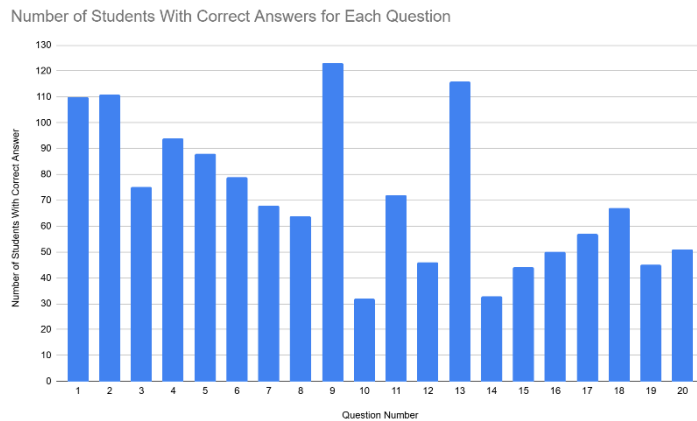


Figure 2: Number of students to correctly answer each question.

Per-Question Statistics

Question 1

This question asked to recognise that the photograph taken was of a total solar eclipse, wherein the disk of the Sun is completely obscured by the Moon.

	Alternatives	Number of Students
Question 1	A	110
	B	13
	C	30
	D	0

All students realised that this was an astronomical phenomenon of some sort, as evidenced by no one going for alternative D about this being a camera artefact. What's surprising is that many went for alternative C (so many sunspots that they cover the Sun), which is not something that has been observed (yet) and certainly not by the name Black Hole Sun.

Question 2

This question asked to estimate the radius of the Moon given distances of Sun and Moon from Earth and Sun's radius.

	Alternatives	Number of Students
Question 2	A	10
	B	111
	C	16
	D	16

The intended solution was based on calculation, but a lot of the correct answers may also be due to the fact that the students knew the order of magnitude of the Moon's size. We specifically put this question after the eclipse one to hint at a possible method for solving.

Question 3

This was a terminology question, giving the definition of zenith and asking the students to mark the word.

	Alternatives	Number of Students
Question 3	A	40
	B	75
	C	23
	D	15

This is one of many questions outside the scope of the Physics curriculum in schools, which might explain the bigger division in answer alternatives. New of this year is that we have published handouts on different topics outside of the curriculum, and we hope that this question might be considered an easier one in the future, now that the students have the necessary resources.

Question 4

This question required the students to recognise the parallax method of measuring distances, which most have done successfully. Parallax was also the only alternative provided that was a measurement method of distance, so one could also deduce the answer from that.

	Alternatives	Number of Students
Question 4	A	10
	B	94
	C	23
	D	25

This is also one of a specific type of question where we like to give a little bit of history / astronomical background as to how certain things were discovered (especially in older times) and by whom. One student did not answer this question, so the numbers sum to 152, not 153.

Question 5

This question was about Kirkwood gaps that arise as a consequence of resonance with Jupiter's orbit. We looked at this as one of the more difficult questions in the problem set, but a lot of students managed to answer correctly!

	Alternatives	Number of Students
Question 5	A	12
	B	88
	C	31
	D	22

We didn't expect the students to know of this phenomenon, but rather think that this can only be caused by a massive object right outside the asteroid belt, which should have led them to the conclusion of Jupiter.

Question 6

The statistics for this problem are a bit stranger, since due to a formatting error, the images with the spectral line were swapped between the English and the Norwegian version. This means that students doing the English problem set had D as the correct answer, and the ones in Norwegian had B. We have taken this into account when scoring.

Question 7

This is another question outside of the curriculum, and relating to elliptical orbits. It is also the first question requiring some algebra of the students. Most of them managed to get to the correct answer, which is great given that it is outside of what they learn in school!

	Alternatives	Number of Students
Question 7	A	34
	B	27
	C	68
	D	21

The handouts on the Olympiad website cover properties of elliptical orbits, so we expect that even more students get this type of question correctly the next time they come up. We attempted to give them everything they needed by explaining the concept in the problem text as well as providing a sketch, which seems to have affected the scores positively. Three students provided no answer.

Question 8

This question tests their knowledge of exoplanet discovery, with what we thought were “dummy” alternatives, but we see a lot of them went for alternative D. Even though gravitational lensing is a phenomenon that exists, it is not used for exoplanet discovery.

	Alternatives	Number of Students
Question 8	A	28
	B	16
	C	64
	D	45

Question 9

The famous image of the black hole in M87 was the topic of this question, and a large majority of students recognised it! This is, again, outside of the curriculum, but expected general knowledge on astronomy and astrophysics.

	Alternatives	Number of Students
Question 9	A	4
	B	123
	C	11
	D	15

Question 10

This is the question that stumped most students, and understandably so – the difference between a solar and a sidereal day is subtle, but important. We point to the handouts again, which should shed some light on the confusion. Given that this is also outside of the curriculum, we expected the question to be on the more difficult end, but it turned out to be the one that stumped most!

	Alternatives	Number of Students
Question 10	A	2
	B	14
	C	105
	D	32

Question 11

Northern lights – a phenomenon near and dear to Norway! We expected most of the students to get this question, which is why we put in alternatives that sound plausible, and we see that B and D tricked a lot of students.

	Alternatives	Number of Students
Question 11	A	9
	B	37
	C	72
	D	35

Question 12

Observational astronomy is a big part of the International Olympiad, but is not taught in schools at all. Most of this is learning by doing and trying to memorise objects and constellations. We have uploaded helpful resources on the website, but when we ask round 1 questions, we give something that is on the easier end of answering. We expect the students to know about the major circumpolar stars in our hemisphere, Cassiopeia included.

	Alternatives	Number of Students
Question 12	A	68
	B	21
	C	18
	D	46

As a side note, ChatGPT can often be quite good at answering astronomy questions, but it can and does go wrong, as in this scenario, so be a little wary of using it as a learning resource. :)

Question 13

We have asked about HR diagrams in every round every year and are happy to see that a great majority of students have managed to answer the question about the axes correctly!

	Alternatives	Number of Students
Question 13	A	14
	B	116
	C	14
	D	9

Familiarity with HR diagram and where the different types of stars are placed (and why) is expected knowledge, and is also a part of the curriculum in schools.

Question 14

This question had a very even spread in which alternatives students chose. It requires the students to know the difference between absolute and apparent magnitudes and realise that star charts are made to reflect the sky as seen from Earth, i.e. show apparent magnitudes.

	Alternatives	Number of Students
Question 14	A	39
	B	40
	C	41
	D	33

A big trick that gets even participants at the International Olympiad is that a bigger number for the magnitude means that the star is actually dimmer! More on star chart reading and how they work can be found in the handouts.

Question 15

Back to more calculation-based questions with this one! Here, we expect the students to convert the frequencies to wavelengths to be used in Wien's Law and realise that the temperature that comes out from the formula is given in Kelvin rather than degrees Celsius. This is also a common mistake we see even in higher levels, and we want the students to be aware of this.

	Alternatives	Number of Students
Question 15	A	44
	B	41
	C	42
	D	25

Question 16

This is a question that combines calculation with astronomical intuition. We expect students to understand the Rayleigh criterion and realise that alternatives B and C are invalid just from reading the problem text. This question has shown that we need to provide a bit more explanation as to the criterion to hopefully reduce this spread.

	Alternatives	Number of Students
Question 16	A	50
	B	35
	C	36
	D	32

Question 17

Another observational question about two big landmarks on the night sky. With more observational training, we expect more students to not go for alternatives A and B and have to think more about C vs. D. It is promising that a lot of them have chosen the correct alternative, though!

	Alternatives	Number of Students
Question 17	A	37
	B	21
	C	57
	D	38

Question 18

This question was a simple “plug into formula” one, and it is surprising that not more got the correct alternative.

	Alternatives	Number of Students
Question 18	A	17
	B	26
	C	43
	D	67

Question 19

This is a question that tests both conceptual understanding and astronomical vocabulary. We have provided explanations as to what the terms mean, but even so, the question still requires careful reading (which is also essential at higher levels of the competition).

	Alternatives	Number of Students
Question 19	A	45
	B	66
	C	25
	D	17

Question 20

Another pure calculation question, but we didn't simply say "use Stefan-Boltzmann's Law here". We suspect that those who went for alternative C only looked at the relation between the temperatures rather than the full picture provided by the formula.

	Alternatives	Number of Students
Question 20	A	51
	B	14
	C	56
	D	32

Questions like this have been asked many times previously, and we recommend students to look at previous years' R1 and R2 exams for practice.