

Youth STEM Cup 2024

Preliminary Round (Senior Category)

Problems and Answers

13 April 2024

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Organising Committee

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Problem Selection Committee

The Problem Selection Committee (PSC) is responsible for setting and selecting problems for the contest. It makes collaborative decisions on the suitability and format of the questions, and performs cross-checks to ensure the questions are valid, clear, and well-posed. It also produces the *Problems and Answers* document, the *Problems and Solutions* document and the question paper.

Special thanks to the PSC for contributing 36 problem proposals for the Preliminary Round:

Biology

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Social Science

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Duration	60 minutes
Full Score	150
Total Number of Responses (Individual participants + Teams)	221
Average Score	54.77
Median Score	54
Range	10 - 121
Standard Deviation	16.4

General Statistics

Score Distribution





Breakdown of Correct Responses

	Bio	C	hem		I	Phy		N	Aaths	E	arth]	Se	ocial
Q	Freq	Q	Freq	1	Q	Freq		Q	Freq	Q	Freq		Q	Freq
1	102	1	29		1	41	1	1	84	1	143	1	1	94
2	85	2	50		2	69		2	Bonus	2	159		2	109
3	104	3	89		3	63		3	68	3	133		3	105
4	97	4	68		4	61		4	63	4	85		4	48
5	37	5	107		5	60		5	70	5	60		5	142
6	71	6	65		6	48		6	57	6	103		6	65
Σ	496	Σ	408	1	Σ	342	1	Σ	342	Σ	683	1	Σ	563

Problems

Biology

1. Meselson and Stahl proved that DNA replication was semi-conservative. Bacteria were grown for many generations in a medium containing 15N (a heavy isotope of nitrogen). They were given time to replicate DNA and divide once. Their DNA was extracted, spun in a centrifuge and observed using ultraviolet light. They then repeated this experiment, this time allowing the bacteria to replicate DNA and divide twice. Again, the DNA was extracted, spun in a centrifuge and observed using ultraviolet light.



Diagram 1

Which shows the predicted results after zero, one and two generations of replication in the medium with the light isotope? (4 marks)

- A. X = 0 Y = 1 Z = 2
- B. X = 0 Y = 2 Z = 1
- C. X = 2 Y = 1 Z = 0
- D. X = 2 Y = 0 Z = 1

2. Diagram 2 below shows how the effect of growing bacteria in the presence of an antibiotic can be investigated. Five different types of bacteria were grown on their own petri dish, one example is show below:



Diagram	2
Diagian	_

The table below shows the result from testing the antibiotic on the growth of these five types of bacteria. Zones of inhibition of less than 13 mm show the presence of resistant bacteria.

Type of bactoria	Diameter of zone/mm						
Type of Dacteria	Week 1	Week 2	Week 3	Week 4	Week 5		
1	24.10	21.90	19.00	17.60	14.30		
2	18.60	15.40	12.20	9.00	0.00		
3	17.90	12.80	12.40	11.10	10.90		
4	19.40	15.30	13.20	8.10	0.00		
5	22.00	21.00	20.50	20.40	20.40		

Which statement is supported by the data?

- A. Bacteria type 5 can never become resistant to the antibiotic.
- B. The antibiotic can be used to treat all five types of bacteria.
- C. Only types 2, 3 and 4 of the bacteria showed resistance to the antibiotic.
- D. Bacteria become more resistant over time.

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(3 marks)

3. Diagram 3 shows the vascular tissue of young stems and roots (capital letters) of two groups of plants, dicotyledonous (eudicots) and monocotyledonous (monocots) (lowercases).



Diagram 3

Which of the following statements is **TRUE**?

(4 marks)

- A. The vascular systems of stems differ from those of roots. In a stem, the vascular tissue lies deep in the interior, with the xylem at or near the centre.
- B. In monocots, the vascular bundles in the stem are arranged in concentric circles while in eudicots they are scattered.
- C. Each vascular bundle contains both xylem and phloem. The xylem in vascular bundles in stems and roots is indicated with the number (1) and the phloem with the number (2).
- D. In addition to the vascular tissues, the stem contains other important storage and supportive tissues. In eudicots, the pith lies inside the ring of vascular bundles and also extends between them, to the outside, the cortex, which may contain supportive collenchyma.

4. The heart tissue or myocardium of fishes can be of two types, which are illustrated in A and B in figure below. In many bony fishes, it is entirely spongy and absorbs oxygen from the blood flowing through the heart during circulation. In many other fishes, myocardium is compact (non-spongy) and oxygen is supplied to heart tissue via coronary arteries.



Diagram 4. A. Spongy myocardium; B. Compact myocardium; 1. Myocardium;
2. Coronary artery; 3. Coronary vein; 4. Ventricular lumen.
(Reference: Animal Physiology by Hill, Wyse and Anderson.(3rd Edition)).

Which of the following statement is **INCORRECT**?

(4 marks)

- A. Exercise performance or migratory abilities of fish with spongy myocardium will be limited as compared to a fish with compact myocardium.
- B. For an active fish having spongy myocardium, circulatory system as found in a mudskipper fish is more advantageous than the one found in a salmon fish.
- C. Circulatory system is more advantageous for a fish with compact myocardium tissue over a fish with spongy myocardium.
- D. Fishes with compact myocardium and those with spongy myocardium have a similar extent of delivery of oxygenated blood to the tissues.

5. Glucagon is secreted from pancreatic A-cells and works as a signal via receptors (GLR) on the cells of target tissues. The amount of GLR expressed on cell surfaces is important in determining the magnitude of the response to glucagon in each target tissue. Figure shows the amount of GLR mRNA in different rat tissues. In the data shown here, the glucagon receptor is not detected in brain tissue, but recent reports have revealed that it is present even in a very small amount, e.g., in the hypothalamus.



GLR mRNA (arbitrary units)

Diagram 5. Relative abundance of GLR (glucagon receptor) mRNA in rat tissue. * indicates less than detectable level.

Indicate whether the following descriptions are **CORRECT**.

(6 marks)

- A. Liver expresses the largest amount of GLR because it is working as one of the major organs that uptake and store glucose in response to glucagon.
- B. A lack of mRNA detection in brain tissue indicates that neural tissue in the brain does not require much glucose as a nutrient.
- C. Skeletal muscle is a major tissue for glucose metabolism but not a major glucose storage site which explains why it lacks GLR and therefore the ability to supply glucose to other cells/tissues through the bloodstream.
- D. Adipose tissue, which has high levels of expression of GLR, is the most important energy source during starvation.

6. Three-spined stickleback Gasterosteus aculeatus are widely distributed in both marine and freshwater areas across the world. Adaptive radiation has led to morphological differences between marine and freshwater populations. Of such differences, all of the marine population have a pair of pelvic spines that evolved from the pelvic skeleton, while some freshwater populations of various localities have lost their spines (Diagram 6). Genetic analyses revealed that the causative genomic region for this pelvic difference is located around the *Pitx1* gene. This *Pitx1* plays an important role in the development of the ventral spine, thymus, and neuromast. Although the amino acid sequences of *Pitx1* transcripts are identical in both populations, the expression patterns of *Pitx1* in the pelvic fin buds of embryos are different: *Pitx1* is expressed in the marine population (purple), while it is not in the freshwater population (Diagram 6 insets).



Diagram 6. Ventral view of marine (left) and freshwater (right) sticklebacks, showing the presence/absence of pelvic spines (shown by dark blue). Anterior is to up. (Boxes)Magnified ventral view of stickleback embryos showing *Pitx1* expressions in the pelvic fin buds.

Indicate whether each of the following statements is **FALSE**. (4 marks)

- A. The freshwater population without pelvic spines independently have likely evolved from the marine population with pelvic spines.
- B. Pelvic spines can function to protect the marine population against predators.
- C. The *Pitx1*-knockout individual of the marine population are likely to show similar phenotypes to those of the freshwater population.
- D. The presence/absence of *Pitx1* expression in the pelvic fin buds of embryos may result from the difference of enhancer sequences that control the gene expression.

Chemistry

- 1. The following cell produces $E_{cell} = 1.5$ V at 30°C and 1 atm.
 - $\begin{array}{l} Pt(s) |VO^{+}(aq, 1.3 \, M), VO_{2}^{+}(aq, 0.75 \, M), OH^{-}(aq, pH = \\ 10) ||BiO_{3}^{-}(aq, 0.56 \, M), OH^{-}(aq, pH = 10) |Bi_{2}O_{3}(s)|Pt(s) \end{array}$

Given that the E° for the conversion of VO₂⁺ to VO⁺ under basic condition is -0.902 V, what is the E° for the conversion of Bi₂O₃ to BiO₃⁻ under the same condition? $(F = 96\,485\,\mathrm{C\,mol^{-1}}; R = 8.314\,\mathrm{J\,K^{-1}\,mol^{-1}})$ (3 marks)

(4 marks)

- A. $+0.298~\mathrm{V}$
- B. +0.478 V
- C. -0.298 V
- D. -0.478 V
- 2. What are the possible products for the reaction below?



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3. Greenhouse gases are gases that absorb infrared radiation and trap heat. In order for a vibrational mode to absorb infrared light, it must result in a periodic change in the dipole moment of the molecule. For instance, CO₂, which is a common greenhouse gas, has several vibration modes that enable it to absorb infrared radiation (IR active), as these vibration modes change the dipole moment of the molecule.



Which of the following molecules possesses more vibrational modes than CO_2 ? (4 marks)

- A. HCl
- B. O_3
- C. NO
- D. XeF_2
- 4. Rearrangement reaction is a type of organic reaction that involves the movement of a particular substituent within a molecule to produce a different carbon skeleton. Fries rearrangement is one such example, which involves the rearrangement of phenyl ethanoate catalysed by a Lewis acid such as AlCl₃. What is the product of Fries rearrangement of the compound below?



¹H-NMR spectrum of product:

 $8.5~{\rm ppm}$ (s,1H), 7.915 ppm (d, 2H), 6.974 ppm (d, 2H), 2.593 ppm (s, 3H)

(Please refer to this table on page 6.)

(6 marks)



5. Porphyrins are widely available in nature, be it as photoactive dyes, enzymatic cofactors, signaling substances, or electron shuffles. In the human body, porphyrin is an important molecule for the synthesis of heme, where it acts as a macrocyclic ligand and chelates with Fe. The figure below shows the chemical structure of compound A, one of the key intermediates in heme synthesis. What is the oxidation number of Fe in compound A?



Compound A

(3 marks)

- A. +1
- B. +2
- C. +3
- D. +4

6. The Statistical Review of World Energy has estimated the world total energy consumption to be 6.44×10^{20} J, out of which 29.6 percent is from oil products.

Bond	H-H	C-H	C - C	C = O	0=0	H-O
Bond energy $(kJ mol^{-1})$	436	412	348	743*	497	463
$^{*}C = O$ bond energy in CO_2 is 799 kJ/mol.						

Assuming that the main component of oil products is octane, C_8H_{18} (molar mass = 114 g/mol), and that 70 percent of the energy by full combustion of octane is utilized, calculate the mass (in tonnes) of octane reacted annually.

 $(1 \text{ tonne} = 1000 \text{ kg} = 10^6 \text{ g})$

(5 marks)

- A. 4.31×10^9
- B. 6.16×10^9
- C. 5.40×10^{10}
- D. 8.21×10^{10}

Physics

1. A ball is projected at an angle 50° on a slope with inclination $\phi = 20^{\circ}$. Find the distance travelled, r by the ball down the slope. Neglect air resistance. Take $g = 9.81 \text{ m/s}^2$.



Figure 1. Projectile ball from a slope.

(3 marks)

A. 13.9 m	B. 35.3 m	C. 40.2 m	D. 61.3 m

- 2. An emission line of wavelength $\lambda = 600$ nm was observed in the spectrum of a white dwarf. Assuming that it originates from the interaction of an electron with a magnetic field, calculate the magnetic flux density of the field. (3 marks)
 - A. 3 kT B. 18 kT C. 3 mT D. 18 mT
- 3. A point charge +Q = 0.32 nC is placed a distance h = 70 cm directly above an infinite plane. The magnitude of the electric flux through this plane is denoted as Φ_1 .



Figure 2. The horizontal plane is infinite, whereas the orange strip is also infinite in extent laterally.

The midline (dotted white) of an infinite strip of width t = 10 cm is a distance d = 20 cmhorizontally away from the point charge. If the flux through this infinite strip has magnitude Φ_2 , find the ratio Φ_1/Φ_2 . (4 marks)

- A. 19.7 B. 23.8 C. 36.2 D. 40.7
- 4. An experiment was set up in which a uniform rod of mass M = 2.0 kg and length L = 1.0 m is suspended on both ends by two light strings of length l = 2.0 m vertically from the ceiling. Fizix decided to set the rod into motion in two ways: (a) he nudges the rod slightly in a direction parallel to the rod, (b) he nudges one end of the rod slightly in a direction perpendicular to the rod. In the latter case, the rod rotates about the vertical axis. If the period of oscillation in case (a) is T_1 and that in case (b) is T_2 , find the ratio T_2/T_1 . (In a single oscillation, the rod moves away from and back to its displaced position.) (5 marks)



Figure 3. Two ways of setting the rod into motion.

- A. 0.873 B. 1.41 C. 1.00 D. 0.577
- 5. A rope of length $L = 2.0 \,\mathrm{m}$ and linear mass density of $\lambda = 0.25 \,\mathrm{kg}\,\mathrm{m}^{-1}$ is initially draped over a ramp inclined at an angle $\theta = 50^{\circ}$.



Figure 4. Pulling a rope down a ramp.

Initially, both ends of the rope are of equal distance from the tip of the ramp. Subsequently, end A is pulled such that the rope moves at a constant speed $v = 0.20 \,\mathrm{m \, s^{-1}}$ down the ramp. The surface of the ramp is rough and has a coefficient of friction $\mu = 0.14$. Find the magnitude of the total *net* force F acting on the rope when end A is 1.5 m away from the tip of the ramp. (5 marks)

<u>**Hint:</u></u> Is there a way to calculate F without calculating any forces?</u>**

A. 7.4 mN B. 11.3 mN C. 18.8 mN D. 24.9 mN

6. A stationary light source S is placed at a distance L = 10 m away from a stationary receiver R. If the light source S and receiver R are immersed in fluid with refractive index n = 1.50, what is the time taken for light emitted by the light source to reach the receiver in the frame of light source if the fluid is travelling at a velocity v = 0.6c in the direction of the line joining S and R?

(Take the speed of light in vacuum as $c = 3.0 \times 10^8 \,\mathrm{m \, s^{-1}}$.) (5 marks)

A. 33.3 ns B. 36.8 ns C. 50.0 ns D. 300

Mathematics

1. Given triangle ABC, D is a point on side BC such that

$$\angle ABC : \angle ACB : \angle BAD : \angle CAD = 5 : 2 : 1 : 4$$
Determine $\frac{BC}{AD}$.
(3 marks)
A. 1
B. $\sqrt{2}$
C. $\sqrt{3}$
D. 2

2. What's the smallest positive integer that has at least 2024 digits and cannot be expressed as the sum of two perfect squares? (Note: 0 is considered a perfect square.) (3 marks)

A. $10^{2024} + 1$ B. $10^{2024} + 2$ C. $10^{2024} + 3$ D. $10^{2024} + 5$

3. Determine the sum of digits of all numbers from 1 to 1001 that does not include the digit 2.

(4 marks)

- A. 10449 B. 10452 C. 12900 D. 12903
- 4. Let x be the number of ways to choose 4 (not necessarily distinct) positive integers a, b, c, d, such that a + b + c + d = 2025 and each of a, b, c, d contains the digit '1'. Calculate the remainder when x is divided by 4. (4 marks)
 - A. 0 B. 1 C. 2 D. 3
- 5. Let α be the largest root of the equation $x^2 5x + 1$. Determine the remainder when $\alpha^{48} + \frac{1}{\alpha^{48}}$ is divided by 101? (5 marks)
 - A. 25 B. 66 C. 78 D. 94
- 6. Given triangle ABC with AB = 4, BC = 5, CA = 6. Suppose the incircle of ABC meets BC, CA, AB at D, E, F. Let circle passing through A, E, F meets the circle passing through A, B, C at two points A and J. Let the line EF intersect the line BC at K, and the circle passing through D, J, K meets the circle passing through ABC again at L. Determine $\frac{BL}{CL}$.

(6 marks)

A.
$$\frac{2}{5}$$
 B. $\frac{17}{40}$ C. $\frac{3}{7}$ D. $\frac{8}{19}$

Earth Science

1. Which soil property is primarily responsible for determining a soil's cation exchange capacity (CEC), an important indicator of its fertility and ability to retain essential nutrients?

(3 marks)

- A. Texture
- B. Temperature
- C. Structure
- D. Organic matter content
- 2. Which of the following factors plays a significant role in determining the climate of a region?

(5 marks)

- A. Proximity to the equator
- B. Altitude above sea level
- C. Distance from a large body of water
- D. All of the above
- 3. Marine biologists are studying the migration patterns of sea turtles in the Pacific Ocean. They notice that sea turtles tend to follow certain routes across the ocean. They hypothesise that these routes are influenced by ocean currents. To test this, they plan to release tracking devices into the ocean at different locations and observe the movement of the devices over time.

Which of the following locations would be most suitable for releasing tracking devices to test the influence of ocean currents on sea turtle migration routes? (4 marks)

- A. Near the equator
- B. Near a major ocean gyre
- C. Near a coastal upwelling zone
- D. Near the North or South Pole

4. TRAPPIST-1d is an exoplanet orbiting a red dwarf star. The physical parameters of the stars are as follow:

\mathbf{Mass}	$0.089~{\rm M}_\odot$
Radius	$0.12~\mathrm{R}_{\odot}$
Temperature	2600 K

In comparison to the Sun, which has a surface temperature of 5800K, the host star of TRAPPIST-1d is only half as hot! However, TRAPPIST-1d receives the same rate of energy from its star as Earth does from the Sun, hence it is considered to be habitable. Calculate the distance between TRAPPIST-1d and its host star given that the solar constant (flux received by Earth from the Sun per square metre) is $1400 \,\mathrm{W m^{-2}}$. (5 marks)

Tips:

- Luminosity (Total flux energy given out by a star) = $4\pi R^2 \sigma T^4$, where σ is the Stefan-Boltzmann's constant = $5.67 \times 10^{-8} \,\mathrm{W m^{-2} K^{-4}}$
- Mass of Sun, $M_\odot = 1.99 \times 10^{30} \, \rm kg$
- Radius of Sun, $R_{\odot} = 6.96 \times 10^8 \,\mathrm{m}$
- A. $1.9 \mathrm{Gm}$
- B. $3.6~\mathrm{Gm}$
- C. 13.0 Gm
- D. 74.5 Gm
- 5. Twilight is classified as civil, nautical and astronomical. Astronomical twilight ends when the centre of the Sun is 18° below the horizon. An observer is at a latitude of 30°. What is the duration of the astronomical twilight if the date is 21st of June? (5 marks)

Hint:

You may find the spherical trigonometry formula below useful:

 $\cos a = \cos b \cos c + \sin b \sin c \cos A$

- A. 1.20 hr
- B. $1.68~{\rm hr}$
- C. 3.20 hr
- D. $8.65\ \mathrm{hr}$

6. Let's have a look at the diagram below:



Don't be traumatised by this adult connect-the-dots, this is part of a star map used by International Astronomy Olympiad (IAO) and International Olympiad on Astronomy and Astrophysics (IOAA) Malaysian representatives to practise on their observation skills. In fact, every single dot in the image represents a star in the sky! Is the observation made in the northern hemisphere? (3 marks)

Hint:

You may start by locating the Big Dipper, it points to the north celestial pole.

- A. Yes
- B. No
- C. Insufficient information is provided.

Social Science

1. Consider the following chart:



What does this chart most likely represent? The X-axis is time from 1 to 2018 AD.

(3 marks)

- A. Gross domestic product per capita
- B. Level of inequality as measured by the wealth distribution for each country
- C. Gross domestic product
- D. Level of freedom in the market
- 2. Which of the following is the best example of a natural monopoly? (3 marks)
 - A. A farm
 - B. A residential power supply company
 - C. A piano teacher giving private lessons
 - D. A petroleum extraction company

3. There is a financial crisis. Liquidity shortages or bank failures can cause financial crises. There are sufficient loans and cash on hand. Hence, some banks must be failing.

Which of the following most closely parallels the logic of the above argument? (4 marks)

- A. The Malthusian trap says that population growth will surpass food production periodically reducing the population. The Malthusian trap is not true. Famine, war or disease do reduce population. Hence, technological innovation must be why the Malthusian trap is not true.
- B. Accemoglu and Robinson say that some former European colonies were among the richest civilisations in 1500, but this has now reversed. This reversal is caused by either changes in the abundance of natural resources in these countries over time, or imperialist nations imposing extractive institutions. We know that some regions now with the same abundance of natural resources are at very different levels of economic development, so imperialist nations must have imposed extractive institutions.
- C. A consumer increases their monthly consumption of discount clothing. This is due to the substitution effect and income effect. As discount clothing is an inferior good, the substitution effect is positive but the income effect is negative.
- D. The Kuznets curve says that as an economy develops past a turning point, it will see falling economic inequality. In theory, farmers moving into industry and rural-urban migration can cause this falling inequality. Inequality has risen in most developed countries since the 1960s. Hence, farmers must not have moved into industry.

Extra info:

- Substitution effect: A consumer replaces a good for another good that has become relatively less expensive due to a change in prices.
- **Income effect:** A consumer changes their demand for a good due to a change in real disposable income.
- 4. The government is concerned about the fossil fuel consumption in Country X and wishes to reduce carbon emissions. One of the policies the government uses to address this issue is implementing a price ceiling on home solar panels. Before the new price ceiling is imposed, a monopolistic home solar panel manufacturing firm operates under the following conditions:

$$Q_D = 1000 - 2P$$

 $TC = 150 \ln(1+Q) + 50Q$

The government sets the price ceiling at $P_{Ceiling} = 200$.

Calculate the rise in quantity demanded for the firm's home solar panels after the new price ceiling is imposed. Assume that before the price ceiling, the firm was selling at the profit-maximising price. (6 marks)

А.	549.67	С.	450.33
В.	349.67	D.	150.33

Questions 5 and 6 are based on this dataset. Listed below are sentences in Language X and their English translations.

Language X	English Translation
utfàblortut	I will do my assignment.
lorditfabet	He has done your assignments.
udfàblortet	We will do his assignment.
etfablortut	She is doing my assignment.
edfablordud	They are doing our assignments.
itfàblorded	You will do their assignments.
lortetfabid	You all had done her assignment.

- 5. Translate "I am doing her assignments." into Language X. (4 marks)
 - A. itfablorded
 - B. etfàblortit
 - C. utfablordet
 - D. udfàblordet

6. Translate "They had done your assignment." into Language X. (5 marks)

- A. udfàblordud
- B. lortitfabed
- C. lorditfàbud
- D. lortidfabet

Answers

Biology Mathematics 1. B 1. D 2. C 2. B 3. D 3. B 4. D 4. A 5. D 5. C 6. C 6. C

Chemistry

1. D	1. D
2. C	2. D
3. B	3. В
4. A	4. B
5. B	5. B
6. B	6. A

Physics

1.	D	1.	A
2.	В	2.	E
3.	В	3.	E
4.	D	4.	D
5.	C	5.	С
6.	В	6.	E

Earth Science

Social Science

- A
- В
- В
- D
- С
- В

Biology

1. **Q1** is sourced from:

Save My Exams Ltd. Structure of nucleic acids & replication of DNA (CIE A Level Biology) [Internet]. 2024 [cited 2024 April 10]. Available from: https://www.savemyexams.com/ a-level/biology/cie/25/topic-questions/6-nucleic-acids-and-protein-synthes is/6-1-structure-of-nucleic-acids-and-replication-of-dna/multiple-choice-q uestions/#hard

2. **Q2** is sourced from:

Save My Exams Ltd. Antibiotics (CIE A Level Biology) [Internet]. 2024 [cited 2024 April 10]. Available from: https://www.savemyexams.com/a-level/biology/cie/25/topic-q uestions/10-infectious-diseases/10-2-antibiotics/multiple-choice-questions /#hard

- 3. **Q3 and Q4** are adapted from: International Biology Olympiad (IBO) 2021.
- 4. **Q5 and Q6** are adapted from: International Biology Olympiad (IBO) 2020.

Earth Science

- 1. **Q4** is adapted from: MOAA Academic Council. MOAA 2024 Example Sheet 1. 2024.
- Q5 is sourced from: Roy AE, Clarke D. Astronomy Principles and Practice. 4th ed. Bristol: Institute of Physics Publishing; 2003.

Social Science

1. The image in Q1 is sourced from: Our World in Data. Data Page: GDP per capita [Image on the internet]. United Kingdom; 2020 [cited 2024 April 11]. Available from: https://ourworldindata.org/grapher/gdp -per-capita-maddison?tab=chart&country=CHN~EGY~FRA~IND~IDN~IRN~JPN~MEX~PER ~GBR~USA#sources-and-processing