RAQ2+

Mathematics
IGSCE Practice
Standard Paper

Scores recorded until: 5 December, 2024

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- You are permitted access to any calculator for this paper.
- Give non-exact numerical answers correct to **3 significant figures**, or **1 decimal place**.
- The total mark for this paper is 63.
- The marks for **each** question are shown in brackets.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- You must **show all your working**.

Advice to candidates

- Read each question carefully before you start to answer it.
- Check your answers at the end of each question.

For Examiner's Use	
Question	Mark
TOTAL	

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1 The most famous type of lottery is Powerball.

To win the jackpot, a candidate must pick the correct 5 numbers from a set of 69 white balls and the correct single number from 26 red balls.

(a) Work out the probability of winning the jackpot in Powerball.

(3)

Answer = ...

The average reward of hitting a Powerball jackpot is £141 million.

Powerball costs £2 per play.

(b) Work out the theoretical loss of a candidate after they win the jackpot.

(2)

Answer = £ .....

(c) State why this lottery benefits its regulators more than its players.

(1)

.....

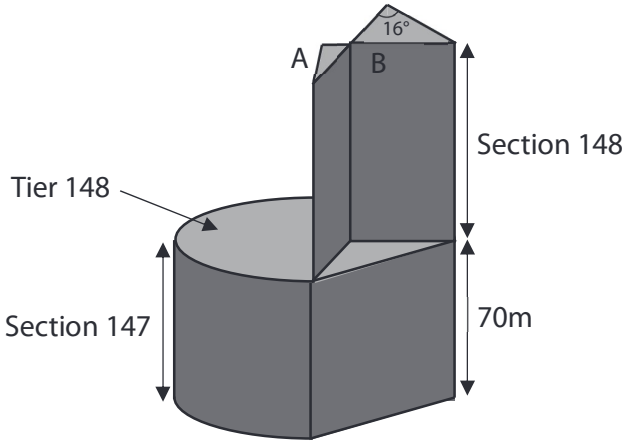
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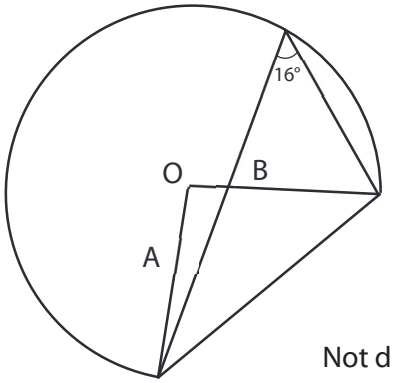
2 Tiers in architectural design refer to different layers in a building, where each section is progressively smaller compared to the one below, creating a stepped appearance.

The Burj Khalifa skyscraper includes many tiers in its design.

Section 147 and 148:



Tier 148:



Not drawn accurately

Section 147 and 148 are prisms with the same cross-sections throughout.

(a) Calculate the volume of Section 147 where A and B are radii of an imaginary circle, each measuring 7.5m.

(5)

Answer = ... m^3

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The three bottom circle tiers of the Burj Khalifa have equations.

Tier 1 circle has equation $x^2 + y^2 + 24y + 139 = 0$
Tier 2 circle has equation $x^2 + y^2 - 4x + 8y + 16 = 0$
Tier 3 circle has equation $x^2 + y^2 + 4x - 8y + 19 = 0$

S_1 is a tangent to the Tier 1 circle at the point $(-2, -13)$
S_2 is a tangent to the Tier 2 circle at the point $(2, -6)$
S_3 is a tangent to the Tier 3 circle at the point $(-2.6, 4.8)$

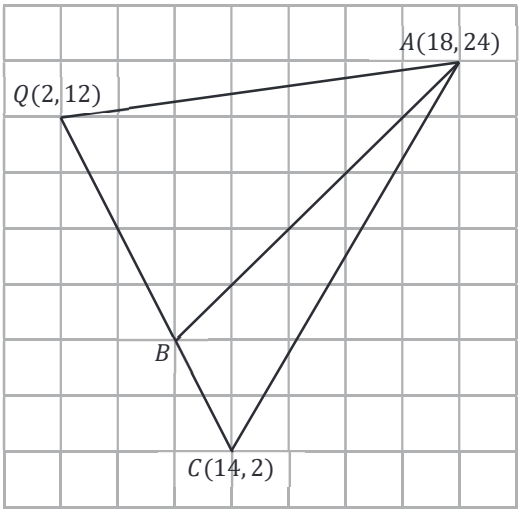
(b) Find the coordinates where structures S_1, S_2, S_3 intersect.

(12)

Answer = (..... , ...)

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3 This diagram shows an inaccurate map grid of an island.



The grid does not align with the coordinates of the corners of the island.

Point B lies on line QC such that $QB : BC = 3 : 1$.
Line BA represents the border of the island.

Work out the length of the border of the island, BA.

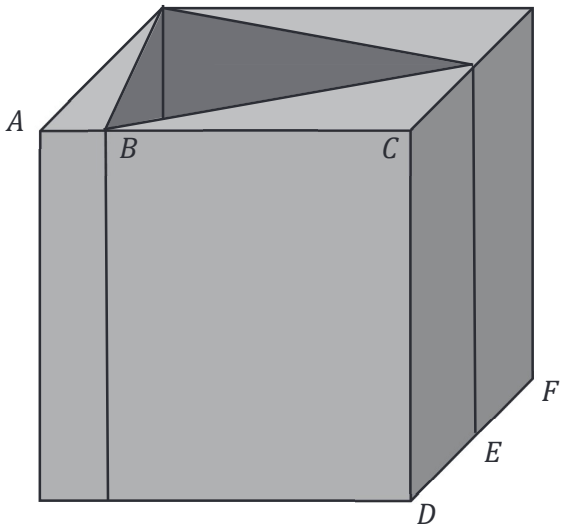
(4)

Answer = ...

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4 A cube has side length $4x$.

Harry cuts a hole through the cube in the shape of a triangular prism.



E is the midpoint of DF.
$AB : BC = 1 : 3$

Work out the volume of the cube that was cut out in terms of x.

(6)

Answer = ...

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5 Lucas is running a race.

He runs the first 800 m at x m/s.
He then slows down by 3 m/s for the final 400 m.
His total time is 130 seconds.

Work out the value of x.

(4)

Answer = ...

6 Factorise $6(y + 3)^5 + 4(y + 3)^4$ fully, giving your answer in its simplest form.

Do not attempt to expand $(y + 3)^5$ or $(y + 3)^4$

(3)

Answer = ...

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7 Solve $\frac{4}{x-3} + \frac{3x-3}{x^2-x-6} = \frac{2-20x}{2x+4}$

(5)

Answer = ... , ...

8 An engineer needs to record the number of cars, c, to correctly use the formula for calculating the red-light duration.

Below shows an equation representing a road, that can be used to find out the number of cars, c.

$9^{0.5c} \times 81 = 27^{2c-2}$

(a) Work out how many cars are at the red light.

(4)

Answer = ...

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The average gap, g, between cars, in metres, can be calculated using the function

$$f(a,c) = \frac{a^2 - 2ac + c^2}{a^2 - c^2} \div \frac{a^2 + ac}{a^2 + 2ac + c^2}$$

where a is the average acceleration of all the cars approaching the red light,
and c is the number of cars.

The average gap between the cars on the road is 3 m.

(b) Using your answer from above, work out the average acceleration, a, of the cars.

(5)

Answer = - ..... m/s^2

Below shows a function for calculating the duration of a red light in seconds.

$$d(a,c,g) = \frac{c^2 - acg + \sqrt{cg + a}}{c^2 - g^2} \div \frac{a^2 + ac}{\sqrt{ag^2 + acg + g^2}}$$

(c) Using the given and found information, work out the duration of the red light.

(3)

Answer = ... seconds

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9 In a factory, 2 different machines process different raw materials, each with a different sequence of steps to produce a final product. a is the initial mass of the raw materials, and b is the mass of the final product after processing.

Machine 1 Process:

Step 1 compression of raw material, resulting in its mass being squared.

Step 2 reinforcement of material, increasing its mass by 3.

Step 3 density adjustment of material, resulting in its mass being multiplied by k.

Machine 2 Process:

Step 1 density adjustment of raw material, resulting in its mass being multiplied by k.

Step 2 durability increase of material, resulting in its mass being squared.

Step 3 coating is applied to material, increasing its mass by 3.

Work out an expression for a in terms of k, giving your answer in its simplest form.

(6)

Answer = ...

END OF QUESTIONS

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