



**AKADEMEIA
HIGH SCHOOL**

Student's name	
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For Examiner's Use

Examiner's Initials

**academic potential test
for future A-level students 2020**

Time allowed: 90 minutes

Instructions:

- Use black ink or black ball-point pen.
- Answer all questions.
- You are allowed to use a calculator.
- Unless otherwise stated in a question, all numerical answers must be given either exactly or correct to 3 significant figures.

Information:

- The test consists of a few sections.
- Note that the last section is for students who consider doing Further Mathematics in A-levels.

Questions	Mark
1-4	/17
5-7	/10
8-10	/7
11-14	/13
15-17	/8
(*)18-24	/18
total Standard	/55
total Advanced	/73
SL score	
AL score	



ARITHMETIC & ALGEBRA

Q1. [8 marks]

Express in terms of a . Give your answer in exact form.

Q1.1 $\sqrt[3]{a^{-2}a^8}$

Q1.2 $\sqrt{a^6 \times \left(1\frac{1}{3}\right)^{-2}}$

Q1.3 $\left(\frac{1}{4}a^{-2}\right)^3 \div \left(\frac{1}{2}a^{-3}\right)^4$

Q1.4 $\frac{(2a)^8(4a^2)^7}{(16a^3)^8 \div (-8a)^3}$

Q2. [2 marks]

Find the number whose 22% is equal 75. Give your answer to 2 decimal places.



Q3. [3 marks]

Rationalize the denominator of the following fractions. Show your workings fully.

Q3.1 $\frac{\sqrt{8}-4}{\sqrt{2}}$

Q3.2 $\frac{2a\sqrt{3}+a}{\sqrt{3}-2}$

Q4. [4 marks]

Expand and leave the answer in simplest form.

Q4.1 $(4x + \frac{1}{2})^2$

Q4.2 $(a - b + ab)^2$

Q4.3 $(a\sqrt{2} - 3)(a\sqrt{8} + 1) - (2a)(2a - 2\sqrt{2})$



STATISTICS & PROBABILITY

Q5. [3 marks]

A fair cubic dice and a fair coin are tossed once. On one side of the coin there is a number 1 and on the other side there is a number 2. What is the probability that the sum of outcomes is larger than 4?

Q6. [4 marks]

Consider four **different** whole numbers that have the following properties:

- their range is 6,
- their median is 7,
- their mean is 7.5.

Find the numbers.

Q7. [3 marks]

In a group of 20 students 14 learn French, 9 learn German and 2 do not learn any of the two languages. A student is chosen at random from the group. What is the probability that he learns both French and German?



EQUATION OF A LINE

Q8. [2 marks]

Consider the points $(-3, 4)$ and $(1, -3)$.

Q8.1 Find the gradient of the line passing through the points.

Give your answer as an exact fraction.

Q8.2 Find the distance between the points.

Q9. [3 marks]

Find the equation of a line perpendicular to $y = 1.5x + 2$ and passing through point $(6, -1)$.

Give your answer in the form $Ax + By + C = 0$, where A , B and C are integers.

Q10. [2 marks]

Find the area of the triangle bounded by the line $y = \frac{2}{3}x - 3$ and the coordinate axes.



EQUATIONS & INEQUALITIES

Q11. [3 marks]

Find the set of common solutions of the following inequalities.

$$7 - 2x > 0 \quad \text{and} \quad 5x + 10 \geq 0 \quad \text{and} \quad |x| < 1$$

Q12. [7 marks]

Solve the equations and inequalities. Give all answers in simplest form.

Q12.1 $x^2 + 7x - 8 = 0$

Q12.2 $\frac{x-1}{3} = \frac{2}{x-1}$

Q12.3 $x + \frac{6}{x} = 7$



Q12.4 $x^2 = 5x$

Q12.5 $|x + 1| = 3$

Q12.6 $x^2 - 2x < 3$

Q13. [1 marks]

Make r the subject of the formula $F = G \frac{m_1 m_2}{r^2}$.

Q14. [2 marks]

Solve the following equations simultaneously.

$$5x + 4y = 6 \quad \text{and} \quad 3x - 2y = 8$$



TRIGONOMETRY

You may like to use the cosine rule in this section: $c^2 = a^2 + b^2 - 2ab \cos C$.

Q15. [3 marks]

In triangle ABC the sides AB and BC are 6 and 4 respectively. The angle at A is 35° . Find the measure of the angle C .

Q16. [2 marks]

Find the measure of the smallest angle in the triangle with sides 3, 5 and 7.



Q17. [3 marks]

Q17.1 Find the obtuse angle B such that $\sin B = \sin 40^\circ$.

Q17.2 Find an angle C such that $\cos C = -\sin C$.

Q17.3 D is an acute angle ($0^\circ < D < 90^\circ$). Find the exact value of $\cos D$ if $\sin D = \frac{2}{3}$.

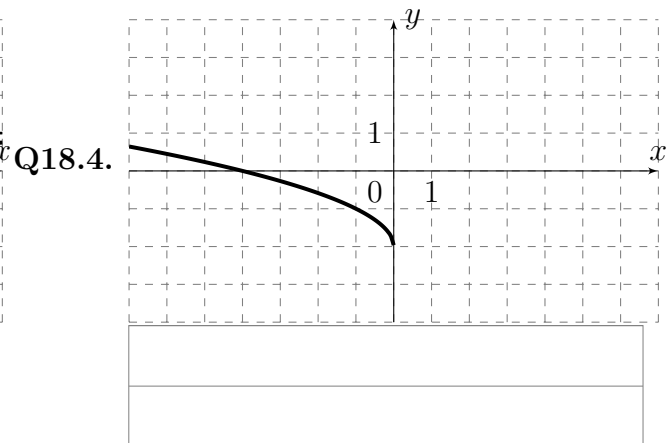
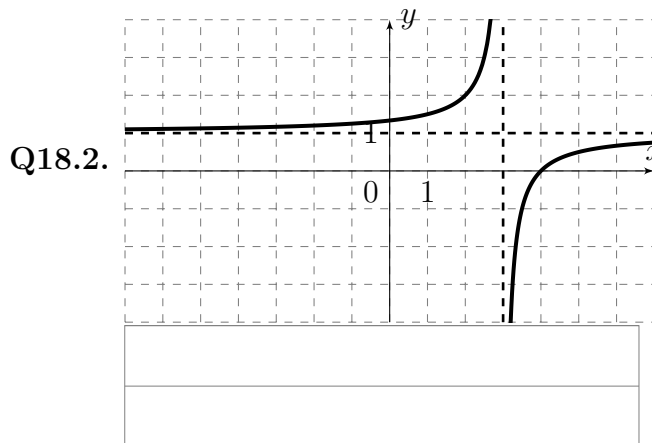
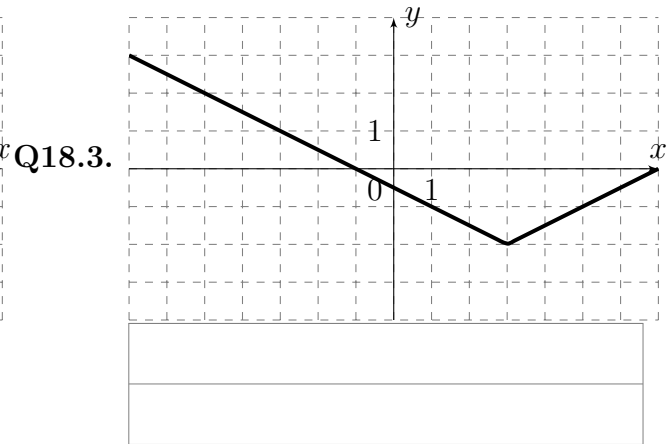
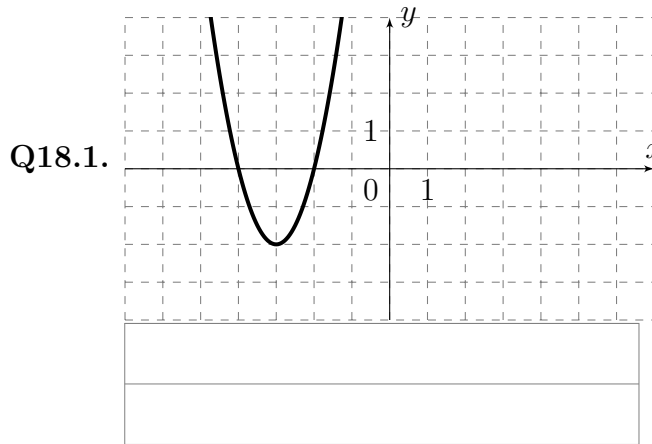
*For candidates who consider doing A Level Mathematics
but not Further Mathematics the exam finishes here.
An additional section for students considering
Further Mathematics starts on the next page.*



ADVANCED PART

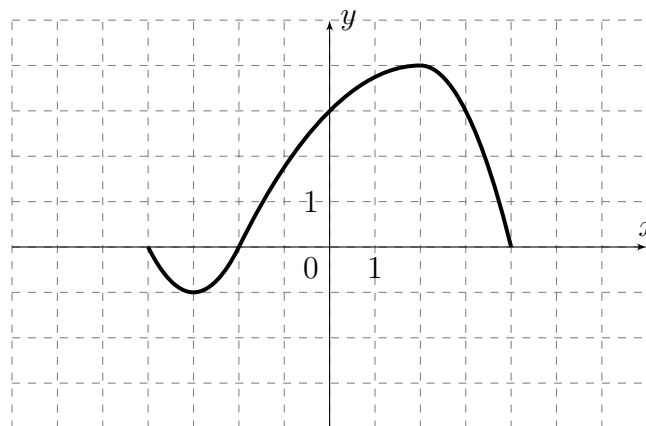
Q18. [4 marks]

Write down an equation of each of the curves shown below.



Q19. [3 marks]

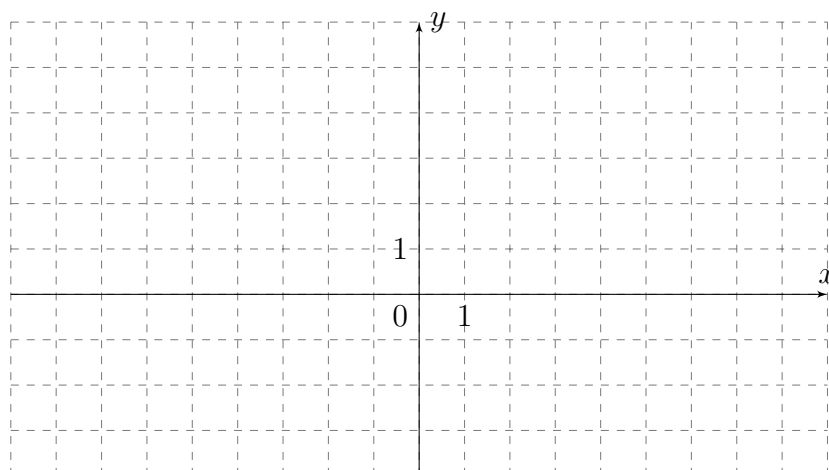
Consider the graph of the function $y = f(x)$ shown below.



In the diagrams on the next page sketch the graphs of the curves with given equations.

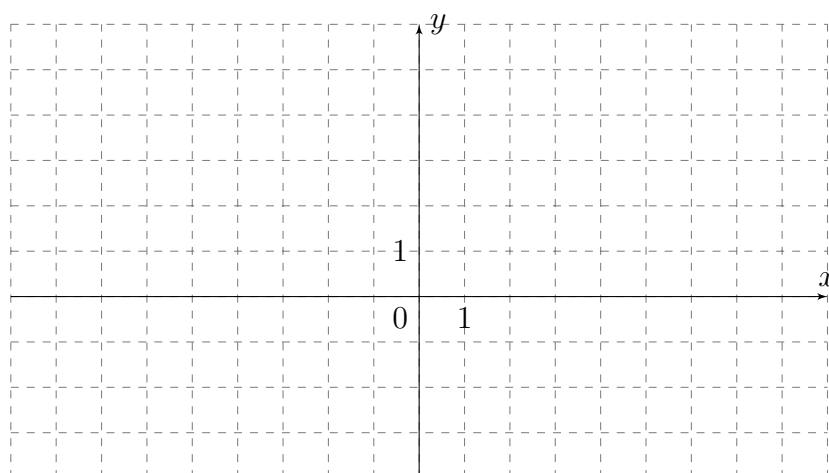


Q19.1.



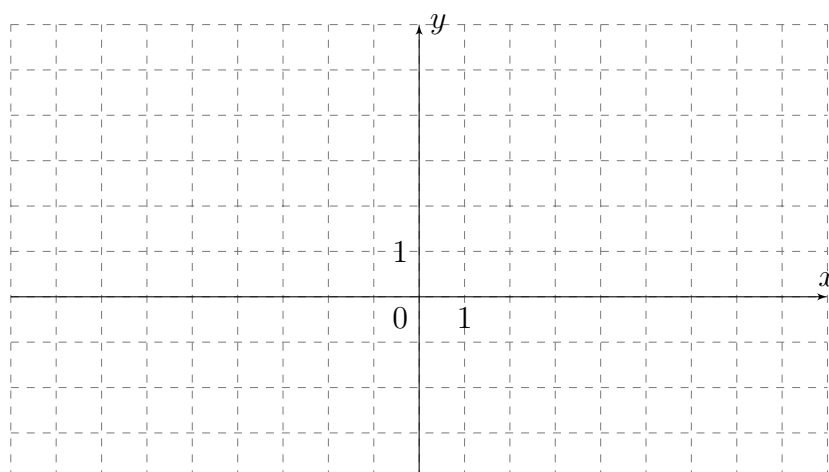
$$y = \frac{1}{2}f(x)$$

Q19.2.



$$y = f(2x)$$

Q19.3.



$$y = f(x + 2)$$



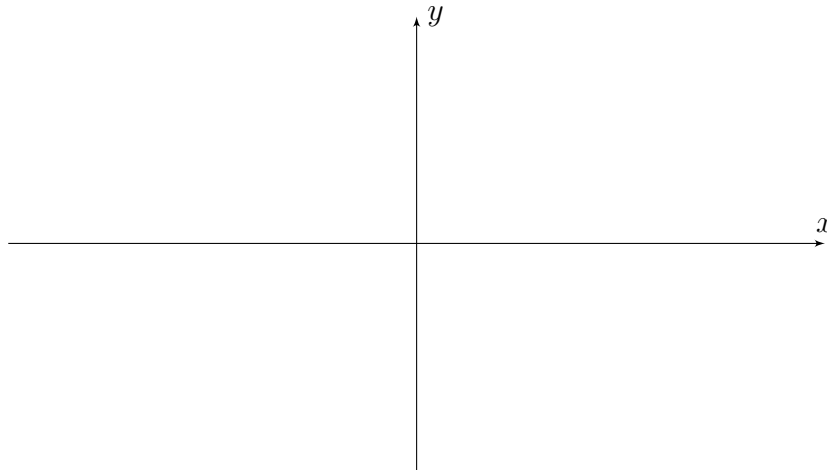
Q20. [2 marks]

Sketch the graph of

$$y = x^2(x - 1)(x - 2)$$

and hence or otherwise solve the inequality

$$x^2(x - 1)(x - 2) < 0.$$



Q21. [3 marks]

Which of the numbers is larger?

Q21.1. $\log_{(a^2)}(a^3)$ or $\log_{(a^3)}(a^2)$

Q21.2. $\left(\frac{1}{2}\right)^x$ or $\left(\frac{1}{2}\right)^{x+1}$

Q21.3. $\log_a b$ or $\log_{(2a)} b$ when $a > 1$



Q22. [1 marks]

Find the distance of the centre of the circle $(x + 6)^2 + (y - 8)^2 = 11$ from the origin.

Q23. [3 marks]

Find the coordinates of the points where the circle $(x - 2)^2 + (y + 8)^2 = 100$ intersects the x -axis.

Q24. [2 marks]

What is the constant term of the expansion $(x + \frac{2}{x})^6$?

