OCR
Oxford Cambridge and RSA

A LEVEL

MATHEMATICS A

H240
For first teaching in 2017

Exam hints for students

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General exam skills

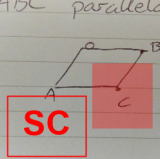### Crossing out

$V = 100\sin 25 + 9.8 \times 4.94$

$v = 35.18$

Cross out mistakes and rewrite your answer. Trying to correct an answer by writing over it can make it unclear and may lose you marks.

Clear working

Show clear working for calculations. You may still gain marks for valid mathematical workings even if the final answer is incorrect.

Layout

Try not to include too many calculations in a single line of working. This will make your workings more difficult to read which could cause you to introduce errors.
Method marks can only be awarded for valid mathematical expressions.

Rounding and accuracy

$\dfrac{\sin 36}{13.5} = \dfrac{\sin x}{8.2}$

$\dfrac{8.2 \sin 36}{13.5} = 0.36$

$x = \sin^{-1}(0.36) = 21.1°$

It's always more accurate to round once, for the final answer, and work with unrounded values on the calculator.
Give final answers to 3 significant figures unless stated otherwise.

Simplify

Simplify fractions, algebraic expressions, logarithms and surds when giving final answers even when the question does not explicitly ask you to do so.

Sign errors

Double check all algebraic manipulation as it is easy to make errors with signs when multiplying out brackets.

Calculator checking

Avoid arithmetic errors by checking with a calculator, for example, that the decimal approximation given by the calculator matches your 'exact' answer.

Calculator use

(a) Calculate an estimate of the mean time per day

Write down any expressions or variables, including standard deviation, that you use the calculator to evaluate as well as the values of any parameters or variables that you input. It is also good mathematical practice to write down the calculations that you solved using your calculator. If the answer is wrong due to an error in calculator input, the examiner may still award method marks.

Mathematical notation

(b) Give details of a sequence of two transformations

Use the correct mathematical notation and terminology rather than 'calculator notation' or informal descriptions. Incorrect notation may result in loss of marks.

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Answer the Q being asked

(a) Find an expression for θ in terms of r.

7(a)
$$\frac{1}{2} r^2 \theta = 36.288$$
$$r^2 \theta = 72.576$$
$$r^2 = \frac{72.576}{\theta}$$
$$r = \sqrt{\frac{72.576}{\theta}}$$

Read the question carefully to make sure your answer is indeed what the question is looking for. It is also good practice to check that your answer fits the context of the question.

No extra responses

(d) Explain why a country like Germany, with a higher median age than Cyprus, might also be expected to have a higher crude death rate than Cyprus. [1]

Germany has a much larger population than Cyprus and therefore which will have more death (crude death rate) Also, the median age of germany is higher so Germany has an older population. Elderly people are ax more likely to die increasing crude death rate **B0**

If correct responses are contradicted, marks can be lost. Avoid writing down everything you can think of; state only what is relevant.

Draw a diagram

Drawing a diagram may help you get started on a problem and the evidence in your diagram may help to secure marks. A visual aid can also prompt you to check that all possible solutions have been identified.

In context

(a) Find Sam's salary in the tenth year. [2]

B1

4(a) $a_1 = 16000 \quad a_2 = 17200 \quad d = 1200$
$a_{10} = 16000 + 1200(9) = 26800$ **B0**

If questions are set in a context then make sure your response is also in context when:
- offering explanations,
- discussing assumptions,
- suggesting improvements, or
- selecting appropriate units to express the answer in.

Quadratic equations

$3\cos^2\theta + 5\cos\theta - 2 = 0$
let $X = \cos\theta$
$3X^2 + 5X - 2 = 0$
$X = \frac{1}{3}, -2$
$\cos\theta = \frac{1}{3} \qquad \cos\theta \neq -2$
$\theta = 1.23, 5.05$

Calculators can be used to solve complex quadratic equations, but you should show the working, including how you have manipulated the given equation into $ax^2 + bx + c = 0$. State any substitutions used, and give either the factorisation step or the completed square arrangement. Any invalid roots should be explicitly rejected.

Formulae and identities

7   The area of a sector of a circle is 36.288cm^2.

7(a) $36.288 = \theta r^2$
$\theta = r^2$
36288

You are expected to recall a number of mathematical formulae and identities. These are listed in section 5d of the specification.

Extended response (5+marks)

Extended response questions generally involve some problem solving. Try to use all the given information in your response as this may warrant some method marks or lead you to the final answer.

Trial and improvement

Standard methods should be used but marks may be awarded for trial and improvement if you show the calculations rejecting values on both sides of the solution.

Further Maths knowledge

Further Maths techniques can be used in A Level Maths exams, but it is unlikely that a question will be set that can be answered more efficiently using these techniques.

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Exact answers

12(b)
$$\frac{dy}{dx} = 6 \times a^{3x^2} \ln a$$
$$x = 1, \frac{dy}{dx} = 6a^3 \ln a$$
line: $y = (6a^3 \ln a)x + C$
① $(a^3) = (6a^3 \ln a)(1) + C$
② $(0) = (6a^3 \ln a)(0.5) + C$ ② $C = -3a^3 \ln a$
①→②
$a^3 = 6a^3 \ln a - 3a^3 \ln a$
$a^3 = 3a^3 \ln a$
$1 = 3 \ln a$
$\ln a = \frac{1}{3}$
$a = e^{\frac{1}{3}}$

If a question asks for an exact answer it means not in rounded form and it may not be possible to get the answer directly from your calculator.

Detailed reasoning

1. **In this question you must show detailed reasoning.**

Show that $\int_4^9 (2x + \sqrt{x})\,dx = \frac{233}{3}$.

$$\int_4^9 (2x + \sqrt{x})\,dx = \frac{233}{3}$$
$$= \int_4^9 (2x + x^{1/2})\,dx = \left[\frac{2x^2}{2} + \frac{2x^{3/2}}{3}\right]_4^9$$
$$= \left[x^2 + \frac{2}{3}x^{3/2}\right]_4^9$$
$$= \left(9^2 + \frac{2}{3} \times (9)^{3/2}\right) - \left(4^2 + \frac{2}{3} \times (4)^{3/2}\right)$$
$$= (81 + 18) - \left(16 + \frac{16}{3}\right) = 99 - \frac{64}{3} = \frac{233}{3}$$

It's always good practice to show workings but the statement '**In this question you must show detailed reasoning.**' emphasises there are marks allocated for workings. You can still use your calculator to check the answer though.

Prove

If you are asked to prove a mathematical statement, you will need to:
• clearly define variables,
• provide a valid mathematical argument with the correct algebraic manipulation, and
• state a concise conclusion.

Determine

3(c) If all times were at the top of the class:
$$\frac{\sum x}{n} = \frac{590}{173} = 3.41 > 3 \therefore \text{is possible}$$

If you are asked to determine, you need to justify any results found; you can't just state the answer, even if you can generate it from the calculator.

Verify

13(b)(i) Area = πr^2. When $y = 0$ the cross sectional area needs to be modelled by C3.1 So set $y = 0$
Area $= \frac{\pi r^2 (h^2 - 0)}{h^2} = \frac{\pi r^2 h^2}{h^2} = \pi r^2$ as required.

If you are asked to verify a statement is correct then you need to show the substitution into the required calculation clearly.

Show that

(a) Show that $V = \frac{1}{3}\pi\sqrt{16r^2 - r^6}$.

Your response must have an explicit conclusion of how the steps used to get from the starting statement to the given answer have shown the given statement is true. The most common source of errors in 'show that' questions is to do too many mathematical steps in one line of working. Do each key process on a new line of working to avoid mistakes.

Find, Solve, Calculate

(i) Find the probability that

9(a)(i) | 0.761

If you are asked to find, solve or calculate, you will be awarded full marks for the correct answer without any justification. The solution could be obtained using the calculator or from a graph.

Give, State, Write down

(a) Write down the value of k.   [1]

11(a) $k = -4$

The instruction to give, state or write down indicates that neither working nor justification is required. Fewer marks are likely to be available for these questions.

Explain

(b) Explain why model A is likely to underestimate the time taken.

16(b) there will be friction which will cause a to be lower therefore velocity will be less and ∴ taking more time.

Questions asking for explanations are looking for concise but sufficiently detailed statements. Use accurate mathematical vocabulary and, if relevant, include a calculation.
If two (or more) reasons are required then make sure you are not just writing the same thing in different ways.
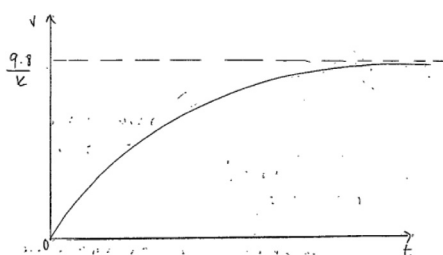
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Plot

If you are asked to plot, you must mark points accurately on a graph. You may also need to join them with a curve or straight line or draw a line of best fit through them.
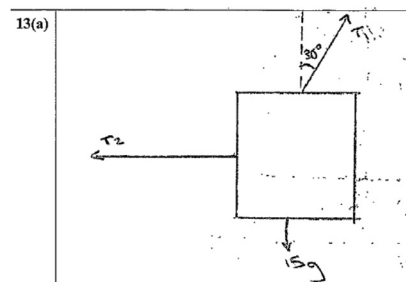
Sketch

(b) Sketch the graph of v against t.

A sketch does not need to be to scale but it should show the main features. This could include turning points, asymptotes, x- and y-axes intersections and behaviour for large x.

Draw

(a) Draw a diagram showing the forces acting on the box.

If you are asked to draw a diagram, it should be to an appropriate accuracy for the problem. Include any labels, annotations, lengths or angles as these may justify marks.

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Mechanics

Define variables

9(a) $t = 0.1$ $u = 0$ $0.5g\sin\theta - T = 0.5a$
$s = 0.3$.
$a = ?$ $0.5g\sin\theta - T = 0.5 \times 3.75$
$s = ut + \frac{1}{2}at^2$
$0.3 = 0 + \frac{1}{2}a(0.1)^2$ $T = 0.5g\sin\theta - \frac{15}{8}$
$0.3 = \frac{1}{25}a$ $= 0.5g\sin(36.87) - \frac{15}{8}$
$a = 0.3 \div \frac{1}{25}$ $= 1.065 N$
$= \frac{15}{4} = 3.75ms^{-2}$ $= 1.07 N$
$(3s.f)$
$\tan\theta = \tan^{-1}(\frac{3}{4}) = 36.87$
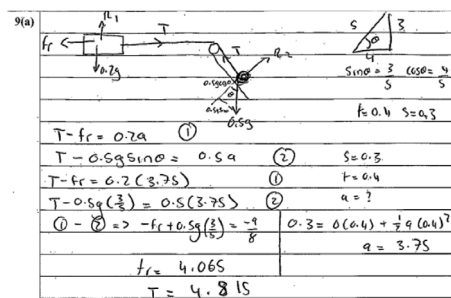
> Variables should be carefully defined to prevent unnecessary mistakes.

Connected particles

9(a) $\tan\theta = (\frac{3}{4})$ $\cos\theta = (\frac{4}{5})$ $\tan\theta$ $\sin\theta = (\frac{3}{5})$
$\frac{0.3}{0.4} = 0.75$ $a = \frac{0.75}{0.4} = 1.875ms^{-2}$
$F = ma$
$0.2 \times 1.875 = T - F$

$0.5 \times 1.875 = \frac{3}{5} \times 0.5g - T$

$T = \frac{3}{10}g - 1.875 \times 0.5 = 2.94 - 0.9375 = 2.0025 N$

> Connected particle questions are generally best solved by applying F = ma to each particle separately rather than attempting to apply the equation to the whole system.

Vector and force diagrams

9(a)

$T - fr = 0.2a$ ①
$T - 0.5g\sin\theta = 0.5a$ ② $s = 0.3$
$T - fr = 0.2(3.75)$ ① $t = 0.4$
$T - 0.5g(\frac{3}{5}) = 0.5(3.75)$ ② $a = ?$
① $-$ ② $\Rightarrow -fr + 0.5g(\frac{3}{5}) = \frac{-9}{8}$ $0.3 = 0(0.4) + \frac{1}{2}a(0.4)^2$
$\qquad\qquad a = 3.75$
$fr = 4.065$
$T = 4.815$

$\sin\theta = \frac{3}{5}$ $\cos\theta = \frac{4}{5}$
$t = 0.4$ $s = 0.3$

> When resolving vector quantities, draw a diagram, clearly labelling the directions and angles of the forces and the direction of motion/acceleration to minimise the risk of errors with sine/cosine.

Acceleration due to gravity

$$V = u + at$$
$$100\sin 25 + (-9.8)t = 0$$

> Use g = ±9.8ms⁻² for acceleration due to gravity, unless otherwise stated in the question. Take care with direction to avoid sign errors.

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Statistics

Statistical tables

$$P(X < 120) = 0.0349 \quad 4 \text{ d.p.}$$

Make sure you know how to use the statistical functions on your calculator to access probabilities from the binomial and normal distributions because only a table of the percentage points of the normal distribution are provided in the exams.
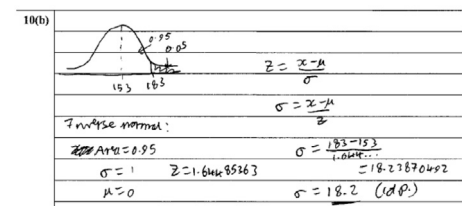
Summary statistics

(b) Calculate the mean and standard deviation of these heights.

8(b) mean = 69
standard deviation = 10.5 (to 3SF)

Make sure you know how to use the statistical functions on your calculator to compute summary statistics and also which value to quote. There are two standard deviations listed on the calculator, *Sx* and *σx*.

Normal distribution

(b) Use the information above to find the standard deviation

10(b)

$$Z = \frac{x - \mu}{\sigma}$$

$$\sigma = \frac{x - \mu}{Z}$$

Inverse normal:
Area = 0.95
$\sigma = 1$ $Z = 1.644853163$
$\mu = 0$

$$\sigma = \frac{183 - 153}{1.644\ldots} = 18.23870492$$

$$\sigma = 18.2 \quad (1 \text{d.p.})$$

When finding probabilities using the normal distribution, it can be useful to draw a sketch of the distribution to check the probabilities generated from the calculator are sensible.

Hypotheses

12(b) $H_0: p = 0.06$
$H_1: p \neq 0.06$
where p is the probability that a random jaguar selected in this population is a black panther.

Hypotheses should be stated in terms of parameter values (where relevant), which should be clearly defined.

Hypothesis test conclusion

∴ Not significant. Do not reject H_0.
∴ There is insufficient evidence at the 5% significance level to support that the percentage of black panthers in this population is not 6%.

The conclusion of the hypothesis test should reflect that it is based upon probabilities and not expressed as a statement of fact.
Take a read of our blog 'Hypothesis testing and the art of being non assertive'.

Pre-release data set

All four show data by Local Authority District (LAD), or Unitary Authority (UA), for England and Wales. Each LAD/UA is also labelled with its region and its nine character geography code introduced from January 2011. The first three characters of the code provide information about the level of geography.
E06: Unitary authority in England
E07: Non-metropolitan district in England
E08: Metropolitan borough in England
E09: London borough.
W06: Unitary authority in Wales

Make sure you are familiar with all the data categories in the large data set. Explanations are given in the information worksheet of the spreadsheet.

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