# GCSE
# MATHEMATICS
# 8300/3H

Higher Tier Paper 3 Calculator

**Mark scheme**

June 2019

Version: 1.0 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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**Glossary for Mark Schemes**

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

| | |
|---|---|
| **M** | Method marks are awarded for a correct method which could lead to a correct answer. |
| **A** | Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied. |
| **B** | Marks awarded independent of method. |
| **ft** | Follow through marks. Marks awarded for correct working following a mistake in an earlier step. |
| **SC** | Special case. Marks awarded for a common misinterpretation which has some mathematical worth. |
| **M dep** | A method mark dependent on a previous method mark being awarded. |
| **B dep** | A mark that can only be awarded if a previous independent mark has been awarded. |
| **oe** | Or equivalent. Accept answers that are equivalent.<br>eg accept 0.5 as well as $\frac{1}{2}$ |
| **[a, b]** | Accept values between a and b inclusive. |
| **[a, b)** | Accept values $a \leq$ value $< b$ |
| **3.14…** | Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416 |
| **Use of brackets** | It is not necessary to see the bracketed work to award the marks. |

Examiners should consistently apply the following principles

**Diagrams**

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

**Responses which appear to come from incorrect methods**

Whenever there is doubt as to whether a student has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the student. In cases where there is no doubt that the answer has come from incorrect working then the student should be penalised.

**Questions which ask students to show working**

Instructions on marking will be given but usually marks are not awarded to students who show no working.

**Questions which do not ask students to show working**

As a general principle, a correct response is awarded full marks.

**Misread or miscopy**

Students often copy values from a question incorrectly. If the examiner thinks that the student has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

**Further work**

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

**Choice**

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

**Work not replaced**

Erased or crossed out work that is still legible should be marked.

**Work replaced**

Erased or crossed out work that has been replaced is not awarded marks.

**Premature approximation**

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

**Continental notation**

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the student intended it to be a decimal point.

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **1** | $\frac{5}{2}$ | B1 | |
| **2** | $\frac{9}{25}$ | B1 | |
| **3** | 75 | B1 | |
| **4** | –3 and 5 | B1 | |
| **5** | Isosceles triangle with base 2 cm and height 3 cm in any orientation | B2 | ± ¼ square on base or height<br>B1<br>isosceles triangle with base 2 cm or height 3 cm in any orientation<br>or<br>acute angled triangle with base 2 cm and height 3 cm in any orientation |
| | **Additional Guidance** | | |
| | Mark intention for isosceles triangle within tolerance, lines do not need to be ruled | | |
| | Enlargement can be drawn wholly or partially inside the original | | |
| | Correct vertices not connected | | B1 |
| | Right angled isosceles triangle | | B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 6 | 8.5(0) or 9.49 or 9.5(0)<br>or<br>6.25 or 6.74 or 6.75 | B1 | |
| | 9.49 + 6.74<br>or<br>(9, 9.5] + (6.5, 6.75] | M1 | |
| | 16.23 | A1 | accept (£)16.23p<br>SC2 16.25 or 16.24 |
| | **Additional Guidance** | | |
| | 9.5(0) and 6.55 with answer 16.05 | | B1M1A0 |
| | 9.4(0) and 6.25 with answer 15.65 | | B1M0A0 |
| | 9.4(0) and 6.55 with answer 15.95 | | B0M1A0 |
| 7 | 6 as density for J or K | B1 | |
| | 13 as volume for K<br>or<br>78 ÷ their 6 as volume for K | B1ft | ft their 6 |
| | g/cm$^3$ as units for densities of J and K<br>and<br>cm$^3$ as unit for volume of K | B1 | allow g cm$^{-3}$ |
| | **Additional Guidance** | | |
| | Mark table first | | |
| | Full marks are only awarded for a fully correct table with no errors or omissions | | |
| | 13 cm$^3$ as a volume for K, 0.006 kg/cm$^3$ for both densities | | B1B1B1 |
| | Condone g per cm$^3$, gpcm$^3$ or g per cubic centimetre as units for density | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **8** | $x = \frac{y+2}{3}$ | B1 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 9 | **Alternative method 1 – PQ as the unknown** | | |
| | $x + 10$ or $2(x + 10)$ | M1 | any unknown |
| | $x + x + 10 + 2(x + 10) = 170$ | M1dep | oe<br>any consistent unknown<br>$x$ + their two expressions (with at least one correct) = 170 |
| | $4x + 30 = 170$ | M1dep | oe $4x = 140$<br>must be correct |
| | 35 | A1 | |
| | **Alternative method 2 – PR as the unknown** | | |
| | $x – 10$ or $2x$ | M1 | any unknown |
| | $x + x – 10 + 2x = 170$ | M1dep | oe<br>any consistent unknown<br>$x$ + their two expressions (with at least one correct) = 170 |
| | $4x – 10 = 170$<br>or $x = 45$ | M1dep | oe $4x = 180$<br>must be correct |
| | 35 | A1 | |
| | **Alternative method 3 – QR as the unknown** | | |
| | $\frac{x}{2}$ or $\frac{x}{2} – 10$ | M1 | any unknown |
| | $x + \frac{x}{2} + \frac{x}{2} – 10 = 170$ | M1dep | oe<br>any consistent unknown<br>$x$ + their two expressions (with at least one correct) = 170 |
| | $2x – 10 = 170$<br>or $x = 90$ | M1dep | oe $2x = 180$<br>must be correct |
| | 35 | A1 | |

**Mark scheme for Question 9 continues on next page**

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 9 cont | **Alternative method 4 – trial and improvement with addition of three lengths** | | |
| | A correctly evaluated trial with<br>a difference of 10 (km) between the two shorter lengths<br>and<br>the longest length twice the length of the middle length | M1 | may be seen as a subtraction of three numbers from 170 |
| | A different correctly evaluated trial with<br>a difference of 10 (km) between the two shorter lengths<br>and<br>the longest length twice the length of the middle length | M1dep | may be seen as a subtraction of three numbers from 170 |
| | 35, 45 and 90 | A1 | |
| | 35 | A1 | |
| | **Alternative method 5 – trial and improvement with subtraction from 170** | | |
| | A correctly evaluated trial of two lengths subtracted from 170 with<br>a difference of 10 (km) between the two lengths<br>or<br>one length twice the length of the other | M1 | |
| | A different correctly evaluated trial of two lengths subtracted from 170 with<br>a difference of 10 (km) between the two lengths<br>or<br>one length twice the length of the other | M1dep | |
| | 35, 45 and 90 | A1 | |
| | 35 | A1 | |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **9 cont** | **Additional Guidance** | |
| | If the student attempts more than one method, mark each method and award the highest mark | |
| | Alt 1 $PQ + PQ + 10 + 2(PQ + 10) = 170$ | M1M1 |
| | Alt 1 $PQ + PQ + 10 + 2PR = 170$ | M1 |
| | Alt 2 $x$, $x + 10$ and $2x$ seen on diagram, $4x + 10 = 170$ | M1M1M0A0 |
| | Alt 4 $35 + 45 + 90$ with no choice made | M1M1A1A0 |
| | Alt 4 $170 – 30 – 40 – 80 = 20$ | M1 |
| | Alt 4 $170 – 30 – 40 – 60 = 40$ incorrect number is doubled | M0 |
| | Alt 5 $170 – 30 – 60 = 80$ | M1 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 10 | **Alternative method 1** | | |
| | 6000 × 1.03 or 6180<br>or 6000 × 0.03 or 180<br>or 6000 × 1.01 or 6060<br>or 6000 × 0.01 or 60 | M1 | 6000 × 1.05 or 6300<br>6000 × 0.05 or 300 |
| | their 6180 × 1.03 or 6365.4(0)<br>or their 6180 × 0.03 or 185.4(0)<br>or 365.4(0)<br>or<br>their 6060 × 1.05 or 6363<br>or their 6060 × 0.05 or 303<br>or 363 | M1dep | $6000 \times 1.03^2$<br>or 6000 × 1.0609<br>or 6000 × 1.01 × 1.05<br>or 6000 × 1.0605<br>or 6300 × 1.01<br>or 6300 × 0.01 or 63 |
| | 6365.4(0) and 6363 and No<br>or<br>365.4(0) and 363 and No | A1 | accept 2.4(0) difference to imply 'No' |
| | **Alternative method 2** | | |
| | 1.03 or 1.01 or 1.05 | M1 | |
| | $1.03^2$ or 1.03 × 1.03 or 1.0609<br>or 0.0609 or 6.09(%)<br>or<br>1.01 × 1.05 or 1.0605<br>or 0.0605 or 6.05(%) | M1dep | |
| | 1.0609 and 1.0605 and No<br>or<br>0.0609 and 0.0605 and No<br>or<br>6.09(%) and 6.05(%) and No | A1 | accept 0.0004 difference to imply 'No'<br>accept 0.04(%) difference to imply 'No' |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **10 cont** | **Additional Guidance** | |
| | Accept any clear indication that the Offer 1 amount is different to the Offer 2 amount for 'No' | |
| | If build up methods are used they must be complete | |
| | $6000 \times 0.03^2$ implies $6000 \times 0.03$ | M1 |
| | $1.03^3$ implies 1.03 | M1 |
| | 360 without 180 seen (simple interest) | M0 |
| | If a different starting value is used, apply Alt 2 with correctly evaluated answers eg<br>$600 \times 1.03^2 = 636.54$<br>$600 \times 1.01 \times 1.05 = 636.30$<br>No, pay less with Offer 1 (condone incorrect choice of Offer 1)<br><br>$500 \times 1.03 = 515$ $515 \times 1.03 = 530.45$<br>$500 \times 1.01 = 505$ $505 \times 1.05 = 530.25$<br>No, they are different | M1M1A1<br><br>M1M1A1 |

| | | | |
|---|---|---|---|
| **11** | (200 + 160 + 104 + 100) ÷ 4<br>or 564 ÷ 4 or 141 | M1 | |
| | their 141 ÷ 3 × 8<br>or 47 × 8<br>or 1128 ÷ 3<br>or 376 | M1dep | oe<br>accept 141 × 2.66(…) or 141 × 2.67 |
| | their 376 × 5 or 1880 | M1dep | |
| | 427 | A1 | |
| | **Additional Guidance** | | |
| | (270 + 400 + 483 + 300 + 427) ÷ 5 embedded answer | | M1M1M1A0 |
| | (1453 + $x$) ÷ 5 = 376 and 1453 + $x$ = 1880 | | M1M1M1 |
| | (1453 + $x$) ÷ 5 = 376 | | M1M1M0 |
| | 200 + 160 + 104 + 100 ÷ 4 scores M0 unless recovered | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 12 | **Alternative method 1** | | |
| | $4 \times 5 + c = 23$ | M1 | oe $20 + c = 23$ |
| | $c = 3$ | A1 | implied by (0, 3)<br>or 3 shown as $y$-axis intercept |
| | $y = 4x + 3$ | A1 | SC1 $y = 4x + c$ $c \neq 3$ |
| | **Alternative method 2** | | |
| | $y - 23 = 4(x - 5)$ | M1 | oe |
| | $y - 23 = 4x - 20$ | M1dep | |
| | $y = 4x + 3$ | A1 | SC1 $y = 4x + c$ $c \neq 3$ |
| | **Additional Guidance** | | |
| | If 3 is clearly linked to $c$ in $y = mx + c$ condone M1A1 | | |
| | $4x + 3$ on answer line, $y = 4x + 3$ seen in working | | M1A1A1 |
| | $4x + 3$ on answer line, $y = 4x + 3$ not seen in working | | M1A1A0 |
| | $m = 4$, $c = 3$ on answer line, $y = 4x + 3$ seen in working | | M1A1A1 |
| | $m = 4$, $c = 3$ | | M1A1A0 |
| | $y = mx + 3$ | | M1A1A0 |
| | $23 = 4 \times 5 + 3$ embedded value for $c$ | | M1A0A0 |
| | $4x + c$ on answer line with $c \neq 3$ | | M0A0A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 13(a) | –2**a** | B1 | oe eg –**a** –**a** or 2(–**a**) |
| | **Additional Guidance** | | |
| | Do not accept in column vector form unless correct answer is also seen | | |
| | Do not accept –**a**2 for –2**a** | | |
| 13(b) | $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$ drawn on the grid with direction shown | B2 | ± ¼ centimetre square<br>B1 $\begin{pmatrix} -8 \\ 2 \end{pmatrix}$ seen in working<br>or<br>correct line drawn with incorrect direction or no direction shown<br>or<br>correctly joined vectors for **c** and –**d** with correct directions shown |
| | **Additional Guidance** | | |
| | Mark intention, line does not need to be ruled and ignore all labelling for **c**, **d** and **c – d** | | |
| 14 | Class X has a greater proportion of boys than class Y | B1 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|

**15**

| | | |
|---|---|---|
| **Alternative method 1 – answer written as a fraction** | | |
| $a^2$ on numerator | B1 | $a$ correctly simplified |
| $b^3$ on denominator<br>or $b^{-3}$ on numerator | B1 | $b$ correctly simplified |
| $c$ cancelled<br>and<br>$d$ on denominator or $d^{-1}$ on numerator | B1 | $d$ correctly simplified |
| **Alternative method 2 – answer written only as a product** | | |
| $a^2$ | B1 | $a$ correctly simplified |
| $b^{-3}$ | B1 | $b$ correctly simplified |
| $d^{-1}$ and $c$ cancelled | B1 | $d$ correctly simplified |

| **Additional Guidance** | |
|---|---|
| If answer line is blank, marks can be awarded in the working | |
| Do not award any marks if addition or subtraction is seen in their best attempt | |
| Condone use of capital letters | |
| Penalise use of × sign by one mark only if full marks would have been awarded eg $a^2 \times b^{-3} \times d^{-1}$ | B1B1 |
| $\frac{a^2}{db^3}$ or $\frac{a^2d^{-1}}{b^3}$ or $\frac{a^2b^{-3}}{d}$ or $a^2b^{-3}d^{-1}$ | B1B1B1 |
| $\frac{a^2b^2}{db^5}$ or $\frac{a^2b^2d^{-1}}{b^5}$ or $a^2b^2d^{-1}b^{-5}$ | B1B0B1 |
| $\frac{a^3}{dab^3}$ | B0B1B1 |
| $\frac{a^2c}{cdb^3}$ | B1B1B0 |
| $\frac{a}{d} \times b^3$ use of × sign not penalised as full marks would not be awarded | B0B0B1 |
| $a^2 + b^{-3} - d^{-1}$ | B0B0B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **16** | $\frac{x}{360} \times \pi \times (1.5r)^2$<br>or $\frac{1}{160}\ \pi x r^2$ or $0.019\ldots xr^2$<br>or<br>$\frac{2x}{360} \times \pi \times r^2$<br>or $\frac{1}{180}\ \pi x r^2$ or $0.017\ldots xr^2$ | M1 | oe<br>eg (working in radians)<br>$\frac{1}{2} \times (1.5r)^2 \times x$ or $\frac{1}{2} \times r^2 \times 2x$ |
| | $\frac{1}{160}\ \pi x r^2$ and $\frac{1}{180}\ \pi x r^2$ and A<br>or<br>$0.019\ldots xr^2$ and $0.017\ldots xr^2$<br>and A | A1 | oe<br>eg (working in radians)<br>$\frac{9}{8} r^2 x$ and $r^2 x$ and A |
| | **Additional Guidance** | | |
| | Methods must be algebraic, containing $x$, $\pi$ and $r$ | | |
| | If a box is not ticked, must say 'A' without contradiction in working to award M1A1 | | |
| | To award A1 their areas must be in a comparable form eg<br>$\frac{2.25}{360}\pi x r^2$ and $\frac{2}{360}\pi x r^2$ and A ticked | | |
| | Ignore further incorrect working after A1 scored | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 17 | **Alternative method 1** | | |
| | 0.03 × 200 or 6<br>or<br>0.035 × 200 or 7<br>or<br>0.015 × 200 or 3<br>or<br>0.01 × 200 or 2 | M1 | |
| | 0.035 × 200 or 7<br>and<br>0.01 × 200 or 2 | M1dep | |
| | 5 | A1 | |
| | **Alternative method 2** | | |
| | 0.035 – 0.01 or 0.025 | M1 | |
| | their 0.025 × 200 | M1dep | |
| | 5 | A1 | |
| | **Additional Guidance** | | |
| | Condone errors in calculating 6 or 3 as only the values 7 and 2 are required to correctly answer the question<br>eg 5, 7, 3, 2 the range is 7 – 2 = 5 | | M1M1A1 |
| | 5 on answer line does not imply full marks, method must be checked<br>eg 0.03 × 200 = 8 8 – 3 = 5 | | M1M0A0 |

| | | | |
|---|---|---|---|
| 18(a) | $3x^2 – 9x – 4 = 0$<br>or $–3x^2 + 9x + 4 = 0$ | B1 | must see = 0 on answer line |
| | **Additional Guidance** | | |
| | Do not accept $x9$ or $9 \times x$ for $9x$ | | |
| | $3x^2 + –9x + –4 = 0$ | | B1 |
| | $3x^2 – +9x – +4 = 0$ | | B0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 18(b) | $\frac{--9 \pm \sqrt{(-9)^2 - 4 \times 3 \times -4}}{2 \times 3}$<br>or $\frac{9 \pm \sqrt{129}}{6}$<br>or $\left(x - \frac{3}{2}\right)^2 - \frac{9}{4} = \frac{4}{3}$<br>or $\frac{3}{2} \pm \sqrt{\frac{43}{12}}$<br>or 3.392… or 3.393<br>or –0.392… or –0.393 | M1 | oe<br>correct or ft their 3-term quadratic seen |
| | 3.39 and –0.39 | A1ft | correct or ft their 3-term quadratic seen<br>ft answers must be rounded to 2 dp |
| | **Additional Guidance** | | |
| | The word 'and' does not need to be seen to award A mark | | |
| | Full fraction line, correct full square root, ± and $(-9)^2$ or $9^2$ must be seen to award M1 but can be recovered by sight of correct solution(s) | | |
| | $3x^2 - 9x + 4 = 0$ in 18(a)<br>$\frac{9 \pm \sqrt{33}}{6}$ or $\frac{3}{2} \pm \sqrt{\frac{11}{12}}$ or 2.457… or 0.542…<br>2.46 and 0.54 | M1<br>A1ft | |
| | 3.39 and –0.39 on answer line with no incorrect working | M1A1 | |
| | 2.46 and 0.54 on answer line with no incorrect working | M1A1ft | |
| | One correct answer with no incorrect working | M1A0 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| | Median is at 10.5 | B1 | oe<br>eg median should be one square to the right |
| | Upper quartile should be at 15 | B1 | oe<br>eg IQR is 9<br>eg UQ should be two squares to the left |
| | **Additional Guidance** | | |
| | Ignore irrelevant and non-contradictory statements alongside a B1 response | | |
| **19** | To score either mark, answers must correctly refer to a number of minutes or exact position on the box plot | | |
| | The median should be at 11 | B1 | |
| | The median is half a minute too low | B1 | |
| | The interquartile range should be 8 | B1 | |
| | The interquartile range is one minute too big | B1 | |
| | Upper quartile = 16 minutes | B1 | |
| | The median is in the wrong place | B0 | |
| | The median is 11 | B0 | |
| | The median is wrong | B0 | |
| | The median is inaccurate by 1 square | B0 | |
| | The interquartile range is too small | B0 | |
| | The upper quartile should be at 16 | B0 | |
| | The upper quartile is wrong by 1 | B0 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 20(a) | $d \propto v^2$<br>or $d = k \times v^2$<br>or $6 = k \times 20^2$<br><br>or $c \times d = v^2$<br>or $c \times 6 = 20^2$ | M1 | oe eg $v = kd^{½}$ |
| | (k =) $6 \div 20^2$ or 0.015<br><br>or (c =) $20^2 \div 6$ or 66.66…or 66.67 | M1dep | oe eg $\frac{6}{400}$ or $\frac{3}{200}$<br>$\frac{400}{6}$ or $\frac{200}{3}$ |
| | $d = 0.015 \times v^2$<br>or<br>$\frac{200}{3} \times d = v^2$ | A1 | oe equation |
| | **Additional Guidance** | | |
| | Working for second M mark must follow from their initial equation | | |
| | $d \propto 0.015 \times v^2$ | | M1M1A0 |
| | (k =) 0.015 or (c =) $\frac{200}{3}$ with no incorrect working | | M1M1A0 |
| | $0.015v^2$ or $\frac{200}{3}d$ | | M1M1A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 20(b) | their $0.015 \times 30^2$<br>their $0.015 \times 900$<br>or $6 \times \left(\frac{30}{20}\right)^2$<br>or $30^2 \div$ their $\frac{200}{3}$<br>or $900 \div \frac{200}{3}$<br>or $6 \div \left(\frac{20}{30}\right)^2$ | M1 | oe |
| | 13.5 | A1ft | oe<br>ft their 0.015 provided using $d$ = their $0.015 \times v^2$ |
| | **Additional Guidance** | | |
| | Must use $\times 30^2$ or $\times 900$ or $\times \left(\frac{30}{20}\right)^2$ for M1 | | |
| | $d$ α 13.5 | | M1A0 |
| | If in part (a)<br>$d = k \times v$ $6 = k \times 20$ $d = \frac{6}{20}v$<br>and in part (b)<br>$d = \frac{6}{20} \times 30$, $m = 9$ | | M0 part (a)<br>M0 part (b) |
| | If in part (a)<br>$d = k \times v$ $6 = k \times 20$ $d = \frac{6}{20}v$<br>and in part (b)<br>$d = \frac{6}{20} \times 30^2$, $d = 270$ | | M0 part (a)<br>M1A1ft part (b) |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 21 | **Alternative method 1 – making 10 litres of paint** | | |
| | 225 ÷ 50 (= 4.5(0))<br>or<br>80 ÷ 20 (= 4(.00)) | M1 | cost of 1 litre for one colour |
| | 225 ÷ 50 (= 4.5(0))<br>and<br>80 ÷ 20 (= 4(.00)) | M1 | cost of 1 litre for both colours |
| | their 4.5(0) × 7 + their 4(.00) × 3<br>or 43.5(0) | M1dep | 31.5(0) + 12(.00)<br>dep on M2 |
| | their 43.5(0) × 1.4 or 60.9(0)<br>or<br>their 43.5(0) ÷ 2 × 1.4 | M1dep | oe<br>dep on M3 |
| | 30.45 | A1 | |
| | **Alternative method 2 – making 5 litres of paint** | | |
| | 5 ÷ (7 + 3) or 0.5 | M1 | |
| | their 0.5 × 7 or 3.5<br>and<br>their 0.5 × 3 or 1.5 | M1dep | 3.5 : 1.5 |
| | $\frac{\text{their } 3.5}{50} \times 225$ or 15.75<br>and<br>$\frac{\text{their } 1.5}{20} \times 80$ or 6 | M1dep | dep on M2 |
| | (their 15.75 + their 6) × 1.4 | M1dep | oe<br>21.75 × 1.4 or 21.75 + 8.7(0)<br>dep on M3 |
| | 30.45 | A1 | |

**Mark scheme for Question 21 continues on next page**

| | | | |
|---|---|---|---|
| **21 cont** | **Alternative method 3 – making 10 litres of paint when profit is added at the start** | | |
| | 225 × 1.4 (= 315)<br>and<br>80 × 1.4 (= 112) | M1 | 40% added to the cost of both colours |
| | their 315 ÷ 50 (= 6.3(0))<br>or<br>their 112 ÷ 20 (= 5.6(0)) | M1dep | selling price of 1 litre of either colour |
| | their 315 ÷ 50 (= 6.3(0))<br>and<br>their 112 ÷ 20 (= 5.6(0)) | M1dep | selling price of 1 litre of both colours |
| | their 6.3(0) × 7 + their 5.6(0) × 3<br>or 60.9(0) | M1dep | oe 44.1(0) + 16.8(0)<br>dep on M3 |
| | 30.45 | A1 | |
| | **Alternative method 4 – making *n* litres of paint** | | |
| | 225 ÷ 50 × 0.7*n* or 3.15*n*<br>or<br>80 ÷ 20 × 0.3*n* or 1.2*n* | M1 | cost of blue or yellow paint in *n* litres of green paint |
| | 225 ÷ 50 × 0.7*n* or 3.15*n*<br>and<br>80 ÷ 20 × 0.3*n* or 1.2*n* | M1 | cost of blue and yellow paint in *n* litres of green paint |
| | their 3.15*n* + their 1.2*n* or 4.35*n* | M1dep | total cost of *n* litres of green paint<br>dep on M2 |
| | their 4.35*n* × 1.4 or 6.09*n* | M1dep | oe<br>dep on M3 |
| | 30.45 | A1 | |
| | **Additional Guidance** | | |
| | If the student attempts more than one method, mark each method and award the highest mark | | |
| | Alt 4 value of *n* must be clear eg 100 litres total or 700:300 (1000 litres implied) | | |
| | Alt 4 their 4.35*n* ÷ k × 1.4 implies their 4.35*n* × 1.4 where ÷ k is their attempt to scale to the cost of a 5-litre tin | | M1M1M1M1 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **22(a)** | $\frac{12}{29}$ | B1 | |
| **22(b)** | $\frac{8}{15}$ | B1 | |
| **23** | Correct curve | B2 | B2 correct curve must be correct shape and pass through (0, 1) and be in correct position relative to $y = 2^x$<br>B1 correct shape and pass through (0, 1) |
| | **Additional Guidance** | | |
| | Correct curve must be an exponential graph | | |
| | Correct position must be<br>above $y = 2^x$ for $x > 0$<br>below $y = 2^x$ for $x < 0$ | | |
| **24** | sin 24 = $\frac{h}{20}$ | M1 | oe<br>$\cos 66 = \frac{h}{20}$<br>$\frac{20}{\sin 90} = \frac{h}{\sin 24}$ |
| | 20 × sin 24 or 8.1… | M1dep | 20 × cos 66<br>$\frac{20}{\sin 90} \times \sin 24$ |
| | [1215, 1221] | A1 | with no incorrect working seen |
| | **Additional Guidance** | | |
| | 150 × 20 × sin 24 | | M1M1 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 25(a) | Reflection | B1 | |
| | $y = 1$<br>or $AC$ | B1 | |
| | **Additional Guidance** | | |
| | Mirror line | | B0 |
| | Contradiction for line of reflection | | B0 |
| | More than one transformation given | | B0 |
| 25(b) | **Alternative method 1** | | |
| | Rotation | B1 | |
| | Centre (0, 1) | B1 | |
| | 180° | B1 | degrees symbol does not have to be seen |
| | **Alternative method 2** | | |
| | Enlargement | B1 | |
| | Centre (0, 1) | B1 | |
| | Scale factor –1 | B1 | |
| | **Additional Guidance** | | |
| | For centre (0, 1) allow about (0, 1) or (0, 1) | | B1 |
| | For centre (0, 1) do not allow 0, 1 | | B0 |
| | More than one transformation given eg rotation then translation | | B0 |
| | Do not allow half turn for 180° | | |
| | Ignore clockwise or anticlockwise | | |
| | For scale factor allow sf or scale or (×) –1 | | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **26** | $16 - x^3$ | M1 | |
| | $x^3 = 16 - 24$<br>or $x^3 = -8$<br>or $x = \sqrt[3]{-8}$<br>or $-x^3 = 24 - 16$<br>or $-x^3 = 8$<br>or $-x = -\sqrt[3]{-8}$ | M1dep | |
| | $-2$ | A1 | |
| | **Additional Guidance** | | |
| | $16 - x^3 = 24$ $x^3 = 24 - 16$ | | M1M0A0 |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| **27** | $\sqrt{144}$ or 12 | B1 | radius of larger circle<br>may be seen on diagram |
| | $\frac{4}{5}$ × their 12 or 9.6 | M1 | their 12 must be a value<br>may be seen on diagram |
| | (cos *AOB* =)<br>$\frac{\text{their } 12^2 + \text{their } 9.6^2 - 20^2}{2 \times \text{their } 12 \times \text{their } 9.6}$<br>or $\frac{144 + 92.16 - 400}{230.4}$<br>or $-\frac{32}{45}$ or –0.71… | M1dep | oe |
| | $\cos^{-1}$ their $-\frac{32}{45}$ | M1dep | dep on M2 |
| | 135.(…) | A1 | |
| | **Additional Guidance** | | |
| | 144 | B0 | |
| | $\frac{4}{5}$ × 144 = 115.2 | M1 | |
| | (cos *AOB* =) $\frac{144^2 + 115.2^2 - 20^2}{2 \times 144 \times 115.2}$ | M1M0A0 | |
| | 12 seen, but a different value used for the radius of the larger circle cannot score B1M1 | | |
| | $x + y = 12$ seen, but $x = 6$ used to find radius *OA* = 4.8 | B0M1 | |

| Question | Answer | Mark | Comments |
|---|---|---|---|
| 28(a) | $\frac{1}{2} \times 5 \times 8$ or 20<br>or<br>$\frac{1}{2} \times (8 + 9) \times (9 - 5)$ or 34 | M1 | oe<br>eg $\frac{1}{2} \times 4$ (× 1) and 4 × 8 or 2 and 32 |
| | $\frac{1}{2} \times 5 \times 8$ or 20<br>and<br>$\frac{1}{2} \times (8 + 9) \times (9 - 5)$ or 34 | M1dep | $\frac{1}{2} \times 4$ (× 1) and 4 × 8 or 2 and 32 |
| | $\frac{1}{2} \times (9 + 4.6) \times 1$<br>$+ \frac{1}{2} \times (4.6 + 2) \times 1$<br>$+ \frac{1}{2} \times 1 \times 2$<br>or 6.8 + 3.3 + 1 or 11.1<br>or<br>$\frac{1}{2} \times (9 + 4.6) \times 1 + \frac{1}{2} \times 2 \times 4.6$<br>or 6.8 + 4.6 or 11.4<br>or<br>$\frac{1}{2} \times (9 + 2) \times 2 + \frac{1}{2} \times 1 \times 2$<br>or 11 + 1 or 12<br>or<br>$\frac{1}{2} \times 3 \times 9$ or 13.5 | M1 | correct attempt to estimate the full area below curve using trapezia, a trapezium and a triangle or a triangle |
| | Correctly evaluates 20 + 34 + their correct estimate for the full area below curve, which must sum to an answer which is less than or equal to 67.5 | A1 | M3 must be awarded |

**Additional Guidance is on the next page**

| | | |
|---|---|---|
| **28(a) cont** | **Additional Guidance** | |
| | If first two marks are awarded, the third area must not come from 67.5 minus their two areas | |
| | If a concluding statement is made do not award A mark if it contains an error | |

| | | | |
|---|---|---|---|
| **28(b)** | 1 | B1 | |
| | $m/s^2$ or $ms^{-2}$<br>or metres per second per second | B1 | oe<br>allow $mps^2$ or m/s/s |
| | **Additional Guidance** | | |
| | Do not accept fractions | | |
| | $m/s^{-2}$ | | B0 |