AQA

# A-level
# Mathematics

Paper 3
Mark scheme

Practice paper – Set 1

Version 1.0

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 has been prepared for practice papers and has not, therefore, been through the process of standardising that would take place for live papers.

Further copies of this mark scheme are available from allaboutmaths.aqa.org.uk

# Mark scheme instructions to examiners

## General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- marking instructions that indicate when marks should be awarded or withheld including the principle on which each mark is awarded. Information is included to help the examiner make his or her judgement and to delineate what is creditworthy from that not worthy of credit
- a typical solution. This response is one we expect to see frequently. However credit must be given on the basis of the marking instructions.

If a student uses a method which is not explicitly covered by the marking instructions 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.

**Key to mark types**

| | |
|---|---|
| M | mark is for method |
| R | mark is for reasoning |
| A | mark is dependent on M marks and is for accuracy |
| B | mark is independent of M marks and is for method and accuracy |
| E | mark is for explanation |
| F | follow through from previous incorrect result |

**Key to mark scheme abbreviations**

| | |
|---|---|
| CAO | correct answer only |
| CSO | correct solution only |
| ft | follow through from previous incorrect result |
| 'their' | indicates that credit can be given from previous incorrect result |
| AWFW | anything which falls within |
| AWRT | anything which rounds to |
| ACF | any correct form |
| AG | answer given |
| SC | special case |
| OE | or equivalent |
| NMS | no method shown |
| PI | possibly implied |
| SCA | substantially correct approach |
| sf | significant figure(s) |
| dp | decimal place(s) |

Examiners should consistently apply the following general marking principles

**No Method Shown**

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly, the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

**Otherwise we require evidence of a correct method for any marks to be awarded.**

**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.

**Work erased or crossed out**

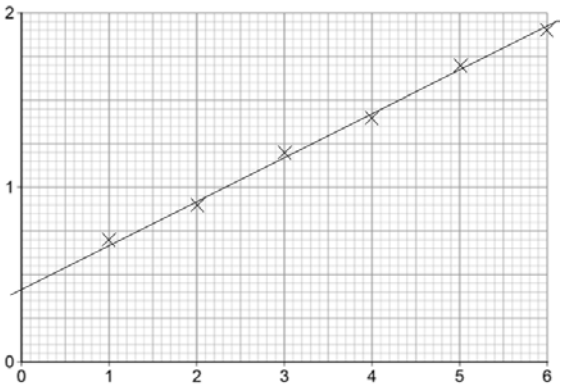
Erased or crossed out work that is still legible and has not been replaced should be marked. Erased or crossed out work that has been replaced can be ignored.

**Choice**

When a choice of answers and/or methods is given and the student has not clearly indicated which answer they want to be marked, only the last complete attempt should be awarded marks.

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **1** | Circles correct answer | AO1.1b | B1 | $y = \ln(5x+2)$ |
| | **Total** | | **1** | |
| **2** | Circles correct answer | AO2.2a | R1 | 16 |
| | **Total** | | **1** | |
| **3 (a)** | Writes the expression in a form that may be expanded | AO1.1a | M1 | $\sqrt{16+x} = 4\left(1+\frac{x}{16}\right)^{\frac{1}{2}}$ |
| | Correctly expands at least three terms | AO1.1b | A1 | $\approx 4\left(1+\left(\frac{1}{2}\right)\left(\frac{x}{16}\right)+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2!}\left(\frac{x}{16}\right)^2+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}\left(\frac{x}{16}\right)^3\right)$ |
| | Obtains correct expansion with all terms simplified | AO1.1b | A1 | $= 4\left(1+\frac{x}{32}-\frac{x^2}{2048}+\frac{x^3}{65536}\right)$<br>$= 4+\frac{x}{8}-\frac{x^2}{512}+\frac{x^3}{16384}$ |
| | **Total** | | **3** | |
| **3 (b)** | States correct range of values | AO2.3 | B1 | $\lvert x\rvert < 16$ |
| | **Total** | | **1** | |

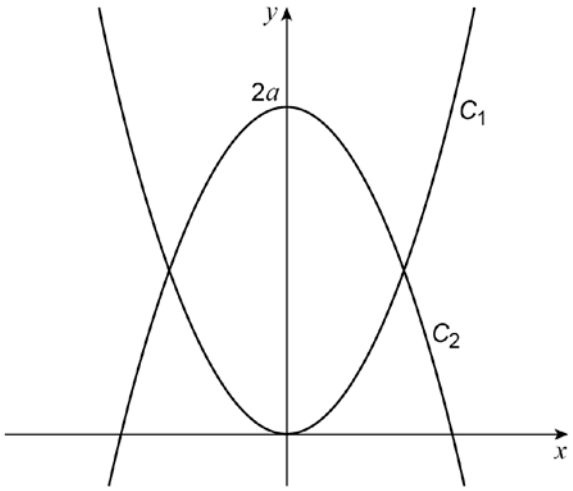
| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **4 (a)** | Takes logs of both sides | AO1.1a | M1 | $y = ab^x$<br>$\log_{10} y = \log_{10}\left(ab^x\right)$<br>$\Rightarrow \log_{10} y = \log_{10} a + \log_{10} b^x$<br>$\Rightarrow \log_{10} y = \log_{10} a + x\log_{10} b$<br><br>If we let $y = \log_{10} y$ and rewrite<br>$y = \left(\log_{10} b\right)x + \log_{10} a$<br>This has the form $Y = mx + c$, which is a linear relationship |
| | Uses an appropriate log rule | AO1.1a | M1 | |
| | Uses a second appropriate log rule to complete demonstration of linear form.<br>Only award if clear with no slips in algebra | AO2.1 | R1 | |
| | Explains clearly how the derived expression gives a linear relationship.<br>This could include a comparison with the structure of $y = mx + c$ or using a substitution $Y = \log_{10} y$ | AO2.4 | E1 | |
| | **Total** | | **4** | |

<table>
<tr><th>Q</th><th>Marking instructions</th><th>AO</th><th>Marks</th><th>Typical solution</th></tr>
<tr><td rowspan="2">4 (b)(i)</td><td>Calculates correct values for $\log_{10} y$<br>At least 5 correct<br>PI by correct points</td><td>AO1.1a</td><td>M1</td><td rowspan="2"><table><tr><td>$x$</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>$y$</td><td>5</td><td>8</td><td>15</td><td>26</td><td>47</td><td>85</td></tr><tr><td></td><td>0.7</td><td>0.9</td><td>1.2</td><td>1.4</td><td>1.7</td><td>1.9</td></tr></table>  </td></tr>
<tr><td>Plots points and draws appropriate straight-line graph</td><td>AO1.1b</td><td>A1</td></tr>
<tr><td></td><td>Total</td><td></td><td>2</td><td></td></tr>
<tr><td rowspan="3">4 (b)(ii)</td><td>Obtains vertical intercept $c$ and attempts $10^c$<br>Condone AWFW<br>0.4 to 0.45 for intercept<br><br>Or<br><br>Obtains gradient $m$ and attempts $10^m$<br>Condone AWRT<br>0.25 for gradient</td><td>AO1.1a</td><td>M1</td><td rowspan="3">Gradient = 0.249<br>Intercept = 0.4<br><br>$a = 10^{0.4} = 2.5$<br><br>$b = 10^{0.249} = 1.8$</td></tr>
<tr><td>Obtains correct value for $a$</td><td>AO1.1b</td><td>A1</td></tr>
<tr><td>Obtains correct value for $b$</td><td>AO1.1b</td><td>A1</td></tr>
<tr><td></td><td>Total</td><td></td><td>3</td><td></td></tr>
</table>

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **4 (c)** | Substitutes $x = 6.5$ into 'their' model | AO3.4 | M1 | $y = 2.5 \times 1.8^{6.5}$<br>$= 114$ |
| | Follow through 'their' $a$ and $b$ Explains that the model predicts a larger value, suggesting that it would need to be modified | AO3.2b | A1F | |
| | **Total** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **5** | Translates finding the area into a definite integral | AO3.1a | M1 | $y = x^2\sin x$<br>$\int x^2\sin x\,\mathrm{d}x$<br>$u = x^2 \qquad u' = 2x$<br>$v' = \sin x \qquad v = -\cos x$ |
| | Solves $y = 0$ to find limits of integration | AO2.2a | R1 | |
| | Uses integration by parts correctly | AO1.1a | M1 | $\int x^2\sin x\,\mathrm{d}x = -x^2\cos x - \int 2x(-\cos x)\,\mathrm{d}x$<br>$= -x^2\cos x + 2\int x\cos x\,\mathrm{d}x$<br>$u = x \qquad u' = 1$<br>$v' = \cos x \qquad v = \sin x$ |
| | Obtains correct integral after first application | AO1.1b | A1 | |
| | Uses integration by parts for a second time correctly | AO1.1a | M1 | $I = -x^2\cos x + 2\left(x\sin x - \int \sin x\,\mathrm{d}x\right)$<br>$= -x^2\cos x + 2x\sin x + 2\cos x$ |
| | All notation including $\mathrm{d}x$ correct | AO2.5 | B1 | |
| | Obtains fully correct integral must have correct limits | AO1.1b | A1 | $\text{area} = \int_0^{\pi} x^2\sin x\,\mathrm{d}x$<br>$= \left[-x^2\cos x + 2x\sin x + 2\cos x\right]_0^{\pi}$<br>$= \left(-\pi^2\cos\pi + 2\pi\sin\pi + 2\cos\pi\right) - \left(0^2\cos 0 + 0\sin 0 + 2\cos 0\right)$ |
| | Substitutes 'their' limits into 'their' integral | AO1.1a | M1 | $= \left(\pi^2 - 2\right) - \left(2\right)$<br>$= \pi^2 - 4$ |
| | Completes argument to show the required result | AO2.1 | R1 | |
| | **Total** | | **9** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **6** | Identifies and clearly defines variables | AO3.1b | B1 | Let<br>$t$ = time in years<br>$M$ = mass |
| | Sets up an exponential model, including the initial mass and a constant | AO3.3 | M1 | $M = M_0 e^{-kt}$<br>When $t = 10$, $M = 0.8M_0$<br>$0.8 = e^{-10k}$ |
| | Uses given condition to determine the constant | AO3.1b | M1 | $-10k = \ln 0.8$<br>$k = -\frac{1}{10}\ln 0.8$ |
| | Obtains correct constant | AO1.1b | A1 | $k = 0.022314...$<br>when $M = 0.1M_0$ |
| | Uses 'their' model to find $t$ | AO3.4 | M1 | $0.1 = e^{-0.022314t}$<br>$t = -\frac{1}{0.022314}\ln 0.1 = 103.18$ |
| | Obtains correct number of years ft 'their' model | AO3.2a | A1F | It will take another 93.2 years |
| | **Total** | | **6** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **7 (a)** | Sketches and labels $C_1$ correctly | AO1.2 | B1 |   |
| | Sketches and labels $C_2$ correctly | AO1.1a | M1 | |
| | Labels correct $y$-intercept | AO1.1b | A1 | |
| | **Total** | | **3** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **7 (b)** | Uses a correct method to find the correct area<br><br>This could be integrating and subtracting<br><br>Or Subtracting then integrating<br><br>Or Finding ¼ of the required area and multiplying by 4 | AO3.1a | M1 | $A = 4\left(a\sqrt{a} - \int_0^{\sqrt{a}} x^2 \, \mathrm{d}x\right)$<br>$= 4\left(a\sqrt{a} - \left[\frac{x^3}{3}\right]_0^{\sqrt{a}}\right)$<br>$= 4\left(a\sqrt{a} - \frac{a\sqrt{a}}{3}\right)$<br>$= 4 \times \frac{2a\sqrt{a}}{3}$<br>$= \frac{8a^{\frac{2}{3}}}{3}$ |
| | Integrates one term correctly | AO1.1b | A1 | ALT<br>$A = \int_{-\sqrt{a}}^{\sqrt{a}} 2a - x^2 - x^2 \mathrm{d}x$ |
| | Obtains correct expression | AO1.1b | A1 | $= \int_{-\sqrt{a}}^{\sqrt{a}} 2a - 2x^2 \mathrm{d}x$ |
| | Obtains correct limits | AO1.1b | A1 | $= \left[2ax - \frac{2}{3}x^3\right]_{-\sqrt{a}}^{\sqrt{a}}$<br>$= \left(2a\sqrt{a} - \frac{2}{3}\sqrt{a}^3\right) - \left(2a\left(-\sqrt{a}\right) - \frac{2}{3}\left(-\sqrt{a}\right)^3\right)$ |
| | Substitutes 'their' limits | AO1.1a | M1 | $= \left(\frac{6}{3}a^{\frac{3}{2}} - \frac{2}{3}a^{\frac{3}{2}}\right) + \left(\frac{6}{3}a^{\frac{3}{2}} - \frac{2}{3}a^{\frac{3}{2}}\right)$ |
| | Obtains correct area through completely correct argument AG | AO2.1 | R1 | $= \frac{4}{3}a^{\frac{3}{2}} + \frac{4}{3}a^{\frac{3}{2}}$<br>$= \frac{8}{3}a^{\frac{3}{2}}$ |
| | **Total** | | **6** | |
| **7 (c)** | Forms and solves correct equation | AO1.1a | M1 | $\frac{8}{3}a^{\frac{3}{2}} = 72$ |
| | Obtains correct value for $a$ CAO | AO1.1b | A1 | $a^{\frac{3}{2}} = 27$<br>$a = 9$ |
| | **Total** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **8 (a)** | Squares the terms of the sequence PI by stating correct first term and ratio | AO3.1a | M1 | $a, ar, ar^2, \ldots$ initial sequence<br>$a^2, (ar)^2, (ar^2)^2, \ldots$ terms squared<br>$a^2, a^2r^2, a^2r^4 \Rightarrow$ 1st term $a^2$, ratio $r^2$<br>$\frac{a^2}{1-r^2} = 2\left(\frac{a}{1-r}\right)$<br>$\Rightarrow a^2(1-r) = 2a(1-r^2)$<br>$\Rightarrow a(1-r) = 2(1-r)(1+r)$<br>Assuming $a \neq 0$<br>$\Rightarrow a = 2(1+r)$ AG<br>Since $r < 1 \Rightarrow 1-r \neq 0$ |
| | Obtains/states correct first term and ratio | AO1.1b | A1 | |
| | Forms an equation using both sums to infinity | AO3.1a | M1 | |
| | Shows clear and correct algebraic reasoning to reach the required result. Factorising must be seen AG | AO2.1 | R1 | |
| | Explains why cancelling $1 - r$ and $a$ is allowed | AO2.4 | E1 | |
| | **Total** | | **5** | |
| **8 (b)** | Uses $-1 < r < 1$ to start to find an inequality for $a$ | AO2.1 | M1 | $-1 < r < 1$<br>$\Rightarrow 0 < r+1 < 2$<br>$\Rightarrow 0 < 2(r+1) < 4$<br>$\therefore\ a \in (0, 4)$ |
| | Obtains correct set for $a$ | AO2.2a | A1 | |
| | **Total** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **9** | Ticks the correct box | AO1.2 | B1 | Approximately 95% of the values are within three standard deviations of the mean |
| | **Total** | | **1** | |
| **10** | Ticks the correct box | AO1.2 | B1 | The data for paper 2 is negatively skewed |
| | **Total** | | **1** | |
| **11 (a)** | Gives two criticisms in context. Allow examples that illustrate the issues<br><br>Any one of A, B or C | AO2.3 | E1 | A: Not every member will be allocated 3 digits because $3 \times 350 > 1000$<br><br>B: Only random numbers with 3 different digits will be chosen so not every member can be chosen.<br><br>C: Repeated numbers are possible so same member could be selected twice. |
| | Any two of A, B or C<br><br>Condone incorrect extras | AO2.3 | E1 | |
| | **Total** | | **2** | |
| **11 (b)** | Gives clear method to achieve a simple random sample. The method suggested here uses the Ranint function on a calculator<br><br>Any one of A, B or C oe | AO3.5c | E1 | A: Allocate every member a number from 1 to 350<br><br>B: Use a random number generator to choose a random integer from 1 to 350<br><br>C: Continue until 20 different numbers have been identified and select the corresponding members |
| | Any two of A, B or C | AO3.5c | E1 | |
| | Any three of A, B or C<br><br>Condone incorrect extras | AO3.5c | E1 | |
| | **Total** | | **3** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **12** | Uses area of rectangles to find either total number of cars or number of cars $\geq$ 30 mph correctly | AO1.1a | M1 | Number of cars = (10 × 5) + (5 × 15) + (5 × 20) + (5 × 10) + (25 × 5) = 400<br><br>Number cars $\geq$ 30mph = (5 × 10) + (25 × 5) = 175 |
| | Obtains correct probability accept ACF | AO1.1b | A1 | P(speed $\geq$ 30) $= \frac{175}{400}$ |
| | **Total** | | **2** | |
| **13 (a)** | Finds the probabilities for $x$ = 1 to 3 using given f($x$) at least 1 correct | AO1.1a | M1 | $P(X=1)=\left(\frac{2}{3}\right)^3+\left(\frac{1}{3}\right)^4=\frac{25}{81}$<br>$P(X=2)=\frac{49}{243}$<br>$P(X=3)=\frac{97}{729}$<br>$k=1-\left[\frac{25}{81}+\frac{49}{243}+\frac{97}{729}\right]$<br>$=\frac{260}{729}$ |
| | Uses $\Sigma p_i = 1$ (at least 2 correct $p_i$s) | AO1.1b | M1 | |
| | Obtains correct **exact** value for $k$<br>CAO | AO1.1b | A1 | |
| | **Total** | | **3** | |
| **13 (b)** | Correctly finds P($3 \leq X \leq 4$)<br>ACF | AO1.1b | B1 | $\frac{119}{243}$ |
| | **Total** | | **1** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **14 (a)(i)** | States weak/some/moderate (nothing stronger than moderate) negative correlation, condone no context. Allow 'no correlation' | AO2.5 | B1 | Weak negative correlation between purchased quantities of brown bread and purchased quantities of white bread |
| | **Total** | | **1** | |
| **14 (a)(ii)** | Infers James is incorrect | AO2.2b | E1 | James is incorrect because the scatter graph does not show trend over the time period of the LDS |
| | Uses their knowledge of the LDS to explain that trend varies over time | AO3.2b | dE1 | Trends vary over time |
| | **Total** | | **2** | |
| **14 (b)** | Calculates a relevant ratio to give a comparison of 2014 and 2011 | AO1.1b | B1 | Change = 13 – 11 = 2<br>Change ratio $= \frac{(13-11)}{11} \equiv \frac{2}{11}$ |
| | Calculates a ratio with rounding considered in both numerator and denominator | AO2.3 | M1 | Using rounding<br>$\frac{(13.5 \to 12.5)-(11.5 \to 10.5)}{(10.5 \to 11.5)}$<br>Min % = $\frac{1}{11.5} \times 100 = 8.70\%$ |
| | Produces a convincing argument to show that 11% is justified or states a calculation that gives 11% | AO3.1b | A1 | Max % $\frac{3}{10.5} \times 100 = 28.6\%$<br>∴ 11% is within this range so a possible value and hence justified. |
| | **Total** | | **3** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **15 (a)(i)** | Uses calculator to find correct probability AWRT 0.106 | AO1.1b | B1 | 0.106 |
| | **Total** | | **1** | |
| **15 (a)(ii)** | Uses calculator to find correct probability AWRT 0.586 | AO1.1b | B1 | 0.586 |
| | **Total** | | **1** | |
| **15 (b)** | Identifies that 30 is a discrete value **or** $T$ is a continuous/Normal distribution | AO2.4 | E1 | 30 is a discrete value but $T$ is a continuous distribution<br><br>So P($T$ = 30) = 0 as $T$ takes an infinite number of possible values |
| | Expresses clearly the idea that P(exact value) = 0 as there are an infinite number of possible values **or** area above that point would be zero (OE) | AO2.4 | E1 | |
| | **Total** | | **2** | |
| **15 (c)** | States correct answer (using inverse normal function on calculator) 41.2 to 41.3 AWFW | AO1.1b | B1 | $y$ = 41.2 |
| | **Total** | | **1** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **15 (d)** | Finds P($T < 0$) from calculator | AO1.1b | B1 | P($T < 0$) = 0.0000884<br><br>As P($T < 0$) is so small the model could be valid, although in reality it should be 0 |
| | Makes appropriate comment supporting the model, comparing the probability found to zero | AO3.5a | E1 | |
| | **Total** | | **2** | |
| **15 (e)** | Recognises the need to find P(30 – 8 $\leq T \leq$ 30 + 8) | AO3.1b | M1 | P(22 $\leq T \leq$ 38)<br><br>= 0.683<br><br>$X$ ~ B(9 , 0.683)<br><br>P($X \geq$ 5)= 0.879 |
| | Obtains correct probability from calculator (AWRT 0.683) | AO1.1b | A1 | |
| | Selects and uses binomial model use of B(9, $p$) for 'their' $p$ seen | AO3.3 | M1 | |
| | Obtains correct value from calculator (AWRT 0.879) | AO1.1b | A1 | |
| | **Total** | | **4** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **16 (a)** | States both hypotheses using correct language | AO2.5 | B1 | $H_0$: $p = 0.7$<br>$H_1$: $p \neq 0.7$ (2 tailed test, 5% level) |
| | States model used PI by 0.0491 or 0.0208 seen | AO1.1a | M1 | $X$ ~ B(28, 0.7) ($X$ = no. who rate app as excellent)<br>P($X \leq 15$) = 0.0491 |
| | Evaluates probability by calculator, AWRT 0.049 | AO1.1b | A1 | As 0.0491 > 0.025 we do not reject $H_0$ |
| | Evaluates Binomial model by comparing P($X \leq 15$) with 0.025 and infers $H_0$ is accepted/not rejected | AO2.2b | B1 | There is insufficient evidence to suggest that the proportion of customers who rate the app as excellent has changed. |
| | Concludes correctly in context requires 'not sufficient' or 'no' oe | AO3.2a | E1 | |
| | **Total** | | **5** | |
| **16 (b)** | States why Derek thinks that the value of $p$ has fallen to below 55% | AO2.4 | E1 | $\frac{15}{28} \times 100\% = 53.8\% < 55\%$ |
| | States valid reason why Derek's conclusion is incorrect | AO2.4 | E1 | Test only confirms that the value of $p$ is unlikely to have changed, not that it has fallen or fallen below a specific value<br>So Derek is incorrect |
| | **Total** | | **2** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **17 (a)(i)** | States clearly the meaning of $A' \cap B$ in context oe | AO3.2a | B1 | Ellie does not order nachos as a starter and does order a chicken burrito as a main course. |
| | **Total** | | **1** | |
| **17 (a)(ii)** | States the event in terms of $A$ and $B$ oe | AO3.1b | B1 | $A \cup B$ |
| | **Total** | | **1** | |
| **17 (b)(i)** | Uses P($B \mid A$) formula and solves for P($A$)<br>ACF | AO1.1b | B1 | $\text{P}(B \mid A) = \dfrac{\text{P}(B \cap A)}{\text{P}(A)} = \dfrac{9}{13}$<br>$\rightarrow \text{P}(A) = \dfrac{\frac{9}{20}}{\frac{9}{13}} = \dfrac{13}{20} = 0.65$ |
| | **Total** | | **1** | |
| **17 (b)(ii)** | Uses expression to find P($B$) or shows probabilities on a Venn diagram or | AO1.1a | M1 | $\text{P}(B) = \text{P}(A' \cap B) + \text{P}(A \cap B)$<br>$= \dfrac{1}{4} + \dfrac{9}{20} = \dfrac{7}{10}$<br>$\text{P}(A \mid B) = \dfrac{\frac{9}{20}}{\frac{7}{10}} = \dfrac{9}{14} = 0.643$ |
| | Obtains correct value of P($B$) | AO1.1b | A1 | |
| | Uses P($A \mid B$) formula and achieves correct result<br>ACF | AO1.1b | A1 | |
| | **Total** | | **3** | |
| **17 (c)** | States 'no' with a valid reason, some comparison of numerical values required | AO2.4 | E1 | $\text{P}(A \cap B) = \dfrac{9}{20}$<br>$\text{P}(A)\text{P}(B) = \dfrac{13}{20} \times \dfrac{7}{10} = \dfrac{91}{200}$<br>$\text{P}(A \cap B) \neq \text{P}(A)\text{P}(B)$ so A and B are not independent |
| | **Total** | | **1** | |

| Q | Marking instructions | AO | Marks | Typical solution |
|---|---|---|---|---|
| **18** | States both hypotheses using correct terminology | AO2.5 | B1 | $H_0$: $\mu = 8$<br>$H_1$: $\mu > 8$<br>(1 tailed test, 1% level) |
| | Finds sample mean | AO1.1b | B1 | $\bar{x} = \frac{492.3}{60} = 8.205$ |
| | Considers<br>$\bar{X} \sim N\left(8, \frac{\sqrt{0.2}}{\sqrt{60}}\right)$ | AO1.1a | M1 | $P(X > 8.205) = 1.92 \times 10^{-4}$<br>$1.92 \times 10^{-4} < 0.01$ we reject $H_0$<br>The evidence suggests that the mean sugar content of the bar has increased |
| | Obtains correct probability<br>$P(X > 8.205)$ | AO1.1b | A1 | |
| | Infers $H_0$ is rejected by comparison of probability and significance level | AO2.2b | A1 | |
| | Concludes correctly in context, not too definitive | AO3.2a | E1 | |
| | **Total** | | **6** | |
| | **TOTAL** | | **100** | |