# Mark Scheme

## Mock Paper (Set 2)

## December 2019

Pearson Edexcel GCE

In Mathematics (9MA0_31) Statistics

**Edexcel and BTEC Qualifications**

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

**Pearson: helping people progress, everywhere**

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

**General Marking Guidance**

- All candidates must receive the same treatment. Examiners must mark the last candidate in exactly the same way as they mark the first.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification/indicative content will not be exhaustive.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, a senior examiner must be consulted before a mark is awarded.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

# PEARSON EDEXCEL GCE MATHEMATICS

## General Instructions for Marking

1. The total number of marks for the paper is 50.

2. These mark schemes use the following types of marks:

- **M** marks: Method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- **A** marks: Accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- **B** marks are unconditional accuracy marks (independent of M marks)
- Marks should not be subdivided.

3. Abbreviations
   These are some of the traditional marking abbreviations that will appear in the mark schemes.
   - **bod** – benefit of doubt
   - **ft** – follow through
   - the symbol $\surd$ will be used for correct ft
   - **cao** – correct answer only
   - **cso** - correct solution only. There must be no errors in this part of the question to obtain this mark
   - **isw** – ignore subsequent working
   - **awrt** – answers which round to
   - **SC**: special case
   - **o.e.** – or equivalent (and appropriate)
   - **d** or **dep** – dependent
   - **indep** – independent
   - **dp** decimal places
   - **sf** significant figures
   - **∗** The answer is printed on the paper or ag- answer given

4. All M marks are follow through.

   A marks are 'correct answer only' (cao.), unless shown, for example, as A1 ft to indicate that previous wrong working is to be followed through. After a misread however, the subsequent A marks affected are treated as A ft, but answers that don't logically make sense e.g. if an answer given for a probability is >1 or <0, should never be awarded A marks.

5. For misreading which does not alter the character of a question or materially simplify it, deduct two from any A or B marks gained, in that part of the question affected.

6. Where a candidate has made multiple responses and indicates which response they wish to submit, examiners should mark this response.
   If there are several attempts at a question which have not been crossed out, examiners should mark the final answer which is the answer that is the most complete.

7. Ignore wrong working or incorrect statements following a correct answer.

8. Mark schemes will firstly show the solution judged to be the most common response expected from candidates. Where appropriate, alternatives answers are provided in the notes. If examiners are not sure if an answer is acceptable, they will check the mark scheme to see if an alternative answer is given for the method used. If no such alternative answer is provided but the response is deemed to be valid, examiners must escalate the response for a senior examiner to review.

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 1(a) | $5 < t \leqslant 7$ group implies area of 1 cm$^2$ = freq 2 | M1 | 2.1 |
| | $14 < t \leqslant 18$ group has area 8 cm$^2$ so frequency 16 | A1 | 1.1b |
| | | (2) | |
| (b) | $18 < t \leqslant 30$ group freq $=120-(10+23+51+'16')=20$ | B1ft | 3.1a |
| | $\bar{x}=\dfrac{6\times 10+8.5\times 23+12\times 51+16\times '16'+24\times '20'}{120}$ | M1 | 1.1b |
| | $=\dfrac{1603.5}{120}=13.3625$ awrt 13.4 | A1 | 1.1b |
| | | (3) | |
| (c) | $15.5 + 1.5 \times (15.5 - 9.6) =$ (awrt 24.3 ~ 24.4)<br>Limit for outlier 24.3~24.4 so (high) chance of outliers in $18 < t \leq 30$ group | M1<br>A1 | 2.4<br>2.2b |
| | | (2) | |
| (d) | $P_5 = 5 + \dfrac{6}{10} \times 2$ | M1 | 3.1b |
| | = 6.2 mins (= 6 minutes 12 seconds) | A1 | 1.1b |
| | | (2) | |
| | | | **(9 marks)** |

| **Notes:** |
|---|
| (a) M1 use of $5 < t \leq 7$ group using area or freq density<br>A1 frequency = 16 only |
| (b) B1 freq of $18 < t \leq 30$ group ft their '16'<br>M1 correct method seen (at least 2 terms) for mean of grouped data, (may be implied by correct answer)<br>A1 awrt 13.4 |
| (c) M1 Use of $Q_3$ + 1.5 × IQR<br>A1 correct limit found and correct conclusion |
| (d) M1 attempt to interpolate $5 < t \leq 7$ in group<br>A1 6.2 minutes or accept 6 minutes 12 seconds. |

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 2(a) (i) (ii) | $\left(\text{Use of } X \sim \text{N}(30, 2^2)\right)$ | | |
| | $\text{P}(X = 31) = 0$ | B1 | 1.2 |
| | From calculator, $\text{P}(X > 31) = 0.3085$ ... awrt 0.309 | B1 | 1.1b |
| | | (2) | |
| (b) (i) | $0.0668 \times (1 - 0.0668)^4$ | M1 | 3.1b |
| | $=0.050665\ldots$ awrt 0.0507 | A1 | 1.1b |
| | | (2) | |
| (ii) | $Y \sim \text{B}(5, 0.0668)$ | M1 | 3.3 |
| | $\text{P}(Y > 1) = 1 - \text{P}(Y \leq 1)$ $= 1 - 0.9610 \ldots = 0.0390$ awrt 0.039 | M1<br>A1 | 3.4<br>1.1b |
| | | (3) | |
| (c) | $H \sim \text{N}(\mu, 1.5^2)$ | | |
| | $\text{P}(H > 42) = 0.0005$ or $\text{P}(H < 42) = 0.9995$ | M1 | 1.1b |
| | $z = 3.2905268 \ldots$ awrt 3.29 | B1 | 1.1b |
| | $z = \dfrac{42 - \mu}{1.5} = 3.29 \ldots$ | M1 | 2.1 |
| | $\mu = 37.0642 \ldots$ awrt 37.1 $^\circ c$ | A1 | 1.1b |
| | | (4) | |
| | | | **(11 marks)** |

| **Notes:** |
|---|
| (a)(i) B1 for 0 no working or justification required<br>(ii) awrt 0.309 |
| (b)(i) M1 $p(1-p)^4$<br>A1 awrt 0.0507 |
| (ii) 1st M1 Binomial B(5, 0.0668)<br>2nd M1 use of correct Binomial to find P($Y > 1$)<br>A1 awrt 0.039 |
| (c) B1 awrt 3.29<br>2nd M1 correct standardised expression with $z > 2$<br>A1 awrt 37.1 |

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 3(a)(i) | P(NNE) = 1/16 oe | B1 | 1.1b |
| (ii) | (Discrete) uniform distribution | B1 | 1.2 |
| | | (2) | |
| (b) | e.g. lds only gives data for months May to October<br>or lds only gives data for 2 specific years | B1 | 2.4 |
| | | (1) | |
| (c) | Any two from eg | | |
| | Create numbered list or sampling frame of days of the year<br>Use random number generator/table to select 36 numbers<br>In the range 001 to 365 (or 366)<br>ignoring others/repeats | B1<br>B1 | 1.1b,<br>1.1b |
| | | (2) | |
| (d)(i) | $H_1 : p \neq 0.25$ | B1 | 2.2a |
| (ii) | Test statistic is in critical region so evidence to reject $H_0$ | M1 | 1.1b |
| | e.g. Significant evidence that the daily mean wind directions are not all equally likely (oe) | A1ft | 3.5a |
| | | (3) | |
| | | | **(8 marks)** |

| **Notes:** |
|---|
| (a)(i) B1 1/16 or 0.0625 only |
| (b) accept reference to Sam's investigation of weather **throughout the year** |
| (c) any 2 valid steps. Accept numbering eg 000 to 364 etc |
| (d) A1ft requires valid comment in context, ft their $H_1$, Accept eg P(wind between 135 $^\circ c$ and 225 $^\circ c$) $\neq 0.25$ , but not just $p \neq 0.25$ , needs context. |

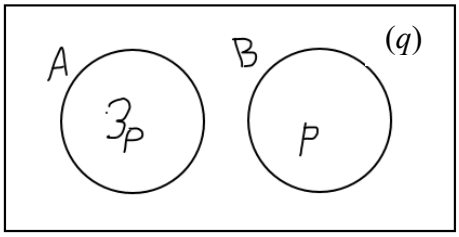
| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 4(a) | $\bar{X} = \frac{1680}{60} = 28\,(\text{minutes})$ | B1 | 1.1b |
| | $S_{xx} = 47654.4 - \frac{1680^2}{60} (= 614.4)$ | M1 | 1.1b |
| | St dev $= \sqrt{\frac{S_{xx}}{60}} = 3.2$ minutes | A1 | 1.1b |
| | | **(3)** | |
| (b) | $H_0 : \mu = 27.5 \quad H_1 : \mu > 27.5$<br>Using $\bar{X} \sim N\left(27.5, \frac{3^2}{60}\right)$ | B1<br>M1 | 2.5<br>3.3 |
| | Test value $z = \frac{28 - 27.5}{3/\sqrt{60}} = 1.2909...$ | A1ft | 1.1b |
| | Critical value $z = 1.64485...$<br>1.64 or better | B1 | 1.1b |
| | Not in critical region so insufficient evidence to support Lucy's belief oe | A1cso | 3.5a |
| | | **(5)** | |
| (c)(i) | Assumption of constant probability of success, $p = 0.2$ is unreasonable oe | B1 | 3.4 |
| | As 5 fastest and 5 beginners have differing chances | B1 | 2.4 |
| (ii) | | **(2)** | |
| | e.g. Model 5 fastest and 5 beginners as 2 independent binomial distributions each with $n = 5$ but different values of $p$ | B1 | 3.5c |
| | | **(1)** | |
| | | | **(11 marks)** |

**Notes:**

(a) B1 28 cao
M1 use of formula for $S_{xx}$ oe alternative method
A1 3.2 minutes or 3 minutes 12 seconds

(b) B1 both hypotheses correct, must be in terms of $\mu$
M1 correct model for $\bar{X}$ using their sample mean and standard deviation
A1 ft their sample mean and standard deviation
B1 correct critical value for $z$ or correct $p$ value (0.09835…) awrt 0.098
A1 cso correct conclusion in context

(c)(i) 1st B1 correct comment on 0.2
2nd B1 valid reason in context
(ii) B1 idea of separate distributions to model each group

| Question | Scheme | Marks | AOs |
|---|---|---|---|
| 5(i)(a) | Box and 2 non-intersecting circles labelled $A$ and $B$<br>  <br> | B1 | 2.1 |
| (b) | $\mathrm{P}(A)+\mathrm{P}(B)\leq 1$ or $4p\leq 1$ oe<br>$0<\mathrm{P}(B)\leq 0.25$ | M1<br>A1 | 1.1b<br>1.1b |
| | | **(3)** | |
| (ii)(a) | If independent $\mathrm{P(C \mid D) = P(C)}$ so $C$ and $D$ not independent | B1 | 2.4 |
| | | **(1)** | |
| (b) | Use of $\mathrm{P(C \mid D)}=\dfrac{P(C\cap D)}{P(D)}$ | M1 | 1.1b |
| | $3\times\mathrm{P}(C)=\dfrac{0.5\times P(C)}{P(D)}$ | A1 | 2.1 |
| | $\mathrm{P(D)}=\dfrac{1}{6}$ | A1 | 1.1b |
| | $P(C'\cap D')=\dfrac{7}{10}$ so $P(C\cup D)=\dfrac{3}{10}$ | B1 | 1.1b |
| | Use of $P(C\cup D)=\mathrm{P}(C)+\mathrm{P}(D)-P(C\cap D)$<br>$\dfrac{3}{10}=\mathrm{P}(D)+\dfrac{1}{6}-0.5\times P(C)$ | M1<br>dM1 | 3.1a<br>1.1b |
| | $P(C)=\dfrac{4}{15}$ | A1 | 1.1b |
| | | **(7)** | |
| | | | **(11 marks)** |

| **Notes:** |
| --- |
| (i) (a) B1 correct shape diagram with $A$ and $B$ labelled and $p$ and $3p$ correctly placed<br>(b) M1 correct idea for upper limit in words or inequality<br>A1 fully correct |
| (ii)(a) B1 needs not independent oe **and** valid reason |
| (b) 1st M1 any attempt to use formula for $\mathrm{P(C \mid D)}$<br>1st A1 may be implied by sight of $\mathrm{P(D)} = \frac{1}{6}$<br>B1 alt award if correct region labelled with $\frac{7}{10}$ in Venn diagram<br>2nd M1 use of formula with their $P(C \cup D)$ and $\mathrm{P}(D)$<br>3rd dM1(dependent on previous M1) complete method to find $\mathrm{P}(C)$<br>3rd A1 $P(C) = \frac{4}{15}$ with valid supporting reasoning |
| |