As part of CIE’s continual commitment to maintaining best practice in assessment, CIE has begun to use different variants of some question papers for our most popular assessments with extremely large and widespread candidature. The question papers are closely related and the relationships between them have been thoroughly established using our assessment expertise. All versions of the paper give assessment of equal standard.

The content assessed by the examination papers and the type of questions are unchanged.

This change means that for this component there are now two variant Question Papers, Mark Schemes and Principal Examiner’s Reports where previously there was only one. For any individual country, it is intended that only one variant is used. This document contains both variants which will give all Centres access to even more past examination material than is usually the case.

The diagram shows the relationship between the Question Papers, Mark Schemes and Principal Examiner’s Reports.

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<th>Question Paper</th>
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Who can I contact for further information on these changes?
Please direct any questions about this to CIE’s Customer Services team at: international@cie.org.uk
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Mark schemes must be read in conjunction with the question papers and the report on the examination.

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M Method mark, awarded for a valid method applied to the problem. Method marks are not lost for numerical errors, algebraic slips or errors in units. However, it is not usually sufficient for a candidate just to indicate an intention of using some method or just to quote a formula; the formula or idea must be applied to the specific problem in hand, e.g. by substituting the relevant quantities into the formula. Correct application of a formula without the formula being quoted obviously earns the M mark and in some cases an M mark can be implied from a correct answer.

A Accuracy mark, awarded for a correct answer or intermediate step correctly obtained. Accuracy marks cannot be given unless the associated method mark is earned (or implied).

B Mark for a correct result or statement independent of method marks.

- When a part of a question has two or more "method" steps, the M marks are generally independent unless the scheme specifically says otherwise; and similarly when there are several B marks allocated. The notation DM or DB (or dep*) is used to indicate that a particular M or B mark is dependent on an earlier M or B (asterisked) mark in the scheme. When two or more steps are run together by the candidate, the earlier marks are implied and full credit is given.

- The symbol √ implies that the A or B mark indicated is allowed for work correctly following on from previously incorrect results. Otherwise, A or B marks are given for correct work only. A and B marks are not given for fortuitously "correct" answers or results obtained from incorrect working.

- Note: B2 or A2 means that the candidate can earn 2 or 0. B2/1/0 means that the candidate can earn anything from 0 to 2.

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The following abbreviations may be used in a mark scheme or used on the scripts:

AEF  Any Equivalent Form (of answer is equally acceptable)
AG   Answer Given on the question paper (so extra checking is needed to ensure that the detailed working leading to the result is valid)
BOD  Benefit of Doubt (allowed when the validity of a solution may not be absolutely clear)
CAO  Correct Answer Only (emphasising that no "follow through" from a previous error is allowed)
CWO  Correct Working Only – often written by a ‘fortuitous’ answer
ISW  Ignore Subsequent Working
MR   Misread
PA   Premature Approximation (resulting in basically correct work that is insufficiently accurate)
SOS  See Other Solution (the candidate makes a better attempt at the same question)
SR   Special Ruling (detailing the mark to be given for a specific wrong solution, or a case where some standard marking practice is to be varied in the light of a particular circumstance)

**Penalties**

**MR −1** A penalty of MR −1 is deducted from A or B marks when the data of a question or part question are genuinely misread and the object and difficulty of the question remain unaltered. In this case all A and B marks then become "follow through √" marks. MR is not applied when the candidate misreads his own figures – this is regarded as an error in accuracy. An MR−2 penalty may be applied in particular cases if agreed at the coordination meeting.

**PA −1** This is deducted from A or B marks in the case of premature approximation. The PA −1 penalty is usually discussed at the meeting.
<table>
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<tr>
<th>Q.</th>
<th>Statement</th>
<th>Mark</th>
<th>Reasoning</th>
</tr>
</thead>
</table>
| 1  | $H_0: \mu = 18.5$  
$H_1: \mu < 18.5$  
Test statistic $z = \frac{18.1 - 18.5}{(1.1/\sqrt{20})}$  
CV $z = \pm 1.96$  
Not enough evidence to support the claim that fingers are smaller. | B1 | Both hypotheses correct  
M1 | Standardising, must have $\sqrt{20}$  
A1 | For correct $z$  
M1 | Correct comparison with correct CV or finding area on LHS of $-1.626$ and comparing with $2.5\%$ (OR comparison with $2.241$ oe if one-tail test set up)  
A1ft | Correct conclusion must fit their CV and their $z$. No contradictions |
| 2  | $\hat{\mu} = 227.1$  
$5 = 2.17 \times \frac{\hat{\sigma}^2}{\sqrt{50}}$  
$\hat{\sigma}^2 = 265$ or $266$ | B1 | Correct mean  
B1 | 2.17 seen  
M1 | Solving an equation with 5 or 10 on the LHS and some $z$ value $\times \frac{\hat{\sigma}}{\sqrt{n}}$ on the RHS  
A1 | Correct answer  
|   | $4 = 2.17 \times \frac{16.3}{\sqrt{n}}$  
$n = 78$ | B1ft | Correct equation fit their wrong $z$ if the same as in part (i) and their $\sigma$  
M1 | Solving an equation with their $z$ and $\sigma$, and width 4 or 8  
A1 | Correct answer (whole number) |
| 3  | $\lambda = 2$  
P$(X > 3) = 1 - P(0, 1, 2, 3)$  
$= 1 - e^{-2} \left( 1 + 2 + \frac{2^2}{2} + \frac{2^3}{3!} \right)$  
$= 1 - 0.857 = 0.143$ | B1 | Correct mean (used)  
M1 | Poisson $1 - P(0,1,2,3)$ or $P(0,1,2)$ or $P(1,2,3)$  
A1 | Correct answer  
|   | $\lambda = 16/3$  
P$(7) = e^{-16/3} \left( \frac{16/3)^7}{7!} \right)$  
$= 0.118$ | B1 | Correct new mean  
M1 | $P(7)$ using a different mean from (i)  
A1 | Correct final answer  
|   | $X \sim N(160, 160)$  
P$(X < 137) = P \left( z < \frac{136.5 - 160}{\sqrt{160}} \right)$  
$= P(z < -1.858)$  
$= 1 - 0.9684 = 0.0316$ | B1 | Correct mean and variance  
M1 | Standardising attempt with or without cc must have sq rt  
M1 | Cc of 136.5 or 137.5 and area < 0.5  
A1 | Correct answer |
<table>
<thead>
<tr>
<th>Question</th>
<th>Details</th>
</tr>
</thead>
</table>
| 4 (i)    | $H_0: p = 0.36$
|          | $H_1: p > 0.36$
|          | $P(7) = \binom{8}{7} (0.36)^7 (0.64)^1 = 0.00401$
|          | $P(8) = (0.36)^8 = 0.000282$
|          | $\Sigma P = 0.00429 < 0.05$
|          | Accept driving instructor’s claim
|          | B1 Both hypotheses correct
|          | M1 Evaluating $P(7)$ or $P(8)$
|          | A1 Correct answer for both
|          | M1 Comparing their prob sum to 0.05 oe
|          | B1 Correct conclusion cwo no contradictions
| (ii)     | Type I error
|          | $P(6) = \binom{8}{6} (0.36)^6 (0.64)^2 = 0.02496$
|          | $P(5) = \binom{8}{5} (0.36)^5 (0.64)^3 = 0.08876,$
|          | $\Sigma P > 0.05$
|          | $P(\text{Type I error}) = 0.0292$ or 0.0293
|          | B1 Correct answer
|          | M1 Evaluating $P(6)$
|          | B1 Correct $P(5)$ and showing this is not in the CR either by $\Sigma P > 0.05$ or $P(5) > 0.05$
|          | A1 Correct answer
|          | NB Marks for part (ii) may be awarded in part (i) but not vice versa.
| 5 (i)    | $\int_{3}^{6} k(6t - t^2) \, dt = 1$
|          | $k \left[ 3t^2 - t^3 / 3 \right]_{3}^{6} = 1$
|          | $k([108 - 216/3] - [27 - 9]) = 1$
|          | $k = 1/18 \text{ AG}$
|          | M1 For equating to 1 and a sensible attempt to integrate
|          | A1 Correct integration and correct limits
|          | A1 Given answer correctly obtained
| (ii)     | $\text{mean} = \int_{3}^{6} k(6t^2 - t^3) \, dt$
|          | $= \left[ k(2t^3 - t^4 / 4) \right]_{3}^{6}$
|          | $= k(432 - 324) - k(54 - 81 / 4)$
|          | $= \frac{33}{8}$ (4.13)
|          | M1 Attempt to evaluate the integral of $t^3 (t^2)$ (t or x)
|          | A1 Correct integral and correct limits (condone loss of k)
|          | A1 Correct answer
| (iii)    | $\int_{3}^{6} k(6t - t^2) \, dt$
|          | $= k \left[ 3t^2 - t^3 / 3 \right]_{5}^{6}$
|          | $= k \left( 36 - \frac{100}{3} \right)$
|          | $= \frac{4}{27}$ (0.148)
|          | M1 Attempt to evaluate the integral between 5 and 6 oe
|          | A1 Correct answer
| (iv)     | $\text{the area on the left is} > 0.75$
|          | or (iii) is < 0.25
|          | UQ is less than 5
|          | M1 sensible reason
|          | A1 ft their (iii)
|          | SR B1 ft correct but 0.25/0.75 implied
6 (i) $T_1 + T_2 + T_4 - T_3 \sim N(-0.95, 4.345)$

\[ P \left[ (T_1 + T_2 + T_4 - T_3) > 0 \right] = P \left( z > \frac{0 - (-0.95)}{\sqrt{4.345}} \right) = P(z > 0.4557) \]

\[ = 1 - 0.0.6758 \]

\[ = 0.324 \]

M1 Attempt to find mean and var of $T_1 + T_2 + T_4 - T_3$ oe

B1 Correct mean $(3.75 + 3.1 + 3.2 - 11)$

A1 Correct variance

M1 Finding $P$ their $[(T_1 + T_2 + T_4 - T_3) > 0]$ oe

M1 Standardising (appropriate variance involving all 4) and area <0.5

A1 Correct answer

6 (ii) $X \sim N(3.1, 0.785/6)$

\[ P (\bar{X} < 4) = P \left( z < \frac{4 - 3.1}{\sqrt{0.785/6}} \right) \]

\[ = P(z < 2.488) \]

\[ = 0.994 \]

M1 Normal distribution mean 3.1, var 0.785/6, can be implied

M1 OR $N(18.6, 4.71)$ if working with totals

M1 Standardising with $\sqrt{rt}$

OR $(24 - 18.6)/\sqrt{4.71}$

A1 Correct answer
MARK SCHEME for the May/June 2009 question paper
for the guidance of teachers

9709 MATHEMATICS
9709/72 Paper 7, maximum raw mark 50

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<th>Mark Scheme</th>
<th>Syllabus</th>
<th>Paper</th>
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</table>
| 1 | $H_0: \mu = 1.746$  
$H_1: \mu \neq 1.746$  
Test statistic $z = \frac{1.765 - 1.746}{0.149 / \sqrt{230}} \pm 1.93(4)$  
CV $z = \pm 1.645$ | B1 | Both hypotheses correct  
M1 | Standardising, must have $\sqrt{230}$  
A1 | For correct $z$  
M1 | Correct comparison with correct CV or finding area on RHS of their $z$ and comparing with 0.05 (must be 0.05)  
OR if one tail test comparison with 1.282 
Correct conclusion must fit their CV and their $z$. No contradictions |
| 2 | $\bar{\mu} = 227.1$  
$\sigma^2 = 265$ or 266 | B1, B1 | Correct mean  
M1 | Solving an equation with 5 or 10 on the LHS and some $z$ value $\frac{\hat{\sigma}}{\sqrt{n}}$ on the RHS  
A1 | Correct answer |
| | 5 | B1ft | Correct equation fit their wrong $z$ if the same as in part (i) and their $\sigma$  
M1 | Solving an equation with their $z$ and $\sigma$, and width 4 or 8  
A1 | Correct answer (whole number) |
| 3 | $\lambda = 4.5$  
P(at most 2) = P(0, 1, 2)  
$= e^{-4.5} \left(1 + 4.5 + \frac{4.5^2}{2!}\right)$  
$= 0.174$ | B1 | Correct mean (used)  
M1 | Poisson (0, 1, 2) or P(0, 1) or P(1, 2)  
A1 | Correct answer |
| | $\lambda = 7.5$  
P(6) = $e^{-7.5} \left(\frac{7.5^6}{6!}\right)$  
$= 0.137$ | B1 | New mean $(1.5 + 6)$ used  
M1 | P(6) using a different mean from (i)  
A1 | Correct answer |
| | $X \sim N(90, 90)$  
P$(X > 100) = P\left(\frac{z > 100.5 - 90}{\sqrt{90}}\right)$  
$= P(z > 1.107)$  
$= 1 - 0.8657 = 0.134$ | B1, M1 | Correct mean and variance  
M1 | Standardising attempt with or without cc must have $\sqrt{90}$  
Cc of 100.5 or 99.5 and area < 0.5  
A1 | Correct answer |
**Second variant Mark Scheme**

<table>
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<tr>
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<tr>
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<td>GCE A/AS LEVEL – May/June 2009</td>
<td>9709</td>
<td>72</td>
</tr>
</tbody>
</table>

### 4 (i) H₀: \( p = 0.36 \)

\[ H₁ : p > 0.36 \]

\[
P(7) = ^8C_7 \times (0.36)^7 (0.64)^1 = 0.00401
\]

\[
P(8) = (0.36)^8 = 0.000282
\]

\[ \Sigma P = 0.00429 < 0.05 \]

Accept driving instructor’s claim

\[ B₁ \]

\[ M₁ \]

\[ A₁ \]

\[ M₁ \]

\[ A₁ \]

\[ [5] \]

Both hypotheses correct

### (ii) Type I error

\[
P(6) = ^8C_6 \times (0.36)^6 (0.64)^2 = 0.02496
\]

\[
P(5) = ^8C_5 \times (0.36)^5 (0.64)^3 = 0.08876,
\]

\[ > 0.05 \]

\[ P(5) = 0.08876 < 0.05 \]

\[ P(6) = 0.02496 \]

\[ P(5) < 0.05 \]

\[ P(6) > 0.05 \]

\[ P(5) > 0.05 \]

\[ \Sigma P > 0.05 \]

\[ M₁ \]

\[ B₁ \]

\[ A₁ \]

\[ [4] \]

Correct answer

Evaluating \( P(6) \)

Correct expression for \( P(5) \) and showing this is not in the CR either by \( \Sigma P > 0.05 \) or \( P(5) > 0.05 \)

Correct answer

NB Marks for part (ii) may be awarded in part (i) but not vice versa.

### 5 (i)

\[ \int_{0}^{2} kx^2 (2-x) \, dx = 1 \]

\[
\left[ \frac{2kx^3}{3} - \frac{kx^4}{4} \right]_0^2 = 1
\]

\[
\frac{16k}{3} - \frac{16k}{4} = 1
\]

\[ k = 3/4 AG \]

\[ A₁ \]

\[ [3] \]

Given answer correctly obtained

### (ii)

Mean = \[ \int_{0}^{2} 2kx^3 - kx^4 \, dx \]

\[
\left[ \frac{2kx^4}{4} - \frac{kx^5}{5} \right]_0^2 = 32k - \frac{32k}{5}
\]

\[ = \frac{4}{5} \]

\[ = 1.2 \text{ m} \]

\[ A₁ \]

\[ [3] \]

Correct answer

### (iii)

\[ \int_{1.3}^{2} kx^2 (2-x) \, dx \]

\[
\left[ \frac{2kx^3}{3} - \frac{kx^4}{4} \right]_{1.3}
\]

\[ = 1 - 0.563 \]

\[ = 0.437 \]

\[ A₁ \]

\[ [2] \]

Correct answer

### (iv)

The area on the right is < 0.5 oe

\[ \text{median is less than 1.3 m} \]

\[ M₁ \]

\[ A₁ \]

Sensible reason

ft their (iii)

SR B₁ ft if correct but 0.5 implied

\[ [2] \]
### Question 6

#### Part (i)

\[ T_1 + T_2 + T_4 - T_3 \sim N(-0.95, 4.345) \]

\[
P \left( \frac{T_1 + T_2 + T_4 - T_3 > 0}{4.345} \right) = P(z > 0.4557) = 1 - 0.6758 = 0.324
\]

**Marking Scheme**
- **M1**: Correct method to find mean and var of \( T_1 + T_2 + T_4 - T_3 \) oe
- **B1**: Correct mean \((3.75 + 3.1 + 3.2 - 11)\)
- **A1**: Correct variance
- **M1**: Finding \( P(\text{their } (T_1 + T_2 + T_4 - T_3) > 0) \) oe
- **M1**: Standardising (appropriate variance involving all 4) and area < 0.5
- **A1**: Correct answer

#### Part (ii)

\[ X \sim N(3.1, 0.785/6) \]

\[
P(\overline{X} < 4) = P \left( z < \frac{4 - 3.1}{\sqrt{0.785/6}} \right) = P(z < 2.488) = 0.994
\]

**Marking Scheme**
- **M1**: Normal distribution mean 3.1, var 0.785/6, can be implied
- **M1**: OR \( N(18.6, 4.71) \) if working with totals
- **M1**: Standardising with \( \sqrt{\text{var}} \)
- **M1**: OR \((24 - 18.6)/\sqrt{4.71}\)
- **A1**: Correct answer