This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners’ meeting before marking began.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates’ scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2007 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.
Mark Scheme Notes

Marks are of the following three types:

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.

The marks indicated in the scheme may not be subdivided. If there is genuine doubt whether a candidate has earned a mark, allow the candidate the benefit of the doubt. Unless otherwise indicated, marks once gained cannot subsequently be lost, e.g. wrong working following a correct form of answer is ignored.

• Wrong or missing units in an answer should not lead to the loss of a mark unless the scheme specifically indicates otherwise.

• For a numerical answer, allow the A or B mark if a value is obtained which is correct to 3 s.f., or which would be correct to 3 s.f. if rounded (1 d.p. in the case of an angle). As stated above, an A or B mark is not given if a correct numerical answer arises fortuitously from incorrect working. For Mechanics questions, allow A or B marks for correct answers which arise from taking g equal to 9.8 or 9.81 instead of 10.
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.
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| **1** | 5 | \[
\text{mean } = 10 \times 0.15 = 1.5, \\
\text{var}=10 \times 0.15 \times 0.85 = 1.275 \\
\text{P}(\bar{X} > 1.4) = 1 - \Phi \left( \frac{1.4(1/100) - 1.5}{\sqrt{1.275/50}} \right) \\
= \Phi(0.5636) = 0.713 \text{ or 0.714 or 0.734 without cc} \]

**Mark Scheme:** 
- B1 B1 \[\text{Mean and variance correct (OR if working with totals mean=75, var=63.75)}\]
- M1 \[\text{Standardising with (correct) or without cc must have } \sqrt{\text{var/50 in denom (OR equiv standardisation using totals)}}\]
- M1 \[\text{Correct area i.e. > 0.5} \]
- A1 \[\text{Correct answer, accept either}\]

| **2** | 5 | \[
\Sigma 60 \text{ obs } \sim N(60 \times 3.2, 60 \times 1.2^2) \\
\sim N(192, 86.4) \\
\text{P}(S > 200) = 1 - \Phi \left( \frac{200 - 192}{\sqrt{86.4}} \right) \\
= 1 - \Phi (0.861) \\
= 0.195 \]

**Mark Scheme:** 
- B1 \[\text{192 or 60 \times 3.2 seen} \]
- B1 \[86.4 \text{ or } 60 \times 1.2^2 \text{ or equivalent seen}\]
- M1 \[\text{standardising with sq rt and no cc correct area i.e. < 0.5}\]
- M1 \[\text{correct answer OR } 200/60 (B1) 1.2/\sqrt{60} (B1) \]
- A1 \[\text{correct answer OR } 3\sqrt{3}-3.2 \text{ or equivalent seen}\]

| **3** | 5 | \[
H_0: \mu = 22 \\
H_1: \mu \neq 22 \\
\text{Under } H_0, \text{ test statistic } z = \frac{21.7 - 22}{\sqrt{0.19/8}} \\
= -1.947 \]

**Mark Scheme:** 
- B1 \[\text{Both correct, alternative hypothesis must be } \neq\]
- M1 \[\text{Standardising, must see } \sqrt{8} \text{ in denom}\]
- A1 \[\text{Correct test statistic } \pm \text{ (accept rounding to 1.95)}\]
- M1 \[\text{Comparison with correct CV must be } \pm 1.96 \text{ (or } z \text{ consistent with } H_1) \text{ or area comparison}\]
- A1 \[\text{Correct conclusion fit their test statistic and CV (OR } 22\pm 1.96 \sqrt{(0.19/8)} \text{ or } z \text{ consistent with } H_1 \text{ M1 A1}\] \[\text{then comparison with } 21.7 \text{ M1 A1}\]

| **4** | 3 | \[
(i) X \sim B(22,0.2) \\
P(0, 1) = 0.8^{22} + 0.2 \times 0.8^{21} 22C_1 \\
= 0.0480 \text{ (4.8%)} \]

(ii) \[\text{P(Type I error) } = 0.0480 \]

(iii) \[\text{P(Type II error) } = 1 - P(0, 1) \\
= 1 - (0.91^{22} + 0.09 \times 0.91^{21} \times 22C_1) \\
= 0.601 \]

**Mark Scheme:** 
- M1 \[\text{For identifying the correct probability}\]
- M1 \[\text{For binomial probs with } C \text{ and powers summing to 22}\]
- A1 \[\text{Correct answer accept 0.048}\]

- B1 ft \[\text{Ft on their (i)}\]
- NB M1 M1 from (i) can be recovered in (ii) if not scored in (i)\]

| **5** | 3 | Identifying the correct probability Binomial probs with 0.09 and 0.91 Correct answer |
### Question 5

**Part (i)**
people call randomly, independently, at an average uniform rate  

**Mark Scheme**
- **B1** Any two seen, or equivalent words in context
- **B1** SR If B0 B0 scored and two correct reasons seen but not in context score B1

**Part (ii)**

\[
P(8) = e^{10} \times \frac{10^8}{8!} = 0.113
\]

**Mark Scheme**
- **M1** 10 seen in a Poisson calculation correct answer
- **A1** mean and variance = 240
- **M1** standardising with their mean and variance
- **M1** subtracting the two relevant \( \Phi \)s
- **A1** 4 correct answer
- **SR** If 0/4 scored P(250) = \( e^{-240} \times 240^{250/250!} \) seen scores B1

**Part (iii)**

\[
X \sim N(240, 240)
\]

\[
P(X=250) = \Phi\left( \frac{250.5 - 240}{\sqrt{240}} \right) - \Phi\left( \frac{249.5 - 240}{\sqrt{240}} \right)
\]

\[
= \Phi(0.678) - \Phi(0.613)
\]

\[
= 0.7512 - 0.7301
\]

\[
= 0.0211 \text{ (accept 3sf or more rounding to 0.021)}
\]

**Mark Scheme**
- **B1** Any two seen, or equivalent words in context
- **B1** SR If B0 B0 scored and two correct reasons seen but not in context score B1

### Question 6

**Part (i)**

\[
\bar{x} = 1050
\]

\[
s^2 = \frac{1}{29} \left( 33141816 - \frac{31500^2}{30} \right)
\]

\[
= 2304
\]

**Mark Scheme**
- **B1** Correct mean
- **M1** Correct formula with 29 in denom
- **A1** 3 Correct answer

**Part (ii)**

\[
1050 \pm 2.326 \times \frac{48}{\sqrt{30}}
\]

\[
= (1030, 1070)
\]

**Mark Scheme**
- **M1** Correct shape with \( \sqrt{30} \) in denom
- **B1** 2.326 seen or equivalent, ft on their mean and variance

**Part (iii)**

\[
1.96 \times \frac{48}{\sqrt{n}} = 6
\]

\[
n = 246
\]

**Mark Scheme**
- **M1** Correct form of LHS of equation/inequality involving 1.96, 48, \( \sqrt{n} \)
- **M1dep** Equated to 6 and attempt to solve (accept factor of 2 errors)
- **A1** 3 correct answer
- **SR** If M0 M0 scored but only error is in \( z \) value score M1
7 (i) no values outside 1 ≤ x ≤ 2 curve through (1,0) and (2, 2.25)  
B1  1 and 2 seen, 
B1  2  no f vals needed, correct shape

(ii) \( \mu = \int_1^2 x \frac{3x^3}{4} \, dx = \frac{3}{4} \left[ \frac{x^4}{16} - \frac{3x^2}{8} \right] \)
= \left[ -\frac{3}{16} \right] - \left[ \frac{3}{16} - \frac{3}{8} \right] 
= 27/16 (1.6875)  
M1  attempt to integrate x(f(x)), any limits 
M1  correct limits on an integration 
A1  3  correct answer legit obtained

(iii) \( \sigma^2 = \int_1^2 x^2 \frac{3x^3}{4} \, dx - \text{mean}^2 \)
= \left[ \frac{3}{4} \left( \frac{x^5}{20} - \frac{3x^3}{12} \right) \right] - 1.6875^2 
= \left[ \frac{96}{20} - \frac{3}{2} \right] - \left[ \frac{3}{20} - \frac{3}{12} \right] - 1.6875^2 
= 0.052343 
sd = 0.2288 to 4 dp AG  
M1  attempt to integrate \( x^2 f(x) \), with – mean^2 seen 
A1  correct integral 
A1  3  correct answer legit obtained

(iv) \( \int_1^{1.9163} x^2 \frac{3x^3}{4} \, dx \)
= \left[ \frac{x^4}{4} - \frac{3x^2}{4} \right]^{1.9163} 
= 0.822 or 0.821  
M1  attempt to integrate f(x), with limits attempted 
A1  correct limits (4 s f) 
A1  3  correct answer