AS Mathematics and Statistics

General Marking Instructions

1. It is very important that all markers should adhere as closely as possible to the marking scheme. In many cases, however, candidates will have obtained a correct answer by an alternative method not specified in the marking scheme. In general, a correct answer merits ***all the marks*** allocated to that part, unless a particular method has been specified in the question. Makers should be patient in marking alternative solutions not specified in the marking scheme.

2. In the marking scheme, marks are classified into the following three categories:

'M' marks	awarded for correct methods being used;
'A' marks	awarded for the accuracy of the answers;
Marks without 'M' or 'A'	awarded for correctly completing a proof or arriving at an answer given in a question.

   In a question consisting of several parts each depending on the previous parts, 'M' marks should be awarded to steps or methods correctly deducted from previous answers, even if these answers are erroneous. However, 'A' marks for the corresponding answers should NOT be awarded (unless otherwise specified).

3. For the convenience of markers, the marking scheme was written as detailed as possible. However, it is still likely that candidates would not present their solution in the same explicit manner, e.g. some steps would either be omitted or stated implicitly. In such cases, markers should exercise their discretion in marking candidates' work. In general, marks for a certain step should be awarded if candidates' solution indicated that the relevant concept/technique had been used.

4. Use of notation different from those in the marking scheme should not be penalized.

5. In marking candidates' work, the benefit of doubt should be given in the candidates' favour.

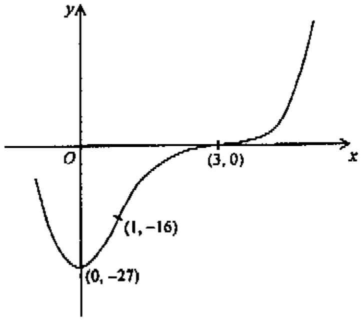
6. Marks may be deducted for poor presentation (*pp*). The symbol (*pp-1*) should be used to denote 1 mark deducted for *pp*. At most deducted 1 mark from Section A and 1 mark from Section B for *pp*. In any case, do not deduct any marks for *pp* in those steps where candidates could not score any marks.

7. Marks may be deducted for numerical answers with inappropriate degree of accuracy (*a*). The symbol (*a-1*) should be used to denote 1 mark deducted for *a*. At most deducted 1 mark from Section A and 1 mark from Section B for *a*. In any case, do not deduct any marks for *a* in those steps where candidates could not score any marks.

8. Marks entered in the Page Total Box should be the NET total scored on that page.

Solution	Marks
1. $\ln(xy)=\frac{x}{y}$	
$\ln x+\ln y=\frac{x}{y}$	
$\frac{1}{x}+\frac{1}{y}\frac{dy}{dx}=\frac{y-x\frac{dy}{dx}}{y^2}$ (or $\frac{x\frac{dy}{dx}+y}{xy}=\frac{y-x\frac{dy}{dx}}{y^2}$)	1M differentaition of ln x 1M chain rule 1M quotient/product rule
$y^2+xy\frac{dy}{dx}=xy-x^2\frac{dy}{dx}$	
$\frac{dy}{dx}=\frac{xy-y^2}{xy+x^2}$	1 at least one step
Alternatively,	
$xy=e^{\frac{x}{y}}$	
$x\frac{dy}{dx}+y=e^{\frac{x}{y}}\left(\frac{y-x\frac{dy}{dx}}{y^2}\right)$	1M differentaition of e^x 1M chain rule 1M quotient rule
$x\frac{dy}{dx}+y=xy\left(\frac{y-x\frac{dy}{dx}}{y^2}\right)$	
$xy\frac{dy}{dx}+y^2=xy-x^2\frac{dy}{dx}$	
$\frac{dy}{dx}=\frac{xy-y^2}{xy+x^2}$	1
	-----(4)

Solution	Marks
2. (a) $(1+2x)^{\frac{1}{2}} = 1+\frac{1}{2}(2x)+\frac{\frac{1}{2}(-\frac{1}{2})}{2}(2x)^2+\frac{\frac{1}{2}(-\frac{1}{2})(-\frac{3}{2})}{3!}(2x)^3+\cdots$	1M any 3 terms
$= 1+x-\frac{1}{2}x^2+\frac{1}{2}x^3+\cdots$	1A
$(1+8x^3)^{-\frac{1}{2}} = 1-\frac{1}{2}(8x^3)+\cdots$	1A
$= 1-4x^3+\cdots$	
(b) $(1-2x+4x^2)^{-\frac{1}{2}} = \frac{(1+8x^3)^{-\frac{1}{2}}}{(1+2x)^{-\frac{1}{2}}}$	
$= (1+8x^3)^{-\frac{1}{2}}(1+2x)^{\frac{1}{2}}$	
$= (1-4x^3+\cdots)(1+x-\frac{1}{2}x^2+\frac{1}{2}x^3+\cdots)$	1M
$= 1+x-\frac{1}{2}x^2+\frac{1}{2}x^3-4x^3+\cdots$	
$= 1+x-\frac{1}{2}x^2-\frac{7}{2}x^3+\cdots$	1A
<u>Alternatively,</u>	
$(1-2x+4x^2)^{-\frac{1}{2}} = [1-2x(1-2x)]^{-\frac{1}{2}}$	
$= 1+\left(-\frac{1}{2}\right)[-2x(1-2x)]+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!}[-2x(1-2x)]^2$	
$+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}[-2x(1-2x)]^3+\cdots$	1A
$= 1+x(1-2x)+\frac{3}{2}x^2(1-2x)^2+\frac{5}{2}x^3(1-2x)^3+\cdots$	
$=1+x-\frac{1}{2}x^2-\frac{7}{2}x^3+\cdots$	1A
	(pp−1 for extra terms or missing '+⋯' in all cases) -----(5)

Solution	Marks
3. Area of the shaded region $= \int_0^8 (1+x^{\frac{1}{3}}-e^{\frac{x}{8}})\,dx$	1A integrand accept $e^{\frac{x}{8}}-1-x^{\frac{1}{3}}$ 1A limits (pp−1 for missing dx)
$= \left[x+\frac{3}{4}x^{\frac{4}{3}}-8e^{\frac{x}{8}}\right]_0^8$	1A for $x+\frac{3}{4}x^{\frac{4}{3}}$ 1A for $-8e^{\frac{x}{8}}$
$\approx 6{,}2537$ (or $28-8e$)	1A $a-1$ for r.t. 6.254 -----(5)
4. (a) The graph of f(x) is concave downward (or convex upward) when $1<x<3$. (or $1 \le x \le 3$ etc.)	1A
(b) The points of inflexion are $(1,-16)$ and $(3,0)$.	1A
(c) 	1A minimum point 1A shape and coordinates of points -----(4)

Solution	Marks

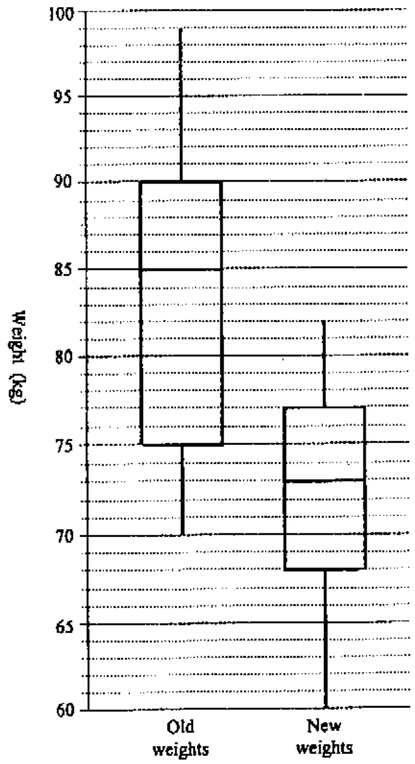
5. (a) Let Q_1 , Q_2 , Q_3 be the 1st quartile, median and 3rd quartile resp., then

Alternative methods ($n = 21$)	Q_1	Q_2	Q_3	IQR
i. $Q_r = \frac{r}{4}n$ th term	75 kg (5.25th)	84.5 kg (10.5th)	89.5 kg (15.75th)	14.5 kg
ii. $Q_r = \frac{r}{4}(n+1)$ th term	75 kg (5.5th)	85 kg (11th)	91 kg (16.5th)	16 kg
iii. $Q_r = \frac{rn+2}{4}$ th term	75 kg (5.75th)	85 kg (11th)	90.5 kg (16.25th)	15.5 kg
iv. $Q_r = \frac{r(n-1)+4}{4}$ th term	75 kg (6th)	85 kg (11th)	90 kg (16th)	15 kg
v. $Q_r \approx \frac{r}{4}n$ and round off to the nearest 0.5th term	75 kg (5th)	84.5 kg (10.5th)	90 kg (16th)	15 kg

1A median
1M 1st or 3rd quartile
1A interquartile range

(*pp*–1 for wrong/missing unit)

(b) (*Illustrating method iv only*)



1A any correct box-and-whisker diagram with scale

1A all correct, same scale

(c) No. The diagrams in (b) cannot show individual difference. 1

or i. There is no substantial evidence for making the claim.
ii. It is possible that the woman weighed 60 kg on completion of the programme is the woman weighed 99 kg when the programme started. (any counterexample)

-----(6)

Solution	Marks

6. (a) Probability of having no vanilla flavour ice-cream

$= \frac{C_3^4}{C_3^6}$ (or $\left(\frac{4}{6}\right)\left(\frac{3}{5}\right)\left(\frac{2}{4}\right)$, $\frac{P_3^4}{P_3^6}$) 1M denominator, 1M numerator

$= \frac{1}{5}$ (or 0.2) 1A

(b) Probability of having exactly 1 cup of vanilla flavour ice-cream

$= \frac{2C_2^4}{C_3^6}$ (or $C_1^3\left(\frac{2}{6}\right)\left(\frac{4}{5}\right)\left(\frac{3}{4}\right)$, $\frac{2\times 3\times P_2^4}{P_3^6}$) 1M numerator

$= \frac{3}{5}$ (or 0.6) 1A

-----(5)

7. The probability that there is no people killed in a traffic accident

$= e^{-0.1}$ (p) 2A

≈ 0.904837418

The required probability

$= p^5 + 5p^4(1-p)$ 1M binomial (at least 2 terms), 1M cases 0 and 1

≈ 0.925477591

≈ 0.9255 1A $a-1$ for r.t. 0.925

-----(5)

<u>Alternatively,</u>

The probability that there is at least 1 people killed in a traffic accident

$= 1 - e^{-0.1}$ (q)

≈ 0.095162582

The required probability

$= (1-q)^5 + 5(1-q)^4 q$

≈ 0.925477591

≈ 0.9255

8. (a) The probability of a customer winning a prize in 1 trial

$= 0.3\left(\frac{5}{9}\right) + 0.7\left(\frac{5}{6}\right)$ 1A

$= 0.75$ 1A

(b) Let x and y be the probabilities of generating games A and B respectively.

Then $\frac{5}{9}x + \frac{5}{6}y = \frac{2}{3}$ 1M

and $x + y = 1$ 1M

$\therefore$ $\frac{5}{9}x + \frac{5}{6}(1-x) = \frac{2}{3}$

$\frac{5}{6} - \frac{5}{18}x = \frac{2}{3}$

$x = \frac{3}{5}$ (or 0.6) 1A or $y = \frac{2}{5}$, $y = 0.4$

$\therefore$ The probabilities of generating game A and game B are $\frac{3}{5}$ (or 0.6) and $\frac{2}{5}$ (or 0.4) respectively. 1A

-----(6)

Solution	Marks

9. (a) (i) $f(x) = 16 + 4xe^{-0.25x}$

$f'(x) = 4e^{-0.25x}(1 - 0.25x)$

1M attempting to find f'
1A

accept considering $f'(x) = e^{-0.25x}(0.25x - 2)$

$$\begin{cases} > 0 & \text{if } 0 < x < 4 \\ = 0 & \text{if } x = 4 \\ < 0 & \text{if } x > 4 \end{cases}$$

$\therefore$ $f(x) \le f(4)$ for $x > 0$.

1 follow through

(ii)

x	0	1	2	3	4	5	6
f(x)	16 (16)	19.1152 (19.1)	20.8522 (20.9)	21.6684 (21.7)	21.8861 (21.9)	21.7301 (21.7)	21.3551 (21.4)

1A correct to 1 d.p.

$\int_0^6 f(x)dx$

$\approx \frac{1}{2}[16 + 21.3551 + 2(19.1152 + 20.8523 + 21.6684 + 21.8861 + 21.7301)]$

1M

≈ 124

$\therefore$ The expected increase in profit is 124 hundred thousand dollars.

1A *a*−1 for r.t. 124
pp−1 for wrong/missing unit

(b) (i) $g(x) = 16 + \frac{6x}{\sqrt{1+8x}}$

$$g'(x) = \frac{6\sqrt{1+8x} - \frac{6x \cdot 8}{2\sqrt{1+8x}}}{1+8x}$$

1A

$$= \frac{6(1+4x)}{(1+8x)^{\frac{3}{2}}}$$

> 0 for $x > 0$.

1

$\therefore$ $g(x)$ is strictly increasing for $x > 0$.

$\because$ $\lim_{x \to \infty}\left(16 + \frac{6x}{\sqrt{1+8x}}\right) = \lim_{x \to \infty}\left(16 + \frac{6\sqrt{x}}{\sqrt{\frac{1}{x} + 8}}\right)$

$\therefore$ $g(x) \to \infty$ as $x \to \infty$

1A

Solution	Marks

(ii) Let $u = \sqrt{1+8x}$, then $u^2 = 1 + 8x$, $2udu = 8dx$

$\int_0^6 g(x)dx = \int_0^6\left(16 + \frac{6x}{\sqrt{1+8x}}\right)dx$ (or $\int_0^6 16dx + \int_0^6 \frac{6x}{\sqrt{1+8x}}dx$)

$= \int_1^7\left(16 + \frac{6(u^2-1)}{8u}\right)\frac{1}{4}udu$ (or $[16x]_0^6 + \int_1^7 \frac{6(u^2-1)}{8u}\frac{1}{4}udu$)

1A integrand
1A limits

$= \int_1^7\left(\frac{3}{16}u^2 + 4u - \frac{3}{16}\right)du$ (or $96 + \int_1^7\left(\frac{3}{16}u^2 - \frac{3}{16}\right)du$)

$= \left[\frac{1}{16}u^3 + 2u^2 - \frac{3}{16}u\right]_1^7$ (or $96 + \left[\frac{1}{16}u^3 - \frac{3}{16}u\right]_1^7$)

1A ignore limits

$= 116\frac{1}{4}$

≈ 116

$\therefore$ The expected increase in profit is 116 hundred thousand dollars.

1A *a*−1 for r.t. 116
pp−1 for wrong/missing unit

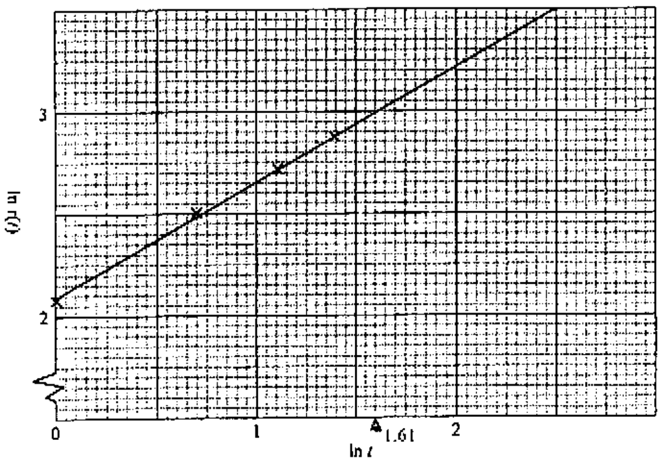
(c) From (a)(i), $f(x) \le f(4)$ ($= 21.8861$) for $x > 0$.
i.e. $f(x)$ is bounded above by $f(4)$.
From (b)(i), $g(x)$ increases to infinity as x increases to infinity.

1M

$\because$ $f(x) > 0$ and $g(x) > 0$ for $x > 0$,
the area under the graph of $g(x)$ will be greater than that of $f(x)$ as x increases indefinitely.
$\therefore$ Plan G will eventually result in a bigger profit.

1A

Alternative graph for 10(a)(ii)



Solution | Marks

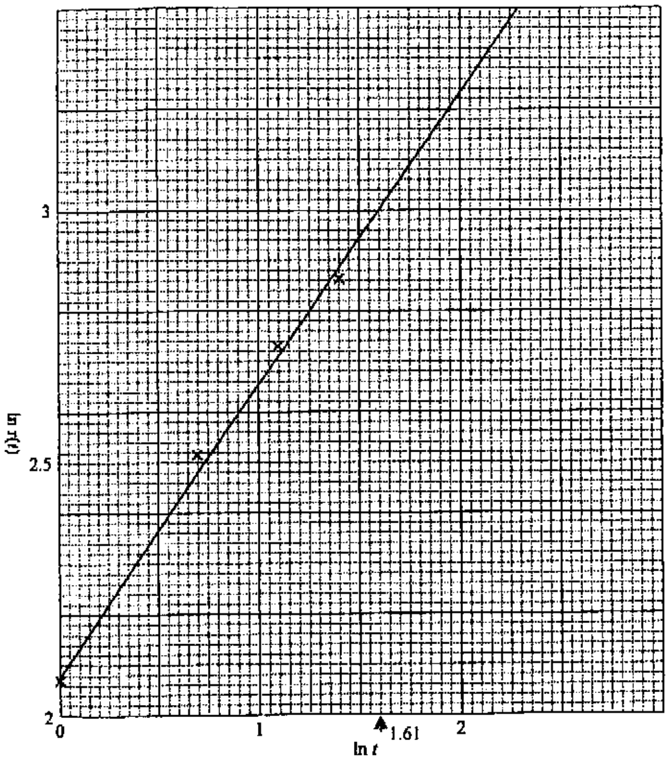
10. (a) (i) $r(t) = at^b$

$\ln r(t) = \ln a + b \ln t$ — 1A

(ii)

$\ln t$	0	0.69	1.10	1.39
$\ln r(t)$	2.07	2.51	2.73	2.86

Accept using common logarithm



1M scale and labelling

1A points and line

When $t = 5$, $\ln t \approx 1.61$

$\therefore$ $\ln r(5) \approx 3$ from the graph.

$r(5) \approx 20.1$

$\Big\}$ 1M for either

1A $r(5) \in [19.1, 21.1]$

$\ln r(5) \in [2.95, 3.05]$

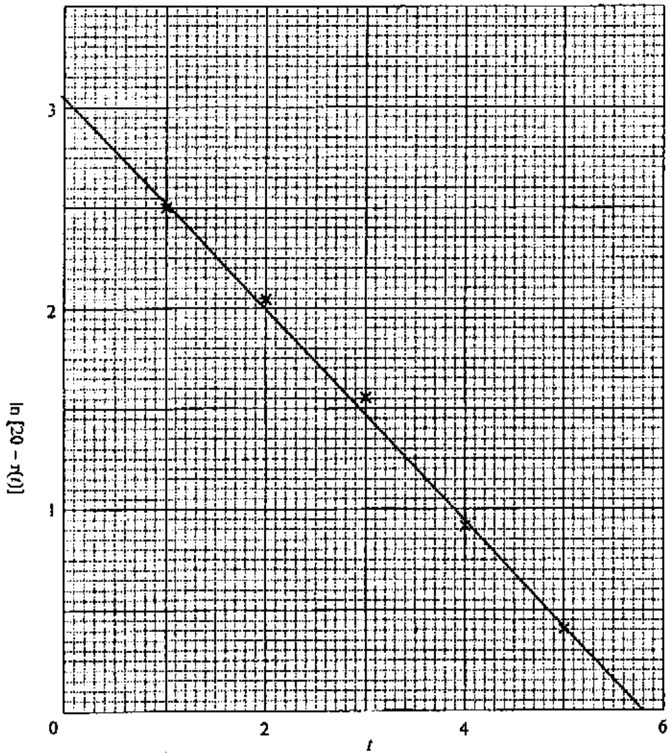
Solution | Marks

(b) (i) $r(t) = 20 - pe^{-qt}$

$\ln[20 - r(t)] = \ln p - qt$ — 1A

(ii)

t	1	2	3	4	5
$\ln[20 - r(t)]$	2.49	2.04	1.55	0.92	0.41



1M scale and labelling

1A ignoring the point at $t = 5$

From the graph, $\ln p \approx 3.05$

$p \approx 21.1$

1A $p \in [20.1, 23.3]$

$\ln p \in [3.00, 3.15]$

$$-q = \frac{0.41 - 3.05}{5} \approx -0.528$$

$q \approx 0.528$

1A $q \in [0.518, 0.550]$

No marks for p or q if the graph is not correct.

Solution	Marks
(iii) The total number, in thousands, of bacteria after 15 days of cultivation	
$= \int_0^{15} [20 - pe^{-qt}]\mathrm{d}t + 100$	1M definite integral 1M adding 100
$= \left[20t + \frac{p}{q} e^{-qt} \right]_0^{15} + 100$	1M for integration
$= 300 + \frac{p}{q} e^{-15q} - \frac{p}{q} + 100$	
$\approx 260 + 100$	1A $\int_0^{15} [20 - pe^{-qt}]\mathrm{d}t \in [255, 263]$
≈ 360	1A Ans. $\in [355, 363]$ *pp*–1 for wrong/missing unit
<u>Alternatively,</u> Let $\mathrm{N}(t)$ thousand be the total number of bacteria after t days of cultivation. Then	
$\mathrm{N}(t) = \int [20 - pe^{-qt}]\mathrm{d}t$	1M
$= 20t + \frac{p}{q} e^{-qt} + c$	1M for integration
$\because \quad \mathrm{N}(0) = 100$	
$\therefore \quad 100 = \frac{p}{q} + c$	
$c = 100 - \frac{p}{q} \approx 60.04$	1A $c \in [55.02, 63.46]$
Hence the total number, in thousands, of bacteria after 15 days of cultivation is	
$\mathrm{N}(15) = 20 \times 15 + \frac{p}{q} e^{-15q} + c \approx 360$	1M+1A $\mathrm{N}(15) \in [355, 363]$

Solution	Marks
11. (a) $\begin{cases} \ln 55 = a - e^{1-2k} \\ \ln 98 = a - e^{1-4k} \end{cases}$	
Eliminating a, we have	
$e^{1-4k} - e^{1-2k} + \ln 98 - \ln 55 = 0$	
$e^{-4k} - e^{-2k} + \frac{1}{e} \ln \frac{98}{55} = 0$	1
$(e^{-2k})^2 - e^{-2k} + \frac{1}{e} \ln \frac{98}{55} = 0$	1M quadratic equation
$e^{-2k} = \frac{1 \pm \sqrt{1 - \frac{4}{e} \ln \frac{98}{55}}}{2}$	
≈ 0.30635 or 0.69365	
≈ 0.306 or 0.694	1A r.t. 0.306 , 0.694
$\begin{cases} k \approx 0.5915 \\ a \approx 4.8401 \end{cases}$ or $\begin{cases} k \approx 0.1829 \\ a \approx 5.8929 \end{cases}$	
$\begin{cases} k \approx 0.59 \\ a \approx 4.84 \end{cases}$ or $\begin{cases} k \approx 0.18 \\ a \approx 5.89 \text{ (or } 5.90) \end{cases}$ (2 d.p.)	1A a–1 for more than 2 d.p.
(b) Using $\begin{cases} k \approx 0.59 \\ a \approx 4.84 \end{cases}$, $\ln\mathrm{N}(7) \approx 4.80$,	1M r.t. 4.80
$\mathrm{N}(7) \approx 121$.	r.t. 121
Using $\begin{cases} k \approx 0.18 \\ a \approx 5.89 \end{cases}$, $\ln\mathrm{N}(7) \approx 5.12$,	r.t. 5.12 – 5.14
$\mathrm{N}(7) \approx 167$. (or comparing $\ln 170 \approx 5.1358$)	r.t. 167 – 170
$\therefore \begin{cases} k \approx 0.18 \\ a \approx 5.89 \end{cases}$ will make the model fit for the known data.	1A follow through
$\because \quad \mathrm{N}(t) = e^{\ln \mathrm{N}(t)} \approx e^{5.89 - e^{1-0.18t}}$	1M
$\therefore \quad \mathrm{N}(t) \to e^{5.89} \approx 361$ as $t \to \infty$	
The total possible catch of coral fish in that area since January 1, 1992 is 361 thousand tonnes.	1A r.t. 361 – 365 *pp*–1 for wrong/missing unit

Solution	Marks
(c) (i) $\because \quad \ln N(t) = a - e^{1-kt}$	
$\therefore \quad \dfrac{N'(t)}{N(t)} = ke^{1-kt}$	
$N'(t) = k\,N(t)e^{1-kt}$	1
Alternatively,	
$N(t) = e^{a-e^{1-kt}}$	
$N'(t) = -e^{1-kt}(-k)e^{a-e^{1-kt}} = ke^{1-kt}\,N(t)$	1
(ii) $N''(t) = k[N'(t)e^{1-kt} - k\,N(t)e^{1-kt}\}$	
$= k^2\,N(t)e^{1-kt}(e^{1-kt} - 1)$	1A
$\begin{cases} > 0 & \text{when} \quad t < \dfrac{1}{k} \\ = 0 & \text{when} \quad t = \dfrac{1}{k} \\ < 0 & \text{when} \quad t > \dfrac{1}{k} \end{cases}$	1M
$\therefore \quad N'(t)$ is maximum at $t = \dfrac{1}{k}$	1A
≈ 5.56	$t \in [5.47, 5.56]$
The maximum rate of change of the total catch of coral fish in that area since January 1, 1992 occurred in 1997.	1A
$\ln N(6) \approx 4.97$, $N(6) \approx 143.6$	$\ln N(6) \in [4.97, 4.99]$ $N(6) \in [143.6, 146.3]$
$\ln N(5) \approx 4.78$, $N(5) \approx 119.7$	$\ln N(5) \in [4.78, 4.80]$ $N(5) \in [119.7, 122.0]$
$\therefore$ The volume of fish caught in 1997	
$= [N(6) - N(5)]$ thousand tonnes	1M
≈ 24 thousand tonnes	1A *pp*−1 for wrong/missing unit

Solution	Marks
12. (a) Let $X \sim N(20, 5^2)$ and $Z \sim N(0, 1)$.	
(i) $P(\text{risky but not hazardous} \mid A)$	
$= P(12 < X < 27)$	1A
$= P(\frac{12-20}{5} < Z < \frac{27-20}{5})$	
$= P(-1.6 < Z < 1.4)$	1M
$\approx 0.4452 + 0.4192$	
≈ 0.8644	1A *a*−1 for r.t. 0.864
(ii) $P(\text{risky} \mid A) = P(X > 12)$	
$= P(Z > -1.6)$	
$\approx 0.4452 + 0.5$	1A
≈ 0.9452	
$P(\text{hazardous} \mid A) = P(X > 27)$	
$= P(Z > 1.4)$	
$\approx 0.5 - 0.4192$	1A
≈ 0.0808	
$\therefore \quad P\,(\text{a risky bottle is hazardous} \mid A) \approx \dfrac{0.0808}{0.9452} \approx 0.0855$	1M
(b) (i) $P(\text{risky}) = 0.6\,P(\text{risky} \mid A) + 0.4\,P(\text{risky} \mid B)$	
$\approx 0.6(0.9452) + 0.4(0.058)$	1M
≈ 0.59032	
$\approx 0.5903 \qquad (p)$	1A *a*−1 for r.t. 0.590
$P(B \text{ and risky} \mid \text{risky}) = \dfrac{P(\text{risky} \mid B)P(B)}{P(\text{risky})}$	
$\approx \dfrac{(0.058)(0.4)}{0.59032}$	1A numerator 1M Bayes' theorem
≈ 0.0393	
(ii) $P(B \text{ and hazardous} \mid \text{risky}) = \dfrac{P(\text{hazardous} \mid B)P(B)}{P(\text{risky})}$	
$\approx \dfrac{(0.004)(0.4)}{0.59032}$	1A numerator 1M Bayes' theorem
≈ 0.00271	
≈ 0.0027	
(iii) $P(\text{license suspended}) = 1 - (1-p)^5 - 5p(1-p)^4$	1M binomial 1M complement of cases 0 & 1 1M *p* from b(i)
$\approx 1 - (1 - 0.59032)^5 - 5(0.59032)(1 - 0.59032)^4$	
≈ 0.9053	

Solution	Marks
13. (a) Possible teams: $B_1 G_1$, $B_1 G_2$, $B_2 G_1$ and $B_2 G_2$.	1A
(b) The probability that $B_1 G_1$ can enter the second round of the contest $= 0.9 \times 0.8$	
$= 0.72$	1A
(c) Probability required $= \frac{1}{4}(0.9\times0.8+0.9\times0.6+0.7\times0.8+0.7\times0.6)$	1M 4 cases
$= 0.56$	1A
(d) Suppose $B_1 G_1$ and $B_2 G_2$ are formed to represent the school.	
(i) The probability that exactly one team can enter the second round	
$= (0.9\times0.8)(1-0.7\times0.6)+(0.7\times0.6)(1-0.9\times0.8)$	1A probability of 1 case 1M summation of 2 cases
$\boxed{\text{or } 1-(0.9\times0.8)(0.7\times0.6)-(1-0.9\times0.8)(1-0.7\times0.6)}$	
$= 0.5352$	1A
(ii) The probability that at least one team can enter the second round $= 0.5352 + 0.9\times0.8\times0.7\times0.6$	1M
$\boxed{\text{or } 1-(1-0.9\times0.8)(1-0.7\times0.6)}$	
$\boxed{\text{or } 0.9\times0.8+0.7\times0.6-0.9\times0.8\times0.7\times0.6}$	
≈ 0.8376	1A
(e) (i) If the two teams are formed randomly, the probability that exactly one team can enter the second round	
$= \frac{1}{2}\times0.5352+\frac{1}{2}[(0.9\times0.6)(1-0.7\times0.8)+(0.7\times0.8)(1-0.9\times0.6)]$	1M the combination B_1G_2, B_2G_1 1M multiplying by $\frac{1}{2}$
$= \frac{1}{2}(0.5352+0.4952)$	
$= 0.5152$	1A
(ii) If $B_1 G_2$ and $B_2 G_1$ are formed to represent the school, the probability that at least one team can enter the second round $= 0.4952 + 0.9\times0.8\times0.7\times0.6$	1M
$\boxed{\text{or } 1-(1-0.9\times0.6)(1-0.7\times0.8)}$	
$\boxed{\text{or } 0.9\times0.6+0.7\times0.8-0.9\times0.6\times0.7\times0.8}$	
$= 0.7976$	1A
From (d)(ii), the combination $B_1 G_1$ and $B_2 G_2$ will have a better chance of having at least one team that can enter the second round of the contest.	1M

Solution	Marks
14. (a)	

	Poisson distribution	Binomial distribution			Marks
frequency:	$100\cdot\frac{e^{-1}}{x!}$	$100\cdot C_x^6\left(\frac{1}{6}\right)^x\left(\frac{5}{6}\right)^{6-x}$			
missing values:	36.79	20.09	(or 20.09	20.10	1A+1A
	6.13	0.80	0.81	0.80)	1A+1A $a-1$ for more than 2 d.p.

(b) The maximum error for Po(1) is 2.79 while that for B(6, $\frac{1}{6}$) is 1.19.	
The binomial distribution is better.	1A awarded only if (a) is correct
(c) (i) The probability of getting at least 1 stamp in a box of the Chips	
$= 1-\left(1-\frac{1}{6}\right)^6$	1M
$\boxed{\text{or } 1-0.3349}$	read from table
≈ 0.6651020233	
≈ 0.6651 (p_1)	1A $a-1$ for r.t. 0.665
$\boxed{\text{or } 0.6650}$	
(ii) The probability of getting at least 1 stamp in buying not more than 3 boxes	
$= p_1+(1-p_1)p_1+(1-p_1)^2p_1$	1M cases 1, 2 and 3 1M Geometric (p)
$\approx (0.665102)[1+(1-0.665102)+(1-0.665102)^2]$	
≈ 0.9624389632	
≈ 0.9624	1A $a-1$ for r.t. 0.962
(iii) The probability of getting exactly 5 stamps in 2 boxes with stamps	
$= 2\left[C_1^6\left(\frac{1}{6}\right)\left(\frac{5}{6}\right)^5 C_4^6\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)^2 + C_2^6\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^4 C_3^6\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^3\right]$	1M combinations (1, 4) and (2, 3) 1M multiplying by 2 1M binomial distribution
$\boxed{\text{or } 2[0.4019\times0.0080+0.2009\times0.0536]}$	read from table
$= 2\left[C_1^6C_4^6\left(\frac{1}{6}\right)^5\left(\frac{5}{6}\right)^7 + C_2^6C_3^6\left(\frac{1}{6}\right)^5\left(\frac{5}{6}\right)^7\right]$	
$= \frac{2\times5^7(6\times15+15\times20)}{6^{12}}$	
≈ 0.027994301 (p_2)	
The probability of getting stamps in both boxes in buying two boxes $= {p_1}^2$	1M
≈ 0.442360701 (p_3)	
The required conditional probability $= \frac{p_2}{p_3}$	1M
$\approx \frac{0.027994301}{0.442360701}$	
≈ 0.0633	0.0632 if using figures in table