SL Paper 2 Mock A 2020 - MARKSCHEME v1

Section A

1. (a) 100 students **A2**

(b) $Q_1 = 200$ **(A1)**

$Q_3 = 600$ **(A1)**

$a = 55,\ b = 75$ **A1**

2. (a) Value after n years $= 3000 \times 1.046^n$ **(M1)A1**

Value after 7 years $= \$4110.01$ **A1**

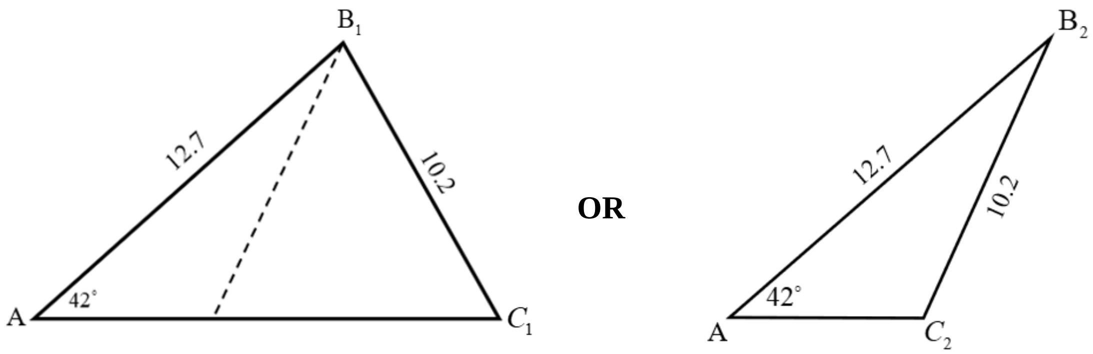
(b) $5000 = 3000 \times 1.046^x$ **(M1)**

$x = 11.3584\ldots$ **(A1)**

The investment will exceed \$5000 after a minimum of 12 full years

Hence, $x = 12$ **A1**

3.



Attempting to use Sine rule **(M1)**

$C_1 = 56.442^\circ,\ C_2 = 123.578^\circ$ **A2**

$B_1 = 81.578^\circ,\ B_2 = 14.422^\circ$ **A2**

$AC_1 \approx 15.1\,\text{cm},\ AC_2 \approx 3.80\,\text{cm}$ **A2**

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4. Recognising general term of $(4x+p)^5$ is $\binom{5}{r}(4x)^{5-r}\,p^r$ **(M1)A1**

Attempting to find the value of r that corresponds to x^3 term **(M1)**

$r=2$ **A1**

Substituting $r=2$ into general term of $(4x+p)^5$ **(M1)**

$\binom{5}{2}(4x)^{5-2}\,p^2=640p^2x^3$; $640p^2=160$ **(A1)**

$p=\pm\frac{1}{2}$ **A1**

5. $\mathrm{P}(X<5)=0.04 \Rightarrow Z\approx -1.75069...$ **A1**

$\mathrm{P}(X<25)=0.7 \Rightarrow Z\approx 0.524401...$ **A1**

Use of formula for standardized normal variable $Z=\frac{x-\mu}{\sigma}$ **(M1)**

$\mu-1.75069\sigma=5$ **(A1)**

$\mu+0.524401\sigma=25$ **(A1)**

$\mu\approx 20.4\,\text{min},\ \sigma\approx 8.79\,\text{min}$ **A2**

6. Recognising that $v(t)=\int a(t)\,\mathrm{d}t=\int\left(\frac{3}{t}+2\sin 2t\right)\mathrm{d}t$ **(M1)**

Attempting to integrate $\int\left(\frac{3}{t}+2\sin 2t\right)\mathrm{d}t$ **(M1)**

$v(t)=3\ln t-\cos 2t$ **A2**

Substituting into $v(1)=0$ **(M1)**

$C=-0.4161\ldots$ **A1**

$v(6)\approx 4.12\ \mathrm{m\,s^{-1}}$ **A1**

Section B

7. (a) $y = 10.7x + 121$ **A2**

(b) (i) **unit cost** (additional cost per box) **A1**

(ii) **fixed costs** (cost when zero boxes are produced) **A1**

(c) Attempting to solve for y when $x = 60$ **(M1)**

$y = 760.124$ **(A1)**

Hence, cost of 60 boxes is approximately $760 **A1**

(d) Attempting to solve for x when $19.99x > y$ **(M1)**

$x > 12.9405\ldots$ **(A1)**

Hence, the factory must produce at least 13 boxes per day to make a profit **A1**

(e) This would be extrapolation, which is not appropriate **A2**

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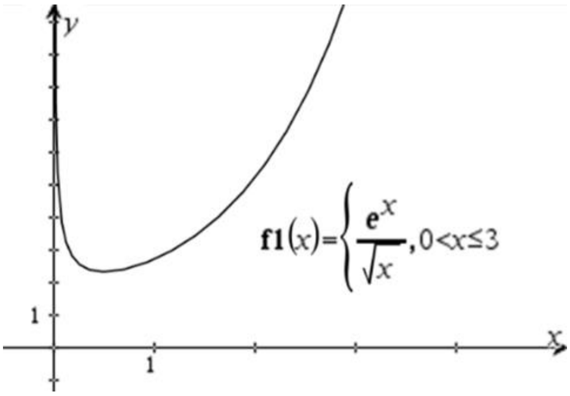
8. (a) (i)



A2

(ii) Attempting to differentiate $h(x)$ using quotient rule **(M1)**

$$h'(x)=\frac{x^{\frac{1}{2}}e^x-\frac{1}{2}x^{-\frac{1}{2}}e^x}{\left(x^{\frac{1}{2}}\right)^2}$$ **(A1)**

$$h'(x)=e^x\left(\frac{2x-1}{2x\sqrt{x}}\right)$$ **A1**

(iii) Recognising that gradient of normal $=-\frac{1}{h'(x)}$ **(M1)**

gradient of normal to curve $=-\frac{2x\sqrt{x}}{e^x(2x-1)}\left(=\frac{2x\sqrt{x}}{e^x(1-2x)}\right)$ **A1**

(b) (i) Substituting $x_1=1,\ y_1=0,\ y=\frac{e^x}{\sqrt{x}}$ into the formula $m=\frac{y-y_1}{x-x_1}$ **(M1)**

$$m=\frac{e^x}{\sqrt{x}(x-1)}$$ **A1**

[Markscheme for question 8 continued on next page]

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8. (b) (continued)

(ii) $\dfrac{e^x}{\sqrt{x}(x-1)}=\dfrac{2x\sqrt{x}}{e^x(1-2x)}$ **(M1)**

x-coordinate of P is $x\approx 0.545428...$

y-coordinate of P is $y\approx 2.33619...$ **A1**

minimum distance from Q to graph of h is length of PQ **R1**

minimum distance ≈ 2.38 **A1**

9. (a) (i) Recognising this as a binomial distribution with $n=5$ and $p=\dfrac{1}{5}$ **M1**

$\mathrm{E}(X)=1$ **A1**

(ii) $\mathrm{P}(X\geq 3)=\mathrm{P}(X=3)+\mathrm{P}(X=4)+\mathrm{P}(X=5)$

$\mathrm{P}(X=3)=\dfrac{32}{625}$ **A1**

$\mathrm{P}(X=4)=\dfrac{4}{625}$ **A1**

$\mathrm{P}(X=5)=\dfrac{1}{3125}$ **A1**

$\mathrm{P}(X\geq 3)=0.05792$ **A1**

(b) (i) Recognising that $\sum \mathrm{P}(Y=y)=1$ **(M1)**

Substituting probabilities into $\sum \mathrm{P}(Y=y)=1$ **(M1)**

$4a+2b=0.24$ **AG**

[Markscheme for question 9 continued on next page]

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9. (b) (continued)

(ii) Substituting probabilities into $\mathrm{E}(Y) = \sum y\mathrm{P}(Y = y) = 1$ **(M1)**

$13a + 5b = 0.75$ **A1**

Attempting to use result from (b) (i) to find values of *a* and *b* **(M1)**

$a = 0.05,\ b = 0.02$ **A2**

(c) $\mathrm{P}(Y \geq 3) = 0.03 + 0.12 + 0.04 = 0.19$ **A1**

$0.19 > 0.05792$ **(A1)**

Hence, Isabel is more likely to pass the test. **A1**