Solomon Practice Paper

Core Mathematics 4C

Time allowed: 90 **minutes**

Question	Points	Score
1	6	
2	7	
3	11	
4	11	
5	13	
6	13	
7	14	
Total:	75	

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Name:

Teacher:

How I can achieve better:

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Last updated: July 14, 2025

1. Use integration by parts to show that [6]

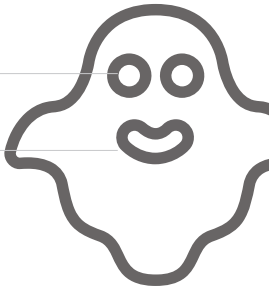
$$\int_1^2 x\ln(x)\,\mathrm{d}x = 2\ln(2) - \frac{3}{4}.$$

2. (a) Use the trapezium rule with two intervals of equal width to find an approximate value for the integral [5]

$$\int_0^2 \arctan(x)\,\mathrm{d}x.$$

(b) Use the trapezium rule with four intervals of equal width to find an improved approximation for the value of the integral. [2]

Total: 7



3. A curve has the equation

$$3x^2 - 2x + xy + y^2 - 11 = 0.$$

The point P on the curve has coordinates $(-1, 3)$.

(a) Show that the normal to the curve at P has the equation $y = 2 - x$. [7]

(b) Find the coordinates of the point where the normal to the curve at P meets the curve again. [4]

Total: 11

4. The points A and B have coordinates $(3, 9, -7)$ and $(13, -6, -2)$ respectively.

   (a) Find, in vector form, an equation for the line l which passes through A and B. [2]

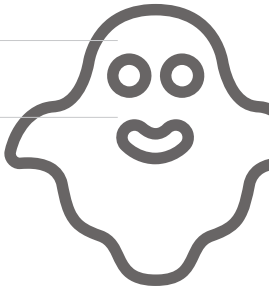
   (b) Show that the point C with coordinates $(9, 0, -4)$ lies on l. [2]

   The point D is the point on l closest to the origin, O.

   (c) Find the coordinates of D. [4]

   (d) Find the area of triangle OAB to 3 significant figures. [3]

Total: 11



5. A bath is filled with hot water which is allowed to cool. The temperature of the water is $\theta°$ C after cooling for t minutes and the temperature of the room is assumed to remain constant at 20° C.

   Given that the rate at which the temperature of the water decreases is proportional to the difference in temperature between the water and the room,

   (a) write down a differential equation connecting θ and t. [2]

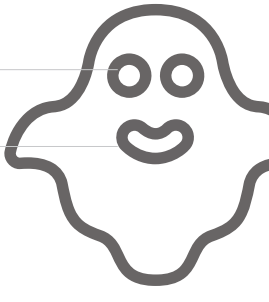
   Given also that the temperature of the water is initially 37° C and that it is 36° C after cooling for four minutes,

   (b) find, to 3 significant figures, the temperature of the water after ten minutes. [8]

   Advice suggests that the temperature of the water should be allowed to cool to 33° C before a child gets in.

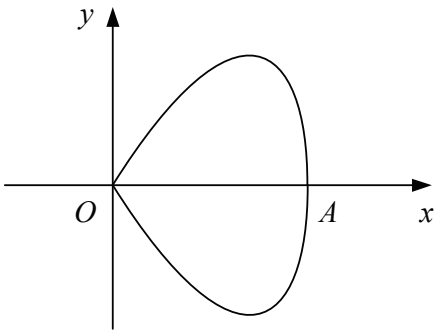
   (c) Find, to the nearest second, how long a child should wait before getting into the bath. [3]

Total: 13



6. Figure shows the curve with parametric equations

$$x = 3\sin(t) \quad \text{and} \quad y = 2\sin(2t), \qquad 0 \leq t < \pi.$$



The curve meets the x-axis at the origin, O, and at the point A.

(a) Find the value of t at O and the value of t at A. [2]

The region enclosed by the curve is rotated through π radians about the x-axis.

(b) Show that the volume of the solid formed is given by [3]

$$\int_0^{\frac{\pi}{2}} 12\pi \sin^2(2t)\cos(t)\,\mathrm{d}t.$$

(c) Using the substitution $u = \sin(t)$, or otherwise, evaluate this integral, giving your answer as an exact multiple of π. [8]

Total: 13

7.

$$\mathrm{f}(x) = \frac{8 - x}{(1 + x)(2 - x)}, \qquad |x| < 1.$$

(a) Express $\mathrm{f}(x)$ in partial fractions. [3]

(b) Show that [5]

$$\int_0^{\frac{1}{2}} \mathrm{f}(x)\,\mathrm{d}x = \ln(k),$$

where k is an integer to be found.

(c) Find the series expansion of $\mathrm{f}(x)$ in ascending powers of x up to and including the term in x^3, simplifying each coefficient. [6]

Total: 14