Solomon Practice Paper

Core Mathematics 4E

Time allowed: 90 minutes

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Name:

Teacher:

Question	Points	Score
1	4	
2	8	
3	9	
4	9	
5	10	
6	10	
7	12	
8	13	
Total:	75	

How I can achieve better:

- •
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Last updated:

June 17, 2025

1.	Find	$\int \cot^2(2x) \mathrm{d}x.$

2. A curve has the equation

 $4\cos(x) + 2\sin(y) = 3.$

(a) Show that

 $\frac{\mathrm{d}y}{\mathrm{d}x} = 2\sin(x)\sec(y).$

(b) Find an equation for the tangent to the curve at the point $(\frac{\pi}{3}, \frac{\pi}{6})$, giving your answer in the [3] form ax + by = c, where a and b are integers.

Total: 8

[5]

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Core Mathematics – Practice Paper 4E

3. (a) Express

$$\frac{2+20x}{1+2x-8x^2}$$

as a sum of partial fractions.

(b) Hence find the series expansion of

$$\frac{2+20x}{1+2x-8x^2}, \quad |x| < \frac{1}{4},$$

in ascending powers of x up to and including the term in x^3 , simplifying each coefficient.

Total: 9

[5]

[4]

- 4. The line l_1 passes through the points P and Q with position vectors $(-\mathbf{i}-8\mathbf{j}+3\mathbf{k})$ and $(2\mathbf{i}-9\mathbf{j}+\mathbf{k})$ respectively, relative to a fixed origin.
 - (a) Find a vector equation for l_1 .

The line l_2 has the equation

$$\mathbf{r} = (6\mathbf{i} + a\mathbf{j} + b\mathbf{k}) + \mu (\mathbf{i} + 4\mathbf{j} - \mathbf{k})$$

and also passes through the point Q.

- (b) Find the values of the constants a and b.
- (c) Find, in degrees to 1 decimal place, the acute angle between lines l_1 and l_2 .

Total: 9

[3]

[4]

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5. At time t = 0, a tank of height 2 metres is completely filled with water. Water then leaks from a hole in the side of the tank such that the depth of water in the tank, y metres, after t hours satisfies the differential equation

$$\frac{\mathrm{d}y}{\mathrm{d}t} = -k\mathrm{e}^{-0.2t},$$

where k is a positive constant,

- (a) Find an expression for y in terms of k and t.
- Given that two hours after being filled the depth of water in the tank is 1.6 metres,
- (b) find the value of k to 4 significant figures.

Given also that the hole in the tank is h cm above the base of the tank,

(c) show that h = 79 to 2 significant figures.

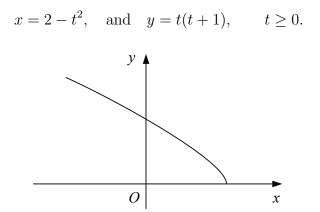
Total: 10

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[3]

[3]

6. Figure shows the curve with parametric equations



- (a) Find the coordinates of the points where the curve meets the coordinate axes. [4]
- (b) Find the exact area of the region bounded by the curve and the coordinate axes.

Total: 10

[6]

7. (a) Prove that

$$\frac{\mathrm{d}}{\mathrm{d}x}a^x = a^x \ln(a).$$

A curve has the equation $4^x - 2^{x-1} + 1$.

(b) Show that the tangent to the curve at the point where it crosses the y-axis has the equation [5]

$$3x\ln(2) - 2y + 3 = 0.$$

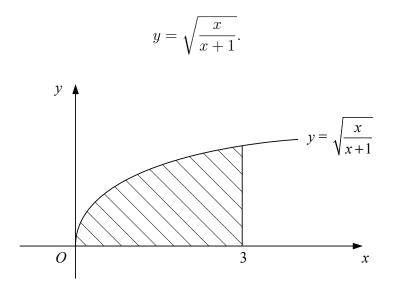
(c) Find the exact coordinates of the stationary point of the curve.

Total: 12

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[4]

8. Figure shows the curve with equation



The shaded region is bounded by the curve, the x-axis and the line x = 3.

- (a) i. Use the trapezium rule with three strips to find an estimate for the area of the shaded [7] region.
 - ii. Use the trapezium rule with six strips to find an improved estimate for the area of the shaded region.

The shaded region is rotated through 2π radians about the x-axis.

(b) Show that the volume of the solid formed is $\pi(3 - \ln(4))$.

[6]

Total: 13

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