Solomon Practice Paper

Core Mathematics 4H

Time allowed: 90 minutes

Centre: www.CasperYC.club

Name:

Teacher:

Question	Points	Score
1	5	
2	6	
3	8	
4	8	
5	8	
6	10	
7	14	
8	16	
Total:	75	

How I can achieve better:

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(a)	Expand $(1+4x)^{\frac{3}{2}}$ in ascending powers of x up to and including the term in x^3 , simplifying each coefficient.	[4
(b)	State the set of values of x for which your expansion is valid.	[:
		Total:

[6]

2	Use the	substitution	y = 1 +	$\sin(r)$	to	find	the	value	οf
∠.	ose me	Substitution	u-1+	$\operatorname{SIII}(x)$	w	ши	une	varue	OI

$$\int_0^{\frac{\pi}{2}} \cos(x) (1 + \sin(x))^3 \, \mathrm{d}x.$$



3.	(a)	Express
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$$\frac{x+11}{(x+4)(x-3)}$$

as a sum of partial fractions.

$$\int_0^2 \frac{x+11}{(x+4)(x-3)} \, \mathrm{d}x,$$

giving your answer in the form ln(k), where k is an exact simplified fraction.

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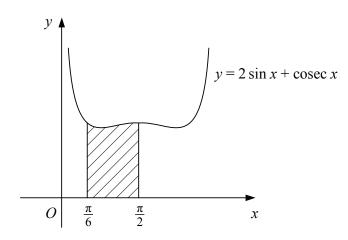
[3]

[5]



[8]

4. Figure shows the curve with equation $y = 2\sin(x) + \csc(x), 0 < x < \pi$.



The shaded region bounded by the curve, the x-axis and the lines $x = \frac{\pi}{6}$ and $x = \frac{\pi}{2}$ is rotated through 360° about the x-axis. Show that the volume of the solid formed is $\frac{1}{2}\pi(4\pi + 3\sqrt{3})$.

5. A curve has the equation

$$x^2 - 3xy - y^2 = 12.$$

(a) Find an expression for $\frac{dy}{dx}$ in terms of x and y.

[5]

(b) Find an equation for the tangent to the curve at the point (2, -2).

[3] Total: 8

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6. Relative to a fixed origin, O, the points A and B have position vectors

$$\begin{pmatrix} 1 \\ 5 \\ -1 \end{pmatrix} \quad \text{and} \quad \begin{pmatrix} 6 \\ 3 \\ -6 \end{pmatrix}$$

respectively.

Find, in exact, simplified form,

- (a) the cosine of $\angle AOB$,
- (b) the area of triangle OAB,
- (c) the shortest distance from A to the line OB.

[4] [2]

Total: 10

7. A curve has parametric equations

$$x = t(t - 1)$$
, and $y = \frac{4t}{1 - t}$, $t \neq 1$.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of t. [4]

The point P on the curve has parameter t = -1.

(b) Show that the tangent to the curve at P has the equation x + 3y + 4 = 0.

[3]

The tangent to the curve at P meets the curve again at the point Q.

(c) Find the coordinates of Q.

[7]

Total:	14



8. An entomologist is studying the population of insects in a colony.

Initially there are 300 insects in the colony and in a model, the entomologist assumes that the population, P, at time t weeks satisfies the differential equation

$$\frac{\mathrm{d}P}{\mathrm{d}t} = kP,$$

where k is a constant.

(a) Find an expression for P in terms of k and t.

[5]

Given that after one week there are 360 insects in the colony,

(b) find the value of k to 3 significant figures.

[2]

Given also that after two and three weeks there are 440 and 600 insects respectively,

(c) comment on suitability of the model.

[2]

An alternative model assumes that

$$\frac{\mathrm{d}P}{\mathrm{d}t} = P(0.4 - 0.25\cos(0.5t)).$$

- (d) Using the initial data, P = 300 when t = 0, solve this differential equation. [4]
- (e) Compare the suitability of the two models.

Total: 16

[3]

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