Solomon Practice Paper

Pure Mathematics 3J

Time allowed: 90 minutes

Centre: www.CasperYC.club

Name:

Teacher:

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

How I can achieve better:

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[5]

| 1. | Given | that |
|----|-------|------|
| | | |

$$\frac{x^2 + 9x - 10}{(x-2)^2(x+1)} \equiv \frac{A}{(x-2)^2} + \frac{B}{x-2} + \frac{C}{x+1},$$

find the values of A, B and C.





[5]

| 2. Show that | |
|--------------|---|
| | $\int_{2}^{4} x \left(x^{2} - 4\right)^{\frac{1}{2}} dx = 8\sqrt{3}.$ |



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| 3. | (a) | Find the binomial expansion of $(1+4x)^{\frac{1}{4}}$ for $ x <\frac{1}{4}$ in ascending powers of x as far as the term in x^3 . | [3] |
|----|-----|--|----------|
| | (b) | By substituting $x=0.01$ into your expansion, find the fourth root of 16.64 correct to 6 decimal places. | [5] |
| | | | Total: 8 |
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| 4. (a) Use the identity | | [4 |
|-------------------------|--|----|
| | $\cot(x) \equiv \frac{\cos(x)}{\sin(x)}$ | - |
| to show that | d = 2(| |

(b) Use integration by parts to find $\int x \csc^2(x) dx. \tag{6}$

| Total: 10 |
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5. At time t the vectors \mathbf{r} and \mathbf{s} are given by

$$\mathbf{r} = 2t^2\mathbf{i} - t\mathbf{j} + \mathbf{k},$$

 $\mathbf{s} = (t+2)\mathbf{i} + (t^2+5)\mathbf{j} + (1-t^3)\mathbf{k}.$

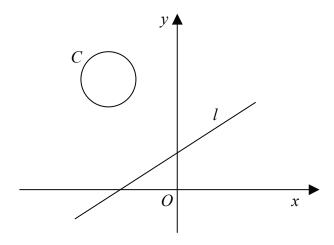
- (a) Find the angle between \mathbf{r} and \mathbf{s} when t=2, giving your answer in degrees correct to 1 decimal place. [5]
- (b) Find the values of t for which \mathbf{r} and \mathbf{s} are perpendicular.

Total: 10

[5]

| | | 0 |
|--|--|---|
| | | C |

6. Figure shows the circle C with equation $x^2 + y^2 + 10x - 16y + 85 = 0$ and the line l with equation 2x - 3y + 8 = 0.



(a) Find an equation of the line which is perpendicular to line l and passes through the centre of circle C.

(b) Hence, or otherwise, find the minimum distance between l and C.

Total: 12

[7]

[5]

7. A physics student is investigating the change in the size of an air bubble as it rises in water. The student believes that the volume, V m³ of a bubble is related to its depth, h m, by the formula

$$V = \frac{k}{h+10},$$

where k is a constant.

A bubble of volume 0.1 m³ is formed at a depth of 5 m in a water tank. Using the student's model,

- (a) find the volume of the bubble when it has risen 3 m, (hint: h = 5 3 = 2) [4]
- (b) show that, at this instant, V is increasing at the rate of $\frac{1}{96}$ m³ per metre the bubble rises. [3]

Assuming that the bubble is spherical as it rises,

(c) find, correct to 2 significant figures, the rate at which the radius of the bubble is increasing per metre the bubble rises at the instant when it has risen 3 m.

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Total: 12

8. (a) By taking logarithms, prove that if $x = 3^{1-t}$, then

$$\frac{\mathrm{d}x}{\mathrm{d}t} = -\left(\ln(3)\right)3^{1-t}.$$

A curve has parametric equations

$$x = 3^{1-t}$$
 and $y = 9^t - 1$.

(b) Show that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = (-2) \cdot 3^{3t-1}.$$

- (c) Find an equation of the tangent to the curve at the point (3,0).
- (d) Find a Cartesian equation for the curve.

Total: 13

[3]

[3]

[3]



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