# ENGR121 Test 2 2016

# Student Name: .....

**Question 1. Differentiation** [9 marks]

Find the derivatives $y'$ for the following functions. You may use the table of derivatives provided in the formula sheet.

**(a)** $y = -3x^{-3}$

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**(b)** $y = e^{-2}$

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**(c)** $y = 10e^{-5x+3}$

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**(d)** $y = \cos(kx)$

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**(e)** $y = \sin x \ \ln(3x)$

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**(f)** $y = e^x \cos x$

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**(g)** $y = (\ln t)/t^2$

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**(h)** $y = (3t^4 + 4t)^{-40}$

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**(i)** Harder-have some fun with this one!

$y = \ln\left(e^{-\cos(3x)}\right)$

**Question 2. Integration** [7 marks]

Find the following integrals

**(a)** $\int (x^{-2} - 7x^4)\,\mathrm{d}x$

**(b)** $\int \cos\left(\frac{1}{3}x\right)\,\mathrm{d}x$

**(c)** $\int \frac{-16}{x^6}\,\mathrm{d}x$

**(d)** $\int \left(\frac{5}{x} + \frac{x}{5}\right)\,\mathrm{d}x$

**(e)** $\int_0^2 e^{-3x/2}\,\mathrm{d}x$

**(f)** The classic integration by parts: Find the following integral

$$\int x^2 e^x \, \mathrm{d}x$$

**Question 3. Vectors** [9 marks]

Given

$$\boldsymbol{a} = \begin{bmatrix} -6 \\ 2 \\ 0 \end{bmatrix} \qquad \boldsymbol{b} = \begin{bmatrix} 2 \\ -1 \\ 2 \end{bmatrix} \qquad \boldsymbol{c} = \begin{bmatrix} 4 \\ 3 \\ -1 \end{bmatrix}$$

Find

**(a)** $2\boldsymbol{a} - 3\boldsymbol{b} - \boldsymbol{c}$

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**(b)** $|\boldsymbol{c} + \boldsymbol{b}|$

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**(c)** $\boldsymbol{b} \cdot \boldsymbol{c}$

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**(d)** the angle $\theta$ between $\boldsymbol{c}$ and $\boldsymbol{b}$

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**(e)** Trickier: Let $\boldsymbol{a}$, $\boldsymbol{b}$ and $\boldsymbol{c}$ represent 3 points in 3D space. Find a vector perpendicular to the plane containing these 3 points.

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