MCV → Practice Exam!

NOTE: 1. Non-programmable calculators are permitted on the exam.
2. Answer all questions on the foolscap provided.
3 A communication mark for the exam will be based on the rubric below.

1. Differentiate the following and do not simplify your answers.

a) $f(x) = 3x^5 + \frac{2}{x^3} - \sqrt[5]{x^7}$

b) $g(x) = (8x^3 + 9)^{5/4}$

c) $P(v) = \frac{7v^2 - 3}{4v + 5}$

d) $y = e^{(2x-3)^5}$

e) $y = -8x^2 \cos(2x+3)$

f) $y = 2^{4x^2 + 3x}$

2. Determine the derivative of $f(x) = x^2 + 6x - 5$ from first principles. {A - 4 marks}

3. Determine the derivative of $y = \frac{(9x-4)^8}{(6x+7)^5}$ and express in simplest form. {K - 4 marks}

4. Graph $y = \frac{x^2}{x-1}$ using calculus methods. {T - 12 marks}

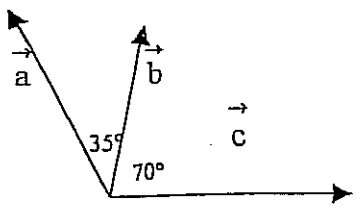
5. A particle travels along a horizontal line so that its position can be modelled by the equation $s(t) = -t^3 + 6t^2 + 15t - 20$, where $s(t)$ is the displacement from the origin measured in metres and t is the time in seconds for $t \geq 0$. Determine the particle's maximum velocity and where it is at this time. {A - 6 marks}

#6. An open top cylindrical container is to be made to hold 2000 cm^3 of liquid. The material for the bottom costs \$5/cm^2 and the material for the sides costs \$10/cm^2. What are the dimensions of the least expensive container? Express answers to one decimal place. {A - 7 marks}

Possible Useful Formulas: $SA_{Total} = 2\pi r^2 + 2\pi rh$ & $V = \pi r^2 h$

1. Given: $|\vec{a}| = 10$ N, $|\vec{b}| = 8$ N and $|\vec{c}| = 15$ N. Determine: a) $\vec{c} \bullet \vec{a}$

[6K]



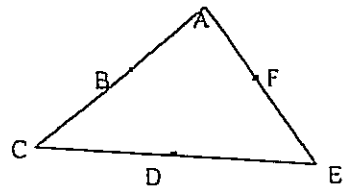
b) $\vec{a} \times \vec{b}$

c) projection of $\vec{b}$ onto $\vec{c}$

2. B, D and F are the midpoints of AC, CE and EA respectively. $\vec{u} = \vec{BC}$ and $\vec{v} = \vec{FE}$. Express each of the following in terms of $\vec{u}$ and / or $\vec{v}$: a) $\vec{CA}$

[3K]

b) $\vec{FB}$



3. [4A] A plane is steering at a heading of N60°E at a speed of 800 km/h. A wind of 75 km/h is blowing from S45°E. Determine the resultant velocity of the plane.

4. [3A] A box of mass 2 kg rests on a ramp which is inclined at 30° to the horizontal. A frictional force of 5 N is exerted up the ramp on the box. Determine the force that must be applied to the box at an angle of 20° to keep the box motionless.

6. Given vectors $\vec{a} = (1, -4, 2)$, $\vec{b} = (6, 1, -3)$ and $\vec{c} = (2, 1, 1)$, determine:

[5K] a) $5\vec{a} - 2\vec{b} + \vec{c}$ b) $\hat{a}$ c) $\vec{c} \bullet \vec{b}$ d) the angle, θ, between $\vec{a}$ and $\vec{c}$

7. [4A] Determine the value of k if $\vec{x} = (k+3, 4)$ and $\vec{y} = (8,6)$ are: a) collinear

b) perpendicular

8. [3T] Determine whether or not the given set of vectors form a basis for space. Justify your answer.

$\vec{u} = (1, 2, -1)$ $\vec{v} = (1, -1, -3)$ $\vec{w} = (2, 11, 12)$

9. [4K] State the parametric equations of:
a) the line through $(11, -2, 7)$ that is parallel to $(x,y,z) = (0, -1, 1) + t(8, 5, -6)$
b) the plane passing through A(4, 2, 2), B(1, 3, 1) and C(−5, 0, 3)

10. [4K] Determine the scalar equation of the plane containing the two lines $\frac{x-3}{4} = \frac{y}{-5} = \frac{z+1}{-2}$ and $\frac{x-3}{-1} = \frac{y}{3} = \frac{z+1}{2}$.

11. [7A] Determine the intersection of:
a) the lines $(x,y,z) = (0, -1, -2) + p(1,2,3)$ and $x = 9 - 4t$, $y = -5 + 3t$, and $z = t - 1$
b) the planes $2x - y + z = 5$ and $4x - y - z = -1$.

12. [4K] Solve: $x - y - z = 2$
$3x + 2y + z = 4$
$x - 3y - z = -2$