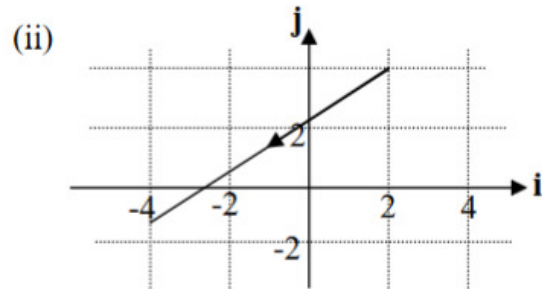
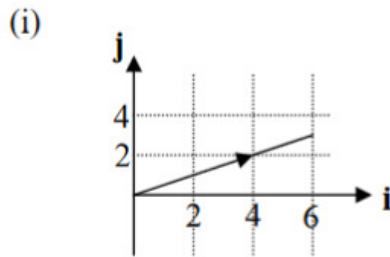


Pure 14 - Differentiation

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

1. Write the following vectors in component form.



2. Find the magnitude of each of these vectors.

- (i) $3\mathbf{i} + 4\mathbf{j}$
- (ii) $3\mathbf{i} - 6\mathbf{j}$
- (iii) $-\mathbf{i} - \mathbf{j}$

3. Write in component form the vector represented by a line from the point A (4, -1) to the point B (3, 7).

4. The vectors \mathbf{a} , \mathbf{b} and \mathbf{c} are given by $\mathbf{a} = 3\mathbf{i} - 4\mathbf{j}$, $\mathbf{b} = 2\mathbf{i} + 5\mathbf{j}$ and $\mathbf{c} = -\mathbf{i} - 3\mathbf{j}$.

Find the vectors

- (i) $\mathbf{b} + 2\mathbf{a}$
- (ii) $2\mathbf{c} - \mathbf{b}$
- (iii) $\mathbf{a} - \mathbf{b} + 3\mathbf{c}$

5. Write out the following binomial expansions.

- (i) $(x+1)^6$
- (ii) $(x-2)^5$
- (iii) $(2x+1)^4$
- (iv) $(2-3x)^3$

6. (i) Write down the first four terms in the binomial expansion of $\left(1 + \frac{x}{2}\right)^9$.

(ii) By substituting $x = 0.1$, find an approximate value for 1.05^9 .

(iii) Find the percentage error in using this approximate value instead of the true value.

Section 2 – Consolidation of this week’s topic. Please complete all questions.

1. For each of the following functions, find $f'(x)$.

(i) $f(x) = 2x + 1$	(ii) $f(x) = x^3 - 5x$	(2)
(iii) $f(x) = \frac{1}{x^3}$	(iv) $f(x) = \sqrt[3]{x}$	(2)
(v) $f(x) = \frac{2}{x} - \frac{3}{x^2}$	(vi) $f(x) = 4\sqrt{x} - \frac{3}{\sqrt{x}}$	(4)
(vii) $f(x) = 3x^{-5} - 2x^{-7}$	(viii) $f(x) = 2x^{\frac{3}{2}} - 5x^{-\frac{3}{2}}$	(4)
(ix) $f(x) = 3x^4 - 4x^{\frac{3}{2}} + \frac{1}{x}$	(x) $f(x) = x(x+2)$	(5)
(xi) $f(x) = (x^2 - 2)\sqrt{x}$	(xii) $f(x) = \frac{x^2 - 2x + 3}{2x^2}$	(5)

2. Given that $y = 12x - x^3$,
 - (i) Find the gradient of the curve at the origin. (2)
 - (ii) Find the coordinates of the two points where the gradient is zero. (4)

3. Find the gradient of each of the following graphs at the given point
 - (i) $y = 2x - \frac{1}{x}$ at the point (1, 1) (3)
 - (ii) $y = 3 - \sqrt{x}$ at the point (4, 1) (3)
 - (iii) $y = x^2\sqrt{x}$ at the point (1, 1) (3)

4. Given that $y = x^3 + 2x^2$, find $\frac{dy}{dx}$. Hence find the x -coordinates of the two points on the curve where the gradient is 4. (3)

5. A curve has equation $y = ax^3 + bx$, where a and b are constants. At the point where $x = 1$, the y – coordinate is 8 and the gradient is 12. Find a and b . (5)

6. Use first principles to show that the derivative of $y = 5x^2$ is $\frac{dy}{dx} = 10x$ (5)

Total: 50 Marks

Section 3 – Extension questions. If you are aiming for a top grade, you should attempt these questions.

1. Use first principles to show that the derivative of $f(x) = (2x + 3)^2$ is
$$f'(x) = 4(2x + 3)$$
2. Use first principles to show that the derivative of $f(x) = (2x + 3)^3$ is
$$f'(x) = 6(2x + 3)^2$$
3. Suggest an expression for the derivative of $f(x) = (ax + b)^n$