

A Level Mathematics A

H240/02 Pure Mathematics and Statistics

Question Set 5

1.	(a)	Differentiate	the	following	with	respect to	o x.
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(i)
$$(2x+3)^7$$
 [2]

(ii)
$$x^3 \ln x$$
 [3]

(b) Find
$$\int \cos 5x \, dx$$
. [2]

(c) Find the equation of the curve through (1, 3) for which
$$\frac{dy}{dx} = 6x - 5$$
. [2]

2 Simplify fully
$$\frac{2x^3 + x^2 - 7x - 6}{x^2 - x - 2}$$
. [4]

- 3 In this question you should assume that $-1 \le x \le 1$.
 - (a) For the binomial expansion of $(1-x)^{-2}$

(ii) write down the term in
$$x^n$$
. [1]

(b) Write down the sum to infinity of the series
$$1 + x + x^2 + x^3 + \dots$$
 [1]

(c) Hence or otherwise find and simplify an expression for
$$2+3x+4x^2+5x^3+...$$
 in the form $\frac{a-x}{(b-x)^2}$ where a and b are constants to be determined. [3]

4 In this question you must show detailed reasoning.

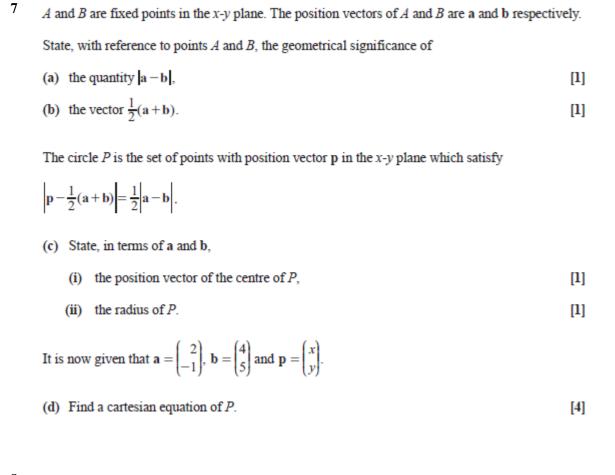
Solve the equation
$$3\sin^4\phi + \sin^2\phi = 4$$
, for $0 \le \phi < 2\pi$, where ϕ is measured in radians. [5]

5 (a) Determine the set of values of n for which
$$\frac{n^2-1}{2}$$
 and $\frac{n^2+1}{2}$ are positive integers. [3]

A 'Pythagorean triple' is a set of three positive integers a, b and c such that $a^2 + b^2 = c^2$.

(b) Prove that, for the set of values of *n* found in part (a), the numbers
$$n$$
, $\frac{n^2-1}{2}$ and $\frac{n^2+1}{2}$ form a Pythagorean triple.

Prove that
$$\sqrt{2}\cos(2\theta + 45^\circ) \equiv \cos^2\theta - 2\sin\theta\cos\theta - \sin^2\theta$$
, where θ is measured in degrees. [3]



The rate of change of a certain population P at time t is modelled by the equation $\frac{dP}{dt} = (100 - P)$.

Initially P = 2000.

- (a) Determine an expression for P in terms of t. [7]
- (b) Describe how the population changes over time. [2]

Total Marks for Question Set 5: 50 Marks



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