

$$\sin(\theta)=\theta$$



Level Two Calculus

There are three questions, worth a total of 24 marks.

Attempt ALL questions, showing all working.

Read questions carefully before attempting them.

Marks are available for partial answers.

The amount of time expected to be spent per question may not necessarily correlate “nicely” to the number of marks.

Diagrams may be used to support answers.

Candidates who do not provide diagrams for some questions may be disadvantaged.

Some marks are given for clarity and neatness of solutions or proofs.

Time Allowed:	One Hour
Achieved:	8 marks
Merit:	14 marks
Excellence:	20 marks

Question:	1	2	3	Total
Points:	8	8	8	24
Score:				

Available Grades: *Not Achieved* *Achieved* *Merit* *Excellence*

1. (a) Suppose $y = 2x^5 - 10x^4 - 5x^2 + 40x - 10$.
 - i. Find $\frac{dy}{dx}$. (2)
 - ii. Show that y is at a minimum when $x = 4$. (3)
- (b) Let f be a function of t defined by (3)

$$f(t) = x^3 + ax^2 - 2x + 3.$$

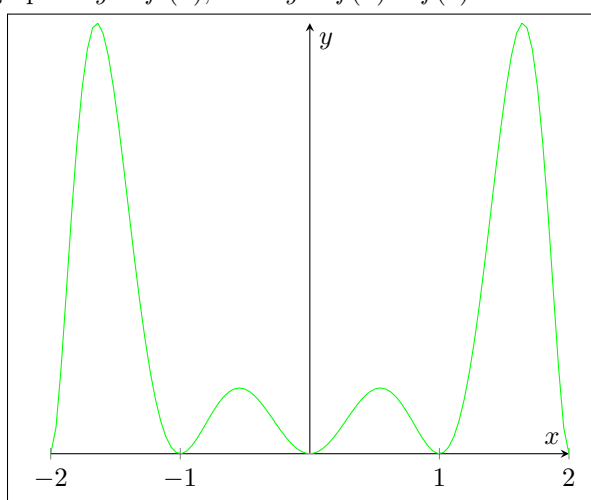
Using calculus methods, find all values for a so that f has two turning points.

2. (a) Find the most general antiderivative of $4x^3 + 12x - \frac{1}{x^2}$ with respect to x . (2)
- (b) Suppose that ϕ is a function of x which passes through the origin and reaches a minimum at $x = -12$. If (3)

$$\phi'(x) = x^2 + 4px - 48,$$

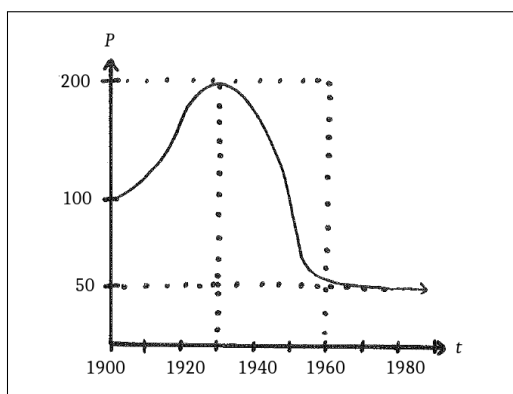
where p is some constant, find $\phi(x)$.

- (c) Given the following graph of $y = f'(x)$, draw $y = f(x)$ if $f(0) = 1$. (3)



The graph of $y = f'(x)$.

3. The following curve models the population P of wombles in the north Wellington area over the 20th century.



- (a)
 - i. What is the value of $\frac{dP}{dt}$ at time $t = 1920$? (2)
 - ii. Draw the graph of $P'(t)$. (3)
- (b) A model for the **rate of population change** between $t = 1900$ and $t = 1960$ is given by (3)

$$R(t) = 562.1 - 0.2916t.$$

Use this to write an equation modelling the **population itself** between those two years.