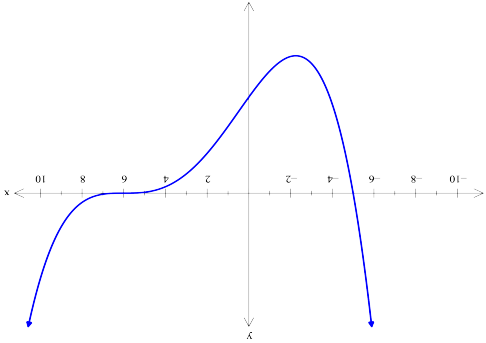
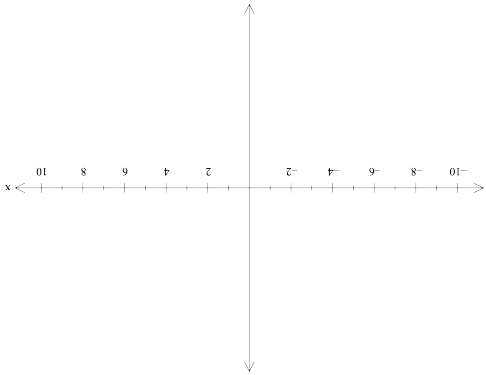


For the function shown below:



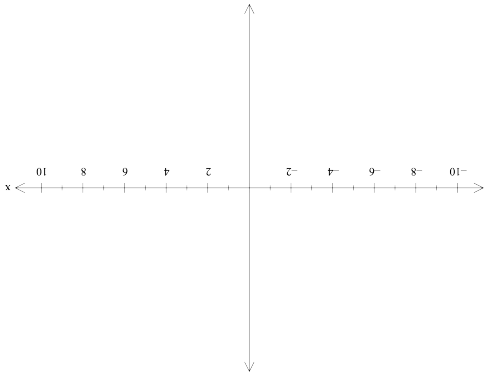
a) Sketch the first derivative, clearly indicating the relationship between relevant points.

(2)



b) and the second derivative, again clearly showing relevant relationships.

(2)



[Care should be taken with the x values of critical points, but the 'heights' of the derivatives are not unique, use whatever makes your sketch easier to draw.]



SHENTON
COLLEGE

ATMAM Mathematics Methods
Test 1
Calculator Assumed

Name:

Teacher: Friday Smith

Time Allowed : 25 minutes

Materials allowed: Classpad, calculator, formula sheet.

Attempt all questions.

All necessary working and reasoning must be shown for full marks.
Where appropriate, answers should be given to two decimal places.
Marks may not be awarded for untidy or poorly arranged work.

1

Find the value of p (to 2 decimal places) if the function $y = e^{x^2-p}$ has a gradient of $2e$ when $x = 3$.

(3)

2 a) Find the gradient of the normal to the function $f(x) = \cos^3 x$ at the point where $x = \frac{\pi}{6}$.

(2)

b) Hence find where this normal crosses the y-axis.

(2)

Marks /24

- 3** The height of the tide in an estuary can be modelled by the equation $H(t) = 3.5 \cos \frac{\pi t}{6}$, where H is the height in metres and t is the time since midnight, measured in hours on the domain $0 \leq t \leq 24$.
- a) What is the difference in height between the highest tide point and the lowest tide point? (1)
- b) What time(s) of the day is the height of the tide decreasing at its fastest rate? (2)
- c) Show how you would use calculus to determine what time(s) of the day the height is increasing at a rate of 1.75m per hour. (4)

- 4** A loaf of bread is removed from an oven where it has been baking at 170°C and placed in a room where the ambient temperature is 20°C . As the loaf cools, the **difference in temperature** between the bread and its surroundings can be modelled by the equation $T = T_0 e^{-0.02t}$ where T_0 is the difference in temperature immediately after the bread is removed from the oven and t is the time in minutes since the bread was removed.
- a) What is the value of T_0 ? (1)
- b) How long does it take for the bread to cool to a temperature of 50°C ? (1)
- c) Write an expression for the rate at which the bread is cooling. (1)
- d) How long after being removed from the oven is temperature of the bread is changing at a rate of -1° per minute? (2)
- e) How long will it take for the bread to cool to 20°C ? (1)