Mathematics S7MA3

Part A: Examination without technological tool

Date: Tuesday 31st January 2023

Duration: 2 hours (120 minutes)

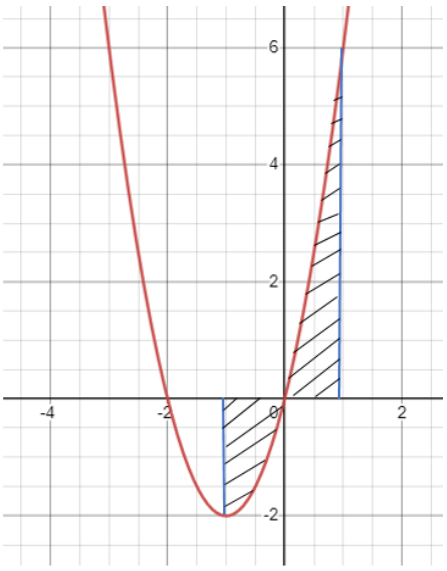
Course: S7-MA3 EN

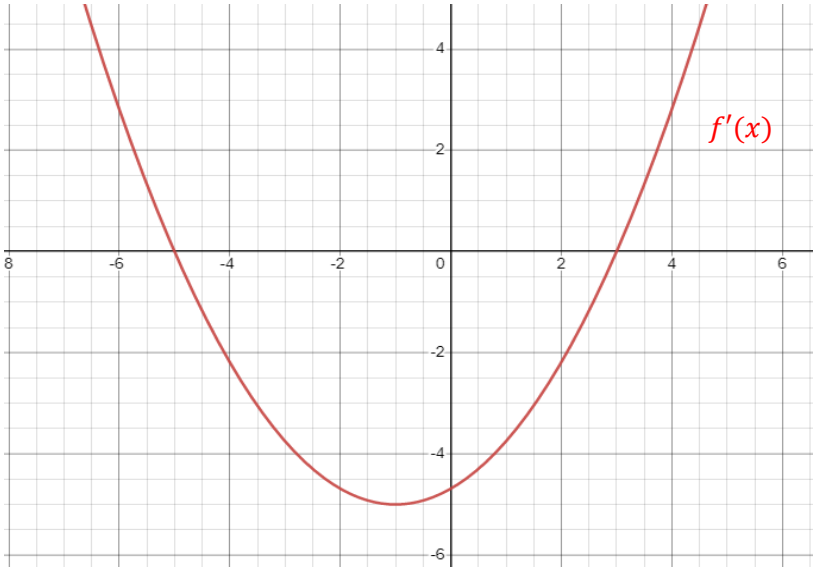
Teacher: K. Osborne

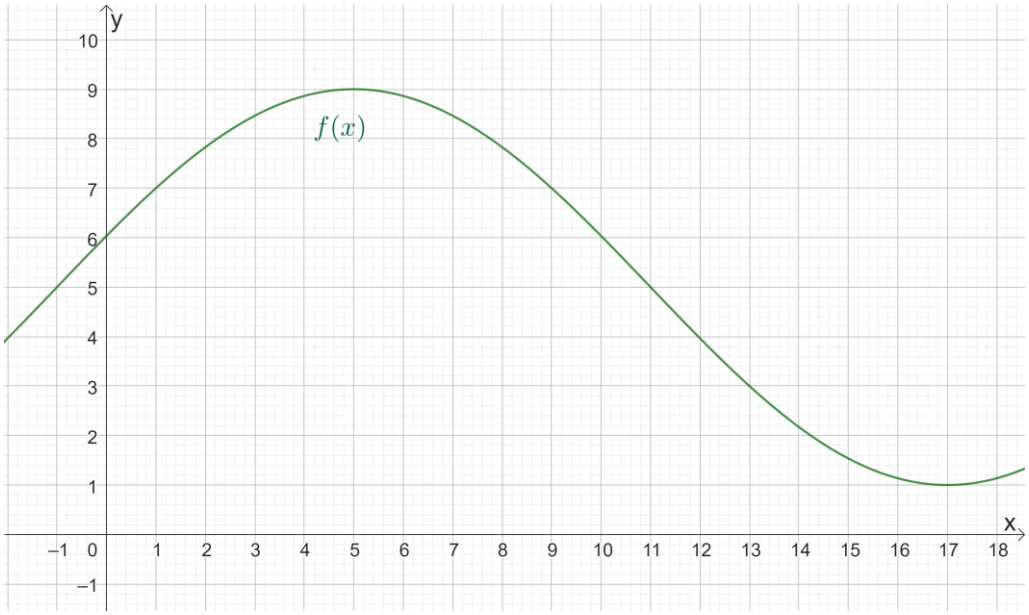
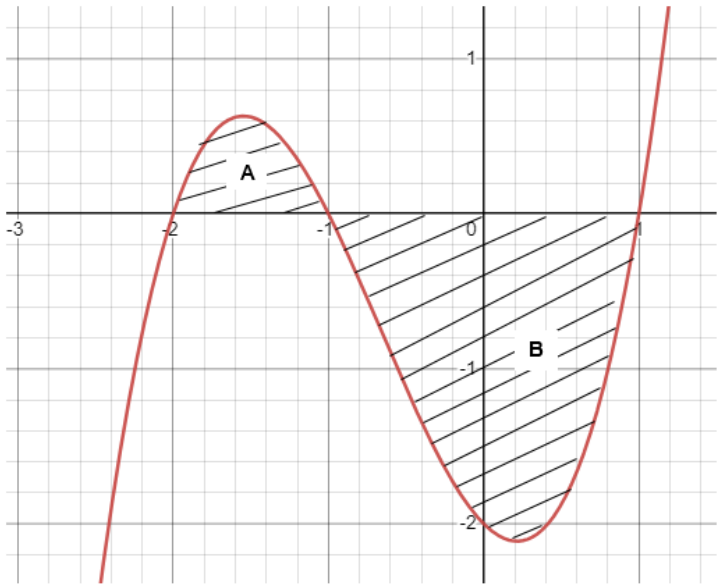
Authorised material:

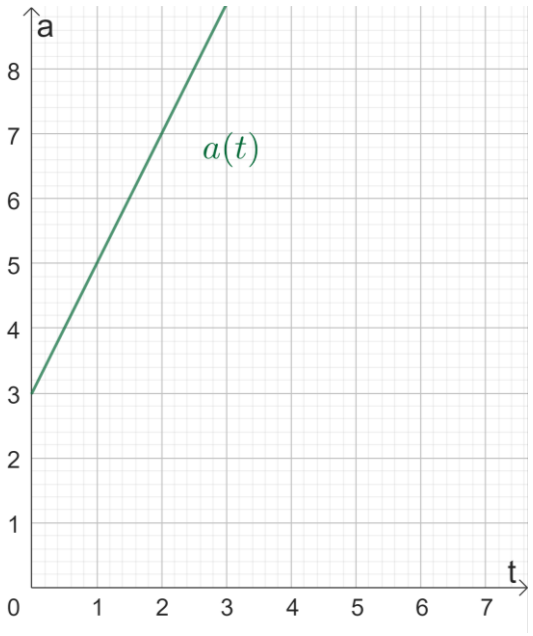
- Formula booklet

Exam without calculator

PART A		
		Marks
1	Consider the function $f(x) = x^3 + 3x^2$. **Determine** the equation of the tangent to the curve at $x = -1$.	**5**
2	The population of a small town increases linearly. In 2012 the population was 5000. Five years later it was found to be 6250. a) **Determine** a model for the population P as a function of t where t is the time in years after 2012. b) **Investigate** in which year the population exceeds 7000.	**3** **2**
3	A student kicks a ball up into the air. The height of the ball, h, in metres, can be modelled by the function $$h(t) = -5t^2 + 15t$$ where h is the height in metres and t is the time in seconds after it is kicked. **Determine** the maximum height reached by the ball.	**5**
4	The function $F(x) = \frac{2}{3}x^3 + 2x^2 + 2$ is a primitive function of $f(x)$. Consider the graph of the function $f(x)$ shown below. **Show** that the shaded area bounded by the graph of $f(x)$, the lines $x = -1$ and $x = 1$, and the x-axis is equal to 4 square units.  	**5**

5	Scientists observe the population of ladybirds in a field. The population can be modelled by the function $P(t) = 200 \cdot e^{\ln(1.015)t}$ where P is the number of ladybirds and t is the time in weeks after the observation starts. a) How many ladybirds are there at the start of the observation? b) **Calculate** the number of ladybirds after one week. c) **Determine** the weekly percentage increase.	**1** **2** **2**
6	An exponential function is of the form $f(x) = e^{ax+b}$. The graph of $f(x)$ passes through the co-ordinates $(0, e)$ and $\left(1, \frac{1}{e}\right)$. **Determine** the parameters a and b, and give the function $f(x)$.	**5**
7	The graph below is the graph of the derivative $f'(x)$. For each of the statements below indicate if it is true or false and give a reason for your answer. Marks will only be given if both the answer and the reason are correct.  a) The function $f(x)$ has a minimum at $x = -1$. b) The function $f(x)$ is decreasing over the interval $-5 < x < 3$. c) The function $f(x)$ has two turning points. d) The y-intercept of the graph of $f(x)$ cannot be determined from the graph of $f'(x)$. e) The graph of $f(x)$ must have two x-intercepts.	**5**

8	The graph of a sine function $f(x)$ is shown below.  a) **Determine** the period. b) **Determine** the parameters a, b, c and d in the function $f(x) = a\sin(b((x-c)) + d$	**1** **4**
9	Consider the graph of $f(x)$ shown below. Given that $A = 1.37$ and $B = 4.50$, **find** $\int_{-2}^{1} f(x)dx$.  	**5**

10	*The acceleration function $a(t)$ is defined as $a(t) = v'(t)$,* *where $v(t)$ is the velocity function.* The acceleration a (in m/s^2) of an object at a time t (in seconds) can be modelled by the function $a(t)$. The graph of $a(t)$ is shown below.  The velocity of the object at $t = 0$ is equal to 7 $\frac{m}{s}$. **Calculate** the velocity after 2 seconds.	**5**