



PERTH MODERN SCHOOL  
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Independent Public School

Year 12 Methods  
TEST 1  
Friday 22 February 2019  
TIME: 45 minutes working  
One page  
Notes allowed  
Calculator Assumed  
39 marks 7 Questions

Name: \_\_\_\_\_ Teacher: \_\_\_\_\_

Note: All part questions worth more than 2 marks require working to obtain full marks.

Question 1

(4 marks)

$x$	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	3	-1	-2	-1
2	2	-1	1	0
3	1	-1	2	1

(a) Define  $h(x) = \frac{f(x)}{g(x)}$ , use the table to find the value for  $h'(2)$ . (2 marks)

(b) Define  $I(x) = f(g(x))$ , use the table to find the value for  $I'(3)$ . (2 marks)

**Question 2****(3 marks)**

Find the equation of the line tangent to the function  $y = (3x^2 - 2)^3$  at the point  $(2, 2)$ . Give your answer in the gradient-intercept form.

**Question 3****(3 marks)**

The time period  $T$  for a simple pendulum of length  $l$  is given by  $T = 2\pi\sqrt{\frac{l}{g}}$  where  $g$  is a constant. If the length changes by 3%, use the incremental formula to estimate the percentage change in the period.

Question 7 (6 marks)

A share portfolio, initially worth \$26000, has a value of  $f$  dollars after  $t$  months, and begins with a negative rate of growth. The rate of growth remains negative until after 20 months ( $t = 20$ ) when the value of the portfolio is momentarily stationary and then continues with negative growth for the life of the investment. The value of the portfolio,  $f(t)$  after  $t$  months can be modelled by the following model,  $f(t) = -2t^3 + bt^2 + ct + d$ ,  $0 \leq t \leq 37$  months where  $b, c$  &  $d$  are constants. Determine the values of the constants.

Question 4

(7 marks)

A company is purchasing a type of thin sheet metal required to make a closed cylindrical container with a capacity of  $4000\pi$  cm<sup>3</sup>.

(a) Let the radius of the cylindrical base be  $r$ . Find the expression for the height  $h$  in terms of  $r$ . (1 mark)

(b) Hence, find the expression for the surface area of the cylinder in terms of  $r$ . (2 marks)

(c) Using calculus, determine the least area of metal required to make a closed cylindrical container from thin sheet metal in order that it will have a capacity of  $4000\pi$  cm<sup>3</sup>. (4 marks)

(Work to one decimal place)

**Question 5****(8 marks)**

The position of a train on a straight mono rail,  $x$  metres at time  $t$  seconds, is modelled by the following formula for the velocity,  $v$  in metres/second,  $v = pt^2 - 12t + q$  where  $p$  &  $q$  are constants.

The deceleration of the train is  $8ms^{-2}$  when  $t=1$ , has a position  $x=\frac{4}{3}$  when  $t=2$  and is initially at the origin ( $x=0$ ).

- a) Determine the values of the constants  $p$  &  $q$ . (4 marks)

- b) Determine the time(s) that the velocity is zero. (2 marks)

- c) The distance travelled when the acceleration is  $12ms^{-2}$ . (2 marks)

**Question 6****(8 marks)**

The volume,  $V$  in cubic metres and radius  $R$  metres, of a spherical balloon are changing with time,  $t$  seconds.  $V = \frac{4\pi R^3}{3}$ . The radius of the balloon at any time is given by  $R = 2t(t+3)^3$ .

Determine the following:

- a) The value of  $\frac{dR}{dt}$  when  $t=1$ . (3 marks)

- b) The value of  $\frac{dV}{dt}$  when  $t=1$ . (3 marks)

Consider the volume of the balloon at  $t=1$ .

- c) Use the incremental formula to estimate the change in volume 0.1 seconds later (i.e  $t=1.1$ ) (2 marks)