



Christ Church  
Grammar School

2020  
TEST 6

# MATHEMATICS METHODS Year 11

## Section One: Calculator-free

Your name \_\_\_\_\_  
*Solutions*

Teacher's name \_\_\_\_\_

## Time and marks available for this section

Working time: 25 minutes  
Marks available: 28 marks

## Materials required/recommended for this section

*To be provided by the supervisor*  
This Question/Answer Booklet  
Formula Sheet

*To be provided by the candidate*  
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: nil

## Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

**Instructions to candidates**

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2. Write your answers in this Question/Answer Booklet using a blue/black pen. Do not use erasable or gel pens.
3. Answer all questions.
4. You must be careful to confine your response to the specific question asked and to follow any instructions that are specified to a particular question.
5. Supplementary pages for the use of planning/continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.
6. **Show all your working clearly.** Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat an answer to any question, ensure that you cancel the answer you do not wish to have marked.
7. It is recommended that **you do not use pencil**, except in diagrams.

**See next page****Additional working space**

Question number: \_\_\_\_\_

(9 marks)

Question 1

(a) Determine the antiderivative of

$$(i) \quad 12x^3 - 2x^2 - 1$$

(3 marks)

✓ 1 correct term

✓ 2 correct terms

✓ 3 correct terms

(no penalty for missing  $+C$ )

✓ rewrites

(3 marks)

$$A.D.'s \quad \frac{1}{2}x^2 + x^{-1} \quad \checkmark \text{ anth-diffs correct expression}$$

✓ correctly expresses  
will positive powers  
and  $+C$

(b) Express  $y$  in terms of  $x$  if  $\frac{dy}{dx} = 6x^2 - 3x + 4$  and  $y = 14$  when  $x = 2$ . (3 marks)

$$y = \int (6x^2 - 3x + 4) dx$$

$$y = 2x^3 - \frac{3}{2}x^2 + 4x + C \quad \checkmark \text{ anth-diffs}$$

$$14 = 2(2)^3 - \frac{3}{2}(2)^2 + 4(2) + C \quad \checkmark \text{ subs } (2, 14)$$

$$14 = 16 - 6 + 8 + C$$

$$C = -4$$

$$\therefore y = 2x^3 - \frac{3}{2}x^2 + 4x - 4$$

✓ solves for  $C$  and  
expresses  $y$  in terms  
of  $x$

See next page

Question 7

(6 marks)

(a) Determine  $x$  if the terms 12,  $x$ , 27 are three consecutive terms of an arithmetic sequence. (2 marks)

$$\frac{27 - 12}{2} = 7.5$$

$$x = 12 + 7.5$$

$$x = 19.5$$

✓ determines  $+d$   
✓ value of  $x$

(b) Determine  $T_{10}$  of the arithmetic sequence where  $T_1 = x - 3$ ,  $T_2 = 2x + 1$  and  $T_3 = 4x - 1$ . (4 marks)

$$d = (2x + 1) - (x - 3) = x + 4$$

$$d = (4x - 1) - (2x + 1) = 2x - 2$$

✓ expression for  $d$

$$\therefore 2x - 2 = x + 4$$

$$x = 6 \quad \checkmark \text{ correct value for } x$$

$$T_1 = 3, T_2 = 13, T_3 = 23 \quad \checkmark \text{ correct terms of sequence}$$

$$\therefore T_{10} = 3 + 9 \times 10 = 93 \quad \checkmark \text{ correct value for } T_{10}$$

End of questions

Question 2

(8 marks)

Consider the following recursive rule  $T_{n+1} = T_n - 3$ ,  $T_1 = 8$ .

(a) State the first 4 terms in the sequence.

(2 marks)

$$T_1 = 8$$

$$T_2 = 5 \quad \checkmark \text{ 2 correct terms}$$

$$T_3 = 2 \quad \checkmark \text{ 4 correct terms}$$

$$T_4 = -1$$

(b) Determine a rule for the  $n^{\text{th}}$  term of this sequence.

(2 marks)

$$T_n = 8 - 3(n-1) \quad \checkmark \text{ uses a and d correctly}$$

$$\text{or } T_n = 11 - 3n \quad \checkmark \text{ correct form}$$

(c) Determine the value of the 52<sup>nd</sup> term.

(1 mark)

$$T_{52} = 11 - 3(52)$$

$$= 11 - 156$$

$$T_{52} = -145 \quad \checkmark$$

(d) Determine the first term in the sequence which is less than  $-500$ .

(3 marks)

$$11 - 3n < -500 \quad \checkmark \text{ writes equation/inequation}$$

$$-3n < -511$$

$$n > \frac{511}{3}$$

$\checkmark$  solves

$$n > 170.\bar{3} \quad \text{i.e. the } 171^{\text{st}} \text{ term}$$

$\checkmark$  gives correct term

See next page

Question 6 continued

(e) Calculate the total distance travelled by the particle during the first six seconds.  
(3 marks)

$$t = 0 \quad x = -3$$

$$t = 3.2 \quad x = -15.12 \quad (2 \text{ d.p.})$$

$$t = 6 \quad x = 9$$

$$\text{total distance} = 12.12 + 24.12$$

$$= 36.2 \text{ m (1 d.p.)}$$

$\checkmark$  considers change of direction

$\checkmark$  calculates distance

$\checkmark$  correct total distance with units

See next page

Question 6

(9 marks)

A particle undergoing rectilinear motion has its displacement, in metres, at any time  $t$ , seconds, given by the equation  $x(t) = \frac{3}{t^3} - t^2 - 4t - 3$ .

(a) Determine the displacement of the particle at six seconds. (1 mark)

$$x(6) = 9 \quad 9 \text{ m} \quad \checkmark$$

(b) Determine the velocity of the particle at any time  $t$  seconds. (1 mark)

$$v = \frac{dx}{dt} = t^2 - 2t - 4 \quad \checkmark$$

(c) Calculate the speed of the particle at three seconds. (2 marks)

$$\text{speed} = |v| \quad v_{t=3} = -1 \quad \checkmark \text{ determines velocity}$$

$$\therefore \text{speed is } 1 \text{ m/s} \quad \checkmark \text{ states speed}$$

(d) Determine when the particle is at rest. Round your answer to one decimal place. (2 marks)

$$\begin{aligned} \text{solve } v(t) &= 0 \\ t &= -1.236, 3.236 \quad \checkmark \text{ solves} \\ t &> 0 \\ \therefore t &= 3.2 \text{ s (1 d.p.)} \quad \checkmark \text{ states solution with rounding} \end{aligned}$$

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Question 3

(5 marks)

Ruth's mother deposited some money into her daughter's savings account for her birthday. Ruth decided to withdraw the same amount of money each month to pay off a purchase she had made. After 4 months, she had \$850 remaining in the account and after 14 months, \$600 remained in the account.

(a) Determine the amount of the initial deposit and the amount withdrawn each month. (3 marks)

$$\begin{aligned} T_4 &= 850 & T_{14} &= 600 \\ T_n &= T_0 + dn \\ A &= \frac{600 - 850}{14 - 4} = -\frac{250}{10} = -25 & \checkmark \text{ adequate working} \\ 850 &= T_0 + (-25)(4) & a &= 950 \\ 850 &= T_0 - 100 & \end{aligned}$$

$$\begin{aligned} \checkmark & \text{ initial deposit of } \$950 \\ \checkmark & \text{ amount withdrawn: } \$25 \text{ each month} \end{aligned}$$

(b) Determine the length of time it takes for the account to reach a balance of \$0. (2 marks)

$$\begin{aligned} 950 - 25n &= 0 & \checkmark \text{ sets up equation} \\ -25n &= -950 \\ n &= \frac{950}{25} \\ n &= 38 \end{aligned}$$

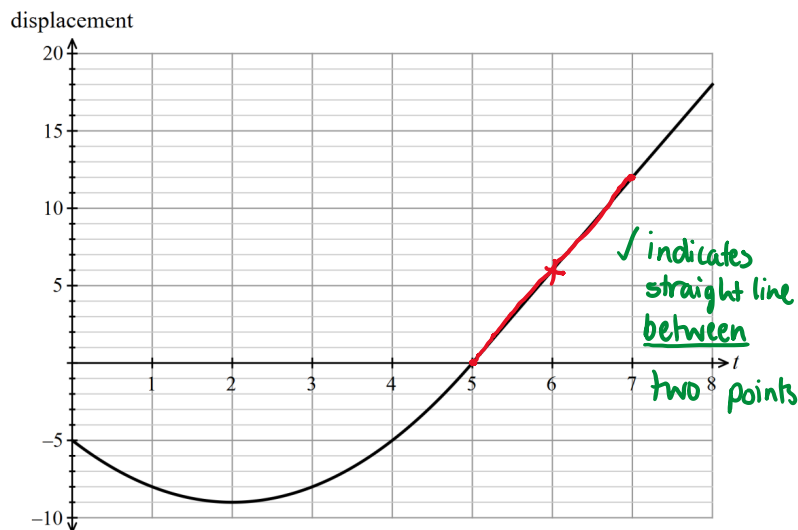
$$\therefore 38 \text{ months} \quad \checkmark \text{ states explicitly number of months}$$

See next page

Question 4

(6 marks)

A particle,  $P$ , is able to travel backwards and forwards along a straight line. The displacement, in metres, of the particle relative to point  $O$ , is shown on the graph below for the interval  $0 \leq t \leq 8$  seconds.



- (a) State an interval of time during which the particle is moving towards point  $O$ .

(1 mark)

$$2 < t < 5 \quad \checkmark$$

- (b) State the value of  $t$  for which the particle is stationary.

(1 mark)

$$t = 2 \quad \checkmark$$

- (c) Determine the total distance that the particle travelled during the 8 second interval.

(1 mark)

$$-5 \rightarrow -9 \quad -9 \rightarrow 18 \quad 4 + 9 + 18 = 31 \text{ m} \quad \checkmark$$

- (d) By showing use of an appropriate average rate of change, determine the velocity of the particle when  $t = 6$ .

(3 marks)

$$V = \frac{12 - 0}{1 - 5} = 6 \text{ m/s} \quad \checkmark \text{ velocity with units}$$

$\checkmark$  uses gradient / average rate of change formula

End of questions

Question 5

(3 marks)

The arithmetic series  $23 + 32 + 41 + 50 + \dots + 2534$  has a sum of 357 980.

- (a) Determine the 100<sup>th</sup> term in the series.

(2 marks)

$$T_n = T_{n-1} + 9 \quad T_1 = 23 \quad \checkmark \text{ writes formula}$$

$$T_{100} = 914 \quad \checkmark \text{ determines } T_{100}$$

- (b) Determine the number of terms in the series.

(1 mark)

$$T_{280} = 2534$$

$$\therefore 280 \text{ terms} \quad \checkmark$$

See next page

Additional working space

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TEST 6**MATHEMATICS METHODS Year 11****Section Two:****Calculator-assumed**Your name Solutions

Teacher's name \_\_\_\_\_

**Time and marks available for this section**

Working time: 20 minutes

Marks available: 18 marks

**Materials required/recommended for this section*****To be provided by the supervisor***

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