Thank you for subscribing to SmarterMaths Teacher Edition (Silver) in 2020.

The "2020 HSC Final Stretch Revision Series" provides around 8 hours of carefully chosen HSC revision questions. It has a weighting toward more difficult examples and is targeted at motivated students aiming for a Band 5 or 6 result. We recommend students ***attempt, carefully review and annotate*** this revision set in Term 3, and use it as the foundation of a concise and high quality revision resource.

While a significant overlap exists between this revision set and the longer CRS released earlier in the term, we have chosen different questions whenever possible for those students who are doing serious revision hours and plan to complete both.

Our analysis on each topic, the common question types, past areas of difficulty and recent HSC trends all combine to create this revision set that ensures students cover a wide cross-section of the key areas.

IMPORTANT: If students have been exposed to many of the questions in these worksheets during the year, we say great. This is the time when minimizing silly errors and developing speed through the paper are critical. Many top performing students agree that the best way to achieve this is to do high quality questions 2-3 times in the lead up to the exam.

HSC Final Study – STD2 Algebra (estimated ~16% of exam)

Key Areas addressed by this worksheet

A1 Formulae and Equations

- harder formula *rearrange* questions of linear equations (note that rearranging non-linear equations is not examinable in the 2020 HSC exam);
- substituting given values into both linear and non-linear equations .. poorly answered examples are a focus;
- algebraic fractions – caused significant issues in 2018!
- "find the mistake" questions, historically poorly answered;
- medicine dosage formulae covered – omitted in 2019 after being tested in each of the previous 5 years;
- stopping distance calculations – sub-50% mean marks the last 2 times it was examined and omitted in the 2019 paper;
- BAC calculations (must review question type);
- *distance, speed and time equations (D=S×T)* have attracted tough multiple-choice questions in the past. *2011 Q21 MC* reviews the upper difficulty level of this area.

A2 Linear Relationships

- most common question types reviewed, primarily identifying simple graphs and finding gradients;
- pay careful attention to avoid silly errors in this area - mean marks often sub-50%!
- *Applications of Linear Relationships* - currency conversion (sub-50% mean mark in 2019) and the regularly tested fuel consumption questions are reviewed.

A4 Types of Relationships

- *Simultaneous Equations and Applications* are a revision focus. The 2019 HSC profit and loss question was poorly answered and we review a similar financial example, along with other harder multiple choice;
- *Non-Linear: Exponentials/Quadratics* is important, due in large part to the chunky allocations it regularly receives when it does appear, often in cross-topic questions;
- revision of multiple-choice questions that require students to recognise non-linear graphs is covered - examined in 50% of papers;
- *Non-Linear: Inverse and Other Problems* is almost always poorly answered (2019's good results in this topic area is an outlier). We look at two challenging multiple choice questions to cover this area.

STANDARD 2:
2020 HSC Final Stretch Revision Series - ALGEBRA

A1 Formulae and Equations (Y11)

A2 Linear Relationships (Y11)

A4 Types of Relationships (Y11)

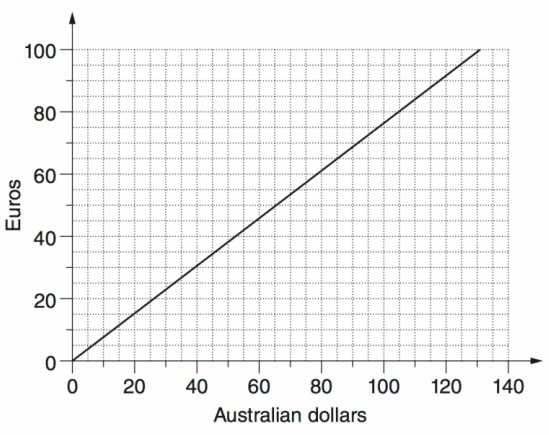
Teacher: Smarter Maths

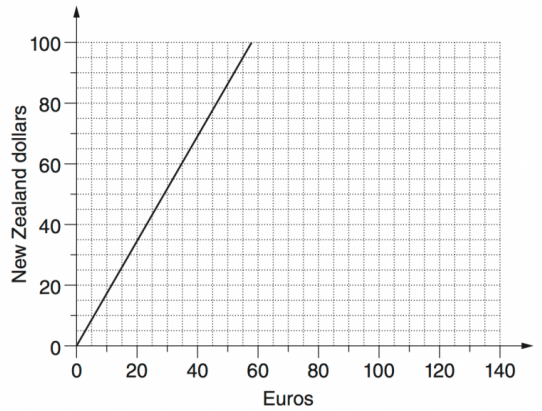
Exam Equivalent Time: 60 minutes *(based on HSC allocation of 1.5 minutes approx. per mark)*

Questions

1. Algebra, STD2 A2 2012 HSC 13 MC

Conversion graphs can be used to convert from one currency to another.





Sarah converted 60 Australian dollars into Euros. She then converted all of these Euros into New Zealand dollars.

How much money, in New Zealand dollars, should Sarah have?

(A) $26

(B) $45

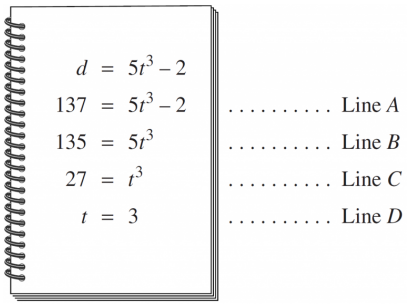
(C) $78

(D) $135

2. Algebra, STD2 A1 2005 HSC 14 MC

Using the formula $d = 5t^3 - 2$, Marcia tried to find the value of t when $d = 137$.

Here is her solution. She has made one mistake.



Which line does NOT follow correctly from the previous line?

(A) Line A

(B) Line B

(C) Line C

(D) Line D

---

3. Algebra, STD2 A4 2006 HSC 14 MC

In 2004 there were 13.5 million registered motor vehicles in Australia. The number of registered motor vehicles is increasing at a rate of 2.3% per year.

Which expression represents the number (in millions) of registered motor vehicles, if y represents the number of years after 2004?

(A) $13.5 \times (1.023)^y$

(B) $13.5 \times (0.023)^y$

(C) $13.5 \times (1.023) \times y$

(D) $13.5 \times (0.023) \times y$

---

4. Algebra, STD2 A1 2010 HSC 7 MC

If $M = -9$, what is the value of $\dfrac{3M^2 + 5M}{6}$

(A) -250.5

(B) -48

(C) 33

(D) 235.5

---

5. Algebra, STD2 A1 2011 HSC 21 MC

A train departs from Town A at 3.00 pm to travel to Town B. Its average speed for the journey is 90 km/h, and it arrives at 5.00 pm. A second train departs from Town A at 3.10 pm and arrives at Town B at 4.30 pm.

What is the average speed of the second train?

(A) 135 km/h

(B) 150 km/h

(C) 216 km/h

(D) 240 km/h

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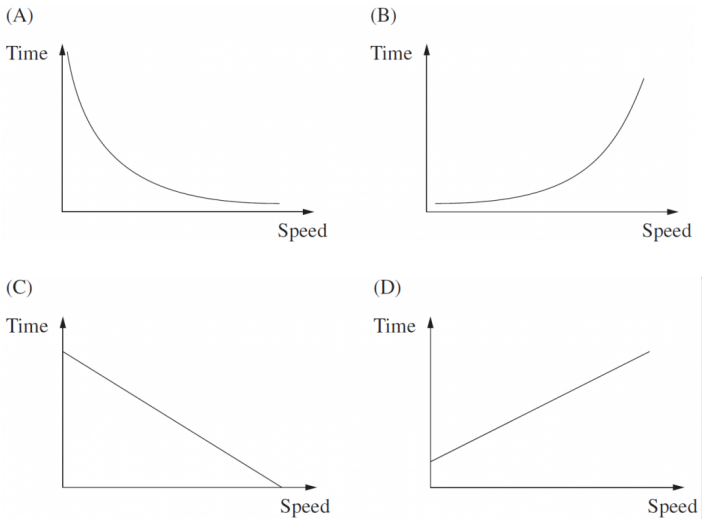
6. Algebra, STD2 A1 2009 HSC 16 MC

The time for a car to travel a certain distance varies inversely with its speed.

Which of the following graphs shows this relationship?



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7. Algebra, STD2 A4 2010 HSC 13 MC

The number of hours that it takes for a block of ice to melt varies inversely with the temperature. At 30°C it takes 8 hours for a block of ice to melt.

How long will it take the same size block of ice to melt at 12°C?

(A) 3.2 hours

(B) 20 hours

(C) 26 hours

(D) 45 hours

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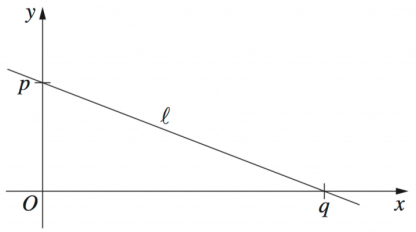
8. Algebra, STD2 A2 2012 HSC 5 MC

The line l has intercepts p and q, where p and q are positive integers.



What is the gradient of line l?

(A) $-\frac{p}{q}$

(B) $-\frac{q}{p}$

(C) $\frac{p}{q}$

(D) $\frac{q}{p}$

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9. Algebra, STD2 A1 2013 HSC 21 MC

Which equation correctly shows r as the subject of $S = 800(1 - r)$?

(A) $r = \frac{800 - S}{800}$

(B) $r = \frac{S - 800}{800}$

(C) $r = 800 - S$

(D) $r = S - 800$

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10. Algebra, STD2 A4 2007 HSC 15 MC

If pressure (p) varies inversely with volume (V), which formula correctly expresses p in terms of V and k, where k is a constant?

(A) $p = \dfrac{k}{V}$

(B) $p = \dfrac{V}{k}$

(C) $p = kV$

(D) $p = k + V$

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11. Algebra, STD2 A1 2007 HSC 19 MC

Which of the following correctly expresses T as the subject of $B = 2\pi\left(R + \dfrac{T}{2}\right)$?

(A) $T = \dfrac{B}{\pi} - 2R$

(B) $T = \dfrac{B}{\pi} - R$

(C) $T = 2R - \dfrac{B}{\pi}$

(D) $T = \dfrac{B}{4\pi} - \dfrac{R}{2}$

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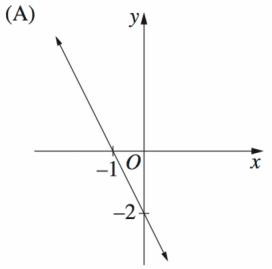
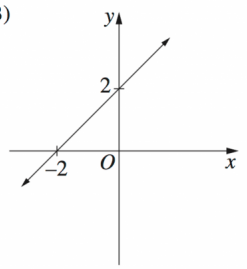
12. Algebra, STD2 A2 2014 HSC 7 MC

Which of the following is the graph of $y = 2x - 2$?

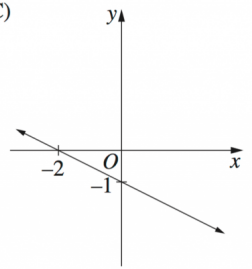
(A)



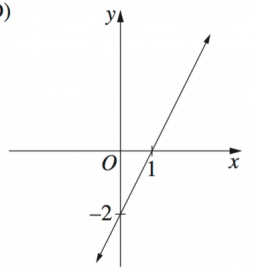
(B)



(C)



(D)



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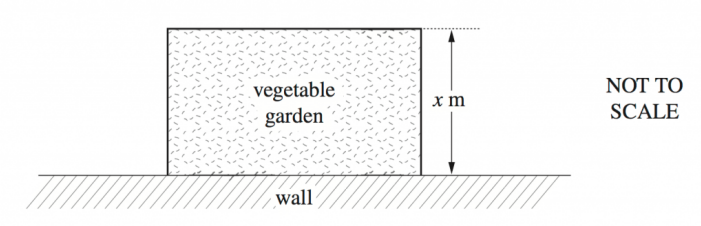
13. Algebra, STD2 A4 2013 HSC 22 MC

Leanne wants to build a rectangular vegetable garden in her backyard. She has 20 metres of fencing and will use a wall as one side of the garden. The plan for her garden is shown, where x metres is the width of her garden.



Which equation gives the area, A, of the vegetable garden?

(A) $A = 10x - x^2$

(B) $A = 10x - 2x^2$

(C) $A = 20x - x^2$

(D) $A = 20x - 2x^2$

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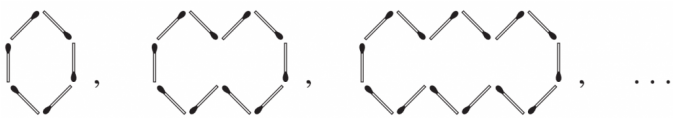
14. Algebra, STD2 A2 2007 HSC 18 MC

Chris started to make this pattern of shapes using matchsticks.



If the pattern of shapes is continued, which shape would use exactly 486 matchsticks?

(A) Shape 96

(B) Shape 97

(C) Shape 121

(D) Shape 122

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15. Algebra, STD2 A2 2016 HSC 26c

Peta's car uses fuel at the rate of 5.9 L /100 km for country driving and 7.3 L /100 km for city driving. On a trip, she drives 170 km in the country and 25 km in the city.

Calculate the amount of fuel she used on this trip. *(2 marks)*

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16. Algebra, STD2 A2 2014 HSC 26f

The weight of an object on the moon varies directly with its weight on Earth. An astronaut who weighs 84 kg on Earth weighs only 14 kg on the moon.

A lunar landing craft weighs 2449 kg when on the moon. Calculate the weight of this landing craft when on Earth. *(2 marks)*

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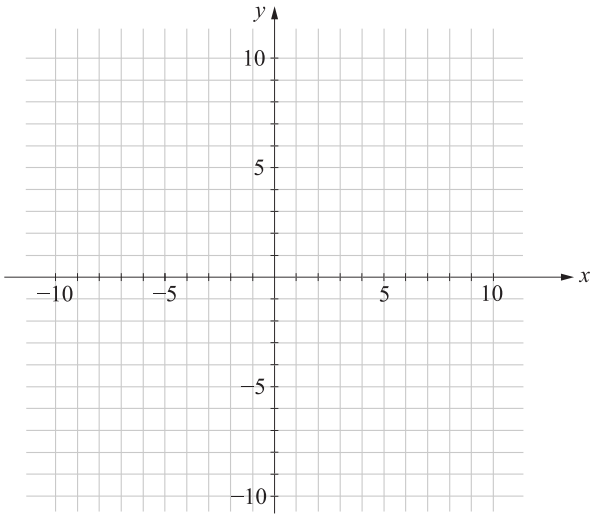
17. Algebra, STD2 A4 2014 HSC 26d

Draw each graph on the grid below and hence solve the simultaneous equations. *(3 marks)*

$y = 2x + 1$

$x - 2y - 4 = 0$ *(3 marks)*



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18. Algebra, STD2 A1 2014 HSC 29b

Blood alcohol content of males can be calculated using the following formula

$$BAC_{\text{Male}} = \frac{10N - 7.5H}{6.8M}$$

where N is the number of standard drinks consumed

H is the number of hours drinking

M is the person's mass in kilograms

What is the maximum number of standard drinks that a male weighing 84 kg can consume over 4 hours in order to maintain a blood alcohol content (BAC) of less than 0.05? ***(3 marks)***

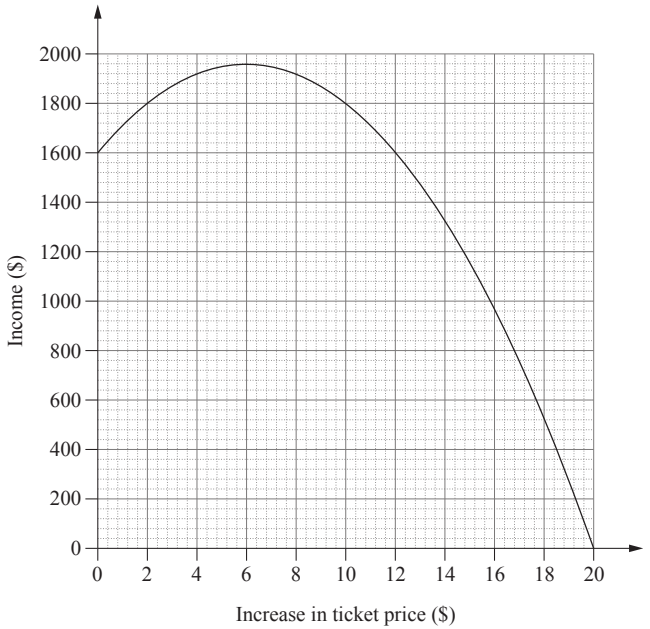
19. Algebra, STD2 A4 2017 HSC 28e

A movie theatre has 200 seats. Each ticket currently costs $8.

The theatre owners are currently selling all 200 tickets for each session. They decide to increase the price of tickets to see if they can increase the income earned from each movie session.

It is assumed that for each one dollar increase in ticket price, there will be 10 fewer tickets sold.

A graph showing the relationship between an increase in ticket price and the income is shown below.



i. What ticket price should be charged to maximise the income from a movie session? ***(1 mark)***

ii. What is the number of tickets sold when the income is maximised? ***(1 mark)***

iii. The cost to the theatre owners of running each session is $500 plus $2 per ticket sold.
Calculate the profit earned by the theatre owners when the income earned from a session is maximised. ***(2 marks)***

20. Algebra, STD2 A2 SM-Bank 3

The average height, C, in centimetres, of a girl between the ages of 6 years and 11 years can be represented by a line with equation

$$C = 6A + 79$$

where A is the age in years. For this line, the gradient is 6.

i. What does this indicate about the heights of girls aged 6 to 11? *(1 mark)*

ii. Give ONE reason why this equation is not suitable for predicting heights of girls older than 12. *(1 mark)*

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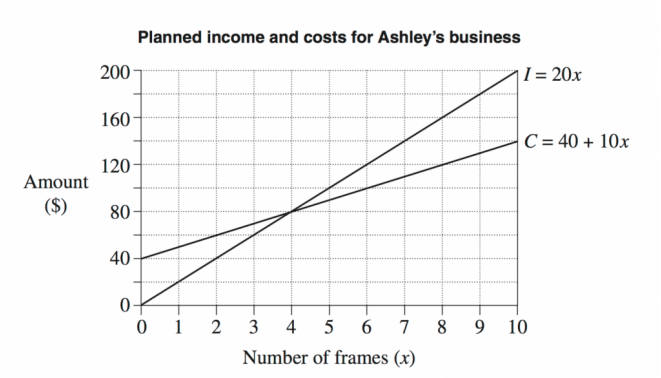
21. Algebra, STD2 A4 2010 HSC 24b

Ashley makes picture frames as part of her business. To calculate the cost, C, in dollars, of making x frames, she uses the equation $C = 40 + 10x$.

She sells the frames for $20 each and determines her income, I, in dollars, using the equation $I = 20x$.



Use the graph to solve the two equations simultaneously for x and explain the significance of this solution for Ashley's business. *(2 marks)*

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22. Algebra, STD2 A1 2018 HSC 28b

Solve the equation $\frac{2x}{5} + 1 = \frac{3x + 1}{2}$, leaving your answer as a fraction. *(3 marks)*

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23. Algebra, STD1 A1 2019 HSC 34

Given the formula $C = \frac{A(y + 1)}{24}$, calculate the value of y when $C = 120$ and $A = 500$. *(3 marks)*

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24. Algebra, STD2 A1 2015 HSC 30d

Claire is driving on a motorway at a speed of 110 kilometres per hour and has to brake suddenly. She has a reaction time of 2 seconds and a braking distance of 59.2 metres.

Stopping distance can be calculated using the following formula

$$\text{stopping distance} = \{\text{reaction time distance}\} + \{\text{braking distance}\}$$

What is Claire's stopping distance. *(2 marks)*

Worked Solutions

1. Algebra, STD2 A2 2012 HSC 13 MC

Using the graphs

$\$60 \text{ Australian} = 46 \text{ Euro}$

$46 \text{ Euro} = \$78 \text{ New Zealand}$

$\Rightarrow C$

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2. Algebra, STD2 A1 2005 HSC 14 MC

$d = 5t^3 - 2$

$137 = 5t^3 - 2 \quad \ldots \text{ Line A}$

$139 = 5t^3 \quad \ldots \text{ Line B}$

$\therefore$ Line B doesn't follow on correctly.

$\Rightarrow B$

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3. Algebra, STD2 A4 2006 HSC 14 MC

In 2004, 13.5 million

$1 \text{ year later} = 13.5 \times (1.023)$

$2 \text{ years later} = 13.5 \times (1.023) \times (1.023)$

$= 13.5 \times (1.023)^2$

$\therefore y \text{ years later} = 13.5 \times (1.023)^y$

$\Rightarrow A$

Worked Solutions

4. Algebra, STD2 A1 2010 HSC 7 MC

$$\frac{3M^2 + 5M}{6} = \frac{3 \times (-9)^2 + 5 \times (-9)}{6}$$

$$= \frac{(3 \times 81) - 45}{6}$$

$$= \frac{198}{6}$$

$$= 33$$

$\Rightarrow C$

♦♦ *Only 31% of students answered correctly!*

---

5. Algebra, STD2 A1 2011 HSC 21 MC

1st train

Travels 2hrs at 90km/h

$\text{Distance} = \text{Speed} \times \text{Time}$

$= 90 \times 2$

$= 180 \text{ km}$

2nd train

Travels 180 km in 1 hr 20 min $\left(\frac{4}{3} \text{ hrs}\right)$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$= 180 \div \frac{4}{3}$$

$$= 180 \times \frac{3}{4}$$

$$= 135 \text{ km/h}$$

$\Rightarrow A$

♦ *Mean mark 49%*

6. Algebra, STD2 A1 2009 HSC 16 MC

♦ *Mean mark 38%*

$$T \propto \frac{1}{S}$$

$$T = \frac{k}{S}$$

As $S \uparrow, T \downarrow \Rightarrow$ cannot be B or D

C is incorrect because it graphs a linear relationship

$\Rightarrow A$

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7. Algebra, STD2 A4 2010 HSC 13 MC

♦ *Mean mark 50%*

$$\text{Time to melt } (T) \propto \frac{1}{\text{Temp}} \Rightarrow T = \frac{k}{\text{Temp}}$$

When $T = 8$, Temp $= 30$

$$8 = \frac{k}{30}$$

$$k = 240$$

When Temp $= 12$:

$$T = \frac{240}{12}$$

$$= 20 \text{ hours}$$

$\Rightarrow B$

---

8. Algebra, STD2 A2 2012 HSC 5 MC

♦ *Mean mark 45%*

$$\text{Gradient} = \frac{\text{rise}}{\text{run}}$$

$$= -\frac{p}{q}$$

$\Rightarrow A$

---

9. Algebra, STD2 A1 2013 HSC 21 MC

♦♦♦ *Mean mark 27%*

$$S = 800(1 - r)$$

$$1 - r = \frac{S}{800}$$

$$r = 1 - \frac{S}{800}$$

$$= \frac{800 - S}{800}$$

$\Rightarrow A$

---

10. Algebra, STD2 A4 2007 HSC 15 MC

$$p \propto \frac{1}{V}$$

$$p = \frac{k}{V}$$

$\Rightarrow A$

---

11. Algebra, STD2 A1 2007 HSC 19 MC

$$B = 2\pi\left(R + \frac{T}{2}\right)$$

$$\frac{B}{2\pi} = R + \frac{T}{2}$$

$$\frac{T}{2} = \frac{B}{2\pi} - R$$

$$T = \frac{B}{\pi} - 2R$$

$\Rightarrow A$

12. Algebra, STD2 A2 2014 HSC 7 MC

♦ *Mean mark 46%*

$y = 2x - 2$

By elimination

It has a y intercept of -2

$\Rightarrow$ Cannot be B or C

(–1, 0) from A doesn't satisfy equation

but (1, 0) from D does

$\Rightarrow D$

---

13. Algebra, STD2 A4 2013 HSC 22 MC

♦♦♦ *Mean mark 24% (lowest mean of any MC question in 2013 exam)*

Length of garden $= (20 - 2x)$

Area $= x(20 - 2x)$

$= 20x - 2x^2$

$\Rightarrow D$

---

14. Algebra, STD2 A2 2007 HSC 18 MC

Shape (S)	1	2	3
Matches (M)	6	10	14

Equation rule:

$M = 4S + 2$

Find x when $M = 486$:

$486 = 4S + 2$

$4S = 484$

$S = 121$

$\therefore$ The 121st shape uses 486 matchsticks.

$\Rightarrow C$

---

15. Algebra, STD2 A2 2016 HSC 26c

Fuel used in country

$= 170 \times \dfrac{5.9}{100}$

$= 10.03$ L

Fuel used in city

$= 25 \times \dfrac{7.3}{100}$

$= 1.825$ L

$\therefore$ Total fuel used

$= 10.03 + 1.825$

$= 11.855$ L

---

16. Algebra, STD2 A2 2014 HSC 26f

$w_{\text{moon}} \propto w_{\text{earth}}$

$\Rightarrow w_{\text{m}} = k \times w_{\text{e}}$

We know when $w_{\text{e}} = 84$, $w_{\text{m}} = 14$

$\therefore 14 = k \times 84$

$k = \dfrac{14}{84} = \dfrac{1}{6}$

If $w_{\text{m}} = 2449$ kg, find w_{e}

$2449 = \dfrac{1}{6} \times w_{\text{e}}$

$w_{\text{e}} = 14\,694$ kg

$\therefore$ Landing craft weighs 14 694 kg on earth

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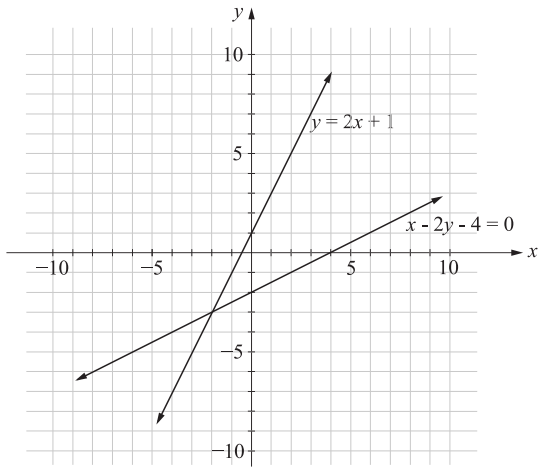
17. Algebra, STD2 A4 2014 HSC 26d



Solution is at the intersection: $x = -2,\ y = -3$

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18. Algebra, STD2 A1 2014 HSC 29b

$$\text{BAC}_{\text{male}} = \frac{10N - 7.5H}{6.8M}$$

Find N for BAC < 0.05, given $H = 4$ and $M = 84$

$$\frac{10N - 7.5(4)}{6.8(84)} < 0.05$$

$$10N - 30 < 0.05(571.2)$$

$$10N < 28.56 + 30$$

$$< 58.56$$

$$N < 5.856$$

$\therefore$ Max number of drinks is 5.

---

19. Algebra, STD2 A4 2017 HSC 28e

i. Graph is highest when increase = \$6

$\therefore$ Ticket price $= 8 + 6$

$= \$14$

♦ *Mean mark 50%.*

ii. Solution 1

Tickets sold $= 200 - (4 \times 10)$

$= 140$

♦ *Mean mark 45%.*

Solution 2

$$\text{Tickets} = \frac{\text{max income}}{\text{ticket price}}$$

$$= \frac{1960}{14}$$

$$= 140$$

iii. Cost $= 140 \times \$2 + \$500$

$= \$780$

$\therefore$ Profit when income is maximised

$= 1960 - 780$

$= \$1180$

---

20. Algebra, STD2 A2 SM-Bank 3

i. It indicates that 6-11 year old girls, on average, grow 6 cm per year.

ii. Girls eventually stop growing, and the equation doesn't factor this in.

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21. Algebra, STD2 A4 2010 HSC 24b

From the graph, intersection occurs at $x = 4$

$\Rightarrow$ Break-even point occurs at $x = 4$

i.e. when 4 frames sold

Income $= 20 \times 4 = \$80$ is equal to

Costs $= 40 + (10 \times 4) = \$80$

If < 4 frames sold $\Rightarrow$ LOSS for business

If > 4 frames sold $\Rightarrow$ PROFIT

♦ *Mean mark 36%.*
MARKER'S COMMENT: The intersection on the graph is the same point at which the two simultaneous equations are solved for the given value of x.

22. Algebra, STD2 A1 2018 HSC 28b

$$\underbrace{\frac{2x}{5} + 1}_{\text{multiply x10}} = \underbrace{\frac{3x+1}{2}}_{\text{multiply x10}}$$

$$4x + 10 = 15x + 5$$

$$11x = 5$$

$$x = \frac{5}{11}$$

♦ *Mean mark 35%.*

23. Algebra, STD1 A1 2019 HSC 34

Make y the subject:

$$C = \frac{A(y+1)}{24}$$

$$24C = A(y+1)$$

$$y + 1 = \frac{24C}{A}$$

$$y = \frac{24C}{A} - 1$$

$$= \frac{24 \times 120}{500} - 1$$

$$= 4.76$$

♦♦ *Mean mark 32% (Std1).*

24. Algebra, STD2 A1 2015 HSC 30d

110 km/hr $= 110\,000$ m/hr

$$= \frac{110\,000}{60 \times 60} \text{ m/sec}$$

$$= 30.555\ldots \text{ m/sec}$$

Reaction time distance $= 2 \times 30.555\ldots$

$= 61.11\ldots$ metres

$\therefore$ Stopping distance

= Reaction time distance + braking distance

$= 61.11\ldots + 59.2$

$= 120.311\ldots$

$= 120.3$ metres (to 1 d.p.)

♦ *Mean mark 34%.*