Thank you for subscribing to SmarterMaths Teacher Edition (Silver) in 2019.

The inaugural Standard 2 HSC exam is charting new territory and smart revision in a difficult landscape is at a premium.

This is our "Final Stretch HSC Revision Series" that we recommend motivated students aiming for a Band 5 or 6 result should ***attempt, carefully review and annotate*** to create a concise and high quality revision resource that they can refer back to.

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

IMPORTANT: If students have been exposed to some of the questions in these worksheets during the year, all the better. Do not underestimate the crucial skill of developing speed through the exam and revisiting quality questions for a second (and third) time in revision is an effective way to achieve this!

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 out of the new syllabus);
- 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;
- substitution into various dosage formulae – tested in each of the last 5 years in Gen2 course;
- stopping distance calculations – sub-50% mean marks the last 2 times it was examined;
- BAC calculations;
- *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

- tested via multiple choice in 4 of the past 5 years, with the notable omission of 2018;
- most common question types reviewed .. identify simple graphs and find gradients;
- pay careful attention to avoid silly errors in this area! (mean marks often sub-50%)
- *Applications of Linear Relationships* - currency conversion reviewed;

A4 Types of Relationships

- *Simultaneous Equations* are a revision focus. A number of *SM-Bank* (supplementary) questions have been included that reflect both the syllabus changes and the question style of NESA's sample exam documents;
- *Non-Linear: Exponentials/Quadratics* is covered in a common question style requiring an understanding of proportional relationships;
- revision of multiple-choice questions that require students to recognise non-linear graphs is covered - examined in over 50% of papers (including 2018 for the first time in 3 years);
- *Non-Linear: Inverse and Other Problems* is covered as it is almost always poorly answered.

STANDARD 2:
HSC Final Stretch Revision Series
- ALGEBRA

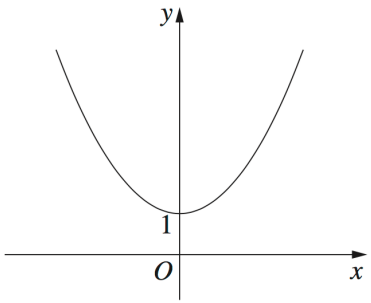
A1 Formulae and Equations (Y11)
A2 Linear Relationships (Y11)
A4 Types of Relationships (Y12)

Teacher: Smarter Maths
Exam Equivalent Time: 45 minutes *(based on HSC allocation of 1.5 minutes approx. per mark)*

Questions

1. Algebra, 2UG 2014 HSC 3 MC

The diagram shows the graph of an equation.



Which of the following equations does the graph best represent?

(A) $y = \frac{3}{x} + 1$

(B) $y = 3^x + 1$

(C) $y = 3x^2 + 1$

(D) $y = 3x^3 + 1$

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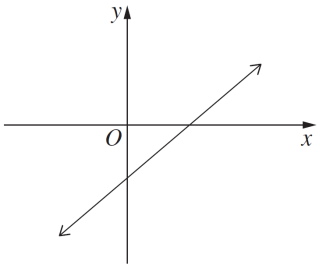
2. Algebra, 2UG 2016 HSC 14 MC

The graph shows a line which has an equation in the form $y = mx + b$.



Which of the following statements is true?

(A) m is positive and b is negative

(B) m is negative and b is positive

(C) m and b are both positive

(D) m and b are both negative

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3. Algebra, 2UG 2016 HSC 24 MC

Which of the following correctly expresses Q as the subject of $e = iR + \frac{Q}{C}$?

(A) $Q = Ce + CiR$

(B) $Q = Ce - CiR$

(C) $Q = \frac{e + iR}{C}$

(D) $Q = \frac{e - iR}{C}$

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4. FS Driving, 2UG 2015 HSC 23 MC

The number of 'standard drinks' in various glasses of wine is shown.

Number of standard drinks

White Wine		*Red Wine*	
small glass	*large glass*	*small glass*	*large glass*
0.9	1.4	1.0	1.5

A woman weighing 62 kg drinks three small glasses of white wine and two large glasses of red wine between 8 pm and 1 am.

Using the formula for calculating blood alcohol below, what would be her blood alcohol content (BAC) estimate at 1 am, correct to three decimal places?

$$BAC_{\text{Female}} = \frac{10N - 7.5H}{5.5M}$$

where N is the number of standard drinks consumed

H is the number of hours drinking

M is the person's mass in kilograms

(A) 0.030

(B) 0.037

(C) 0.046

(D) 0.057

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5. Algebra, 2UG 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

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6. FS Driving, 2UG 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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7. Algebra, 2UG 2009 HSC 14 MC

If $A = 6x + 10$, and x is increased by 2, what will be the corresponding increase in A?

(A) $2x$

(B) $6x$

(C) 2

(D) 12

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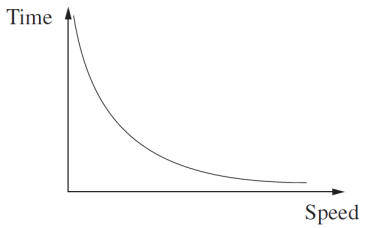
8. Algebra, 2UG 2009 HSC 16 MC

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

Which of the following graphs shows this relationship?

(A)



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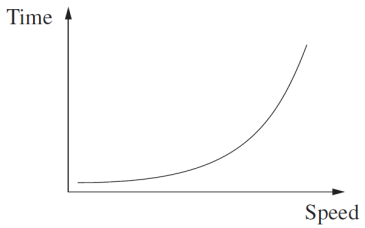

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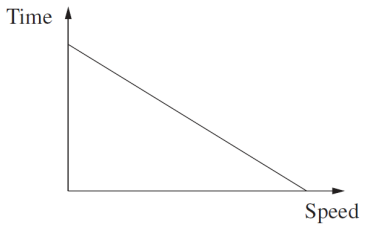

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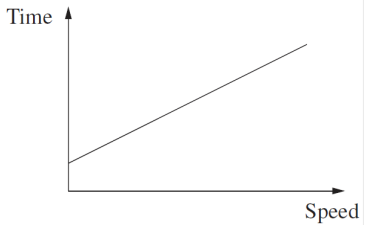

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9. Algebra, 2UG 2010 HSC 13 MC

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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10. Algebra, 2UG 2013 HSC 21 MC

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

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

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

(C) $r = 800 - S$

(D) $r = S - 800$

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11. Algebra, 2UG 2004 HSC 22 MC

John knows that

- one Australian dollar is worth 0.62 euros
- one Vistabella dollar ($\$V$) is worth 1.44 euros.

John changes 25 Australian dollars to Vistabella dollars.

How many Vistabella dollars will he get?

(A) $\$V10.76$

(B) $\$V22.32$

(C) $\$V28.00$

(D) $\$V58.06$

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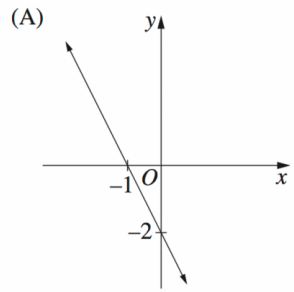
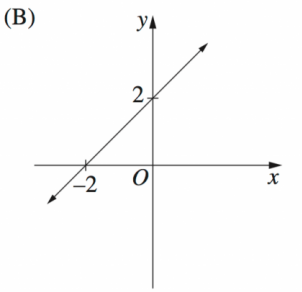
12. Algebra, 2UG 2014 HSC 7 MC

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

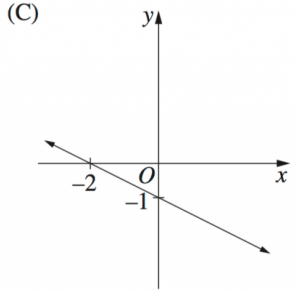
(A)



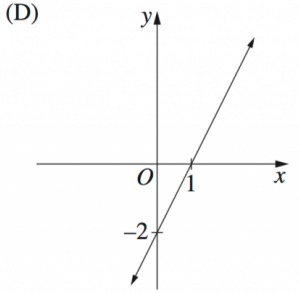
(B)



(C)



(D)



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13. FS Health, 2UG 2014 HSC 4 MC

Young's formula below is used to calculate the required dosages of medicine for children aged 1–12 years.

$$\text{Dosage} = \frac{\text{age of child (in years)} \times \text{adult dosage}}{\text{age of child (in years)} + 12}$$

How much of the medicine should be given to an 18-month-old child in a 24-hour period if each adult dosage is 45 mL? The medicine is to be taken every 6 hours by both adults and children.

(A) 5 mL

(B) 20 mL

(C) 27 mL

(D) 30 mL

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14. Algebra, STD2 A4 SM-Bank 06

A student was asked to solve the following simultaneous equations.

$$y = 2x - 8$$

$$x - 4y + 3 = 0$$

After graphing the equations, the student found the point of intersection to be $(5, 2)$?

Is the student correct? Support your answer with calculations. *(2 marks)*

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15. Algebra, 2UG 2009 HSC 28c

The height above the ground, in metres, of a person's eyes varies directly with the square of the distance, in kilometres, that the person can see to the horizon.

A person whose eyes are 1.6 m above the ground can see 4.5 km out to sea.

How high above the ground, in metres, would a person's eyes need to be to see an island that is 15 km out to sea? Give your answer correct to one decimal place. *(3 marks)*

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16. Algebra, 2UG 2013 HSC 29a

Sarah tried to solve this equation and made a mistake in Line 2.

$$\frac{W+4}{3} - \frac{2W-1}{5} = 1 \quad \text{..... Line 1}$$

$$5W + 20 - 6W - 3 = 15 \quad \text{..... Line 2}$$

$$17 - W = 15 \quad \text{..... Line 3}$$

$$W = 2 \quad \text{..... Line 4}$$

Copy the equation in Line 1 into your writing booklet and continue your solution to solve this equation for W.

Show all lines of working. *(2 marks)*

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17. Algebra, 2UG 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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18. Algebra, STD2 A2 SM-Bank 02

The weight of a steel beam, w, varies directly with its length, ℓ.

A 1200 mm steel beam weighs 144 kg.

Calculate the weight of a 750 mm steel beam. *(2 marks)*

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19. FS Driving, 2UG 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)*

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20. Algebra, 2UG 2004 HSC 28a

A health rating, R, is calculated by dividing a person's weight, w, in kilograms by the square of the person's height, h, in metres.

(i) Fred is 150 cm and weighs 72 kg. Calculate Fred's health rating. *(1 mark)*

(ii) Over several years, Fred expects to grow 10 cm taller. By this time he wants his health rating to be 25. How much weight should he gain or lose to achieve his aim? Justify your answer with mathematical calculations. *(2 marks)*

Worked Solutions

1. Algebra, 2UG 2014 HSC 3 MC

Graph is a parabola that passes through $(0, 1)$

$\Rightarrow C$

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2. Algebra, 2UG 2016 HSC 14 MC

$\Rightarrow A$

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3. Algebra, 2UG 2016 HSC 24 MC

$$e = iR + \frac{Q}{C}$$

$$\frac{Q}{C} = e - iR$$

$$\therefore Q = C(e - iR)$$

$$= Ce - CiR$$

$\Rightarrow B$

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4. FS Driving, 2UG 2015 HSC 23 MC

$$N = 3 \times 0.9 + 2 \times 1.5$$

$$= 5.7 \text{ standard drinks}$$

$$H = 5 \text{ hours}$$

$$M = 62 \text{ kg}$$

$$\therefore BAC_f = \frac{10 \times 5.7 - 7.5 \times 5}{5.5 \times 62}$$

$$= 0.05718\ldots$$

$\Rightarrow D$

Worked Solutions

5. Algebra, 2UG 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!*

6. FS Driving, 2UG 2011 HSC 21 MC

1st train

Travels 2hrs at 90km/h

Distance = Speed × Time
$= 90 \times 2$
$= 180$ 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%*

7. Algebra, 2UG 2009 HSC 14 MC

$A = 6x + 10$

If x increases by 2

A increases by $6 \times 2 = 12$

$\Rightarrow D$

♦ Mean mark 50%.
STRATEGY: Substituting real numbers into the equation can work well in these type of questions. eg. If $x = 0$, $A = 10$ and when $x = 2$, $A = 22$.

8. Algebra, 2UG 2009 HSC 16 MC

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

As S ↑ , T ↓ $\Rightarrow$ cannot be B or D

C is incorrect because it graphs a linear relationship

$\Rightarrow A$

♦ *Mean mark 38%*

9. Algebra, 2UG 2010 HSC 13 MC

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

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

$$8 = \frac{k}{30}$$
$$k = 240$$

When Temp $= 12$

$$T = \frac{240}{12}$$
$$= 20 \text{ hours}$$
$$\Rightarrow B$$

♦ *Mean mark 50%*

10. Algebra, 2UG 2013 HSC 21 MC

♦♦♦ *Mean mark 27%*

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

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

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

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

$\Rightarrow A$

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11. Algebra, 2UG 2004 HSC 22 MC

John has 25 Aust dollars.

Converting to Euros

$$25 \text{ Aust} = 25 \times 0.62$$

$$= 15.5 \text{ Euros}$$

Converting to Vistabella dollars

$$15.5 \text{ Euros} = \frac{15.5}{1.44}$$

$$= \$V10.76$$

$\Rightarrow A$

---

12. Algebra, 2UG 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. FS Health, 2UG 2014 HSC 4 MC

♦ *Mean mark 42%*

$$\text{Dosage} = \frac{1.5 \times 45}{1.5 + 12}$$

$$= 5 \text{ mL}$$

Since 1 dosage every 6 hrs

In 24 hours,

Medicine given $= 4 \times 5 = 20$ mL

$\Rightarrow B$

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14. Algebra, STD2 A4 SM-Bank 06

Substitute (5, 2) into $y = 2x - 8$

LHS $= y = 2$

RHS $= 2(5) - 8 = 2$

$\therefore$ LHS = RHS

Substitute (5, 2) into $x - 4y + 3 = 0$

$$\text{LHS} = 5 - 4(2) + 3$$

$$= 0$$

$$= \text{RHS}$$

$\Rightarrow$ (5, 2) satisfies both equations.

$\therefore$ Student is correct.

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15. Algebra, 2UG 2009 HSC 28c

$h \propto d^2$

$h = kd^2$

When $h = 1.6, \quad d = 4.5$

$1.6 = k \times 4.5^2$

$\therefore k = \dfrac{1.6}{4.5^2}$

$= 0.07901\ldots$

Find h when $d = 15$

$h = 0.07901\ldots \times 15^2$

$= 17.777\ldots$

$= 17.8$ m (to 1 d.p.)

♦♦ *Mean mark 22%*
CRITICAL STEP: Reading the first line of the question carefully and establishing the relationship $h = kd^2$ is the key part of solving this question.

16. Algebra, 2UG 2013 HSC 29a

$\dfrac{W+4}{3} - \dfrac{2W-1}{5} = 1$ ... Line 1

$5W + 20 - 6W + 3 = 15$ ... Line 2

$23 - W = 15$ ... Line 2

$W = 8$ ... Line 4

♦♦ *Mean mark 27%*
STRATEGY: The RHS of the equation increases from 1 to 15 (from Line 1 to Line 2), indicating both sides must have been multiplied by 15.

17. Algebra, 2UG 2018 HSC 28b

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

$4x + 10 = 15x + 5$

$11x = 5$

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

♦ *Mean mark 35%.*

18. Algebra, STD2 A2 SM-Bank 02

$w \propto \ell$

$w = k\ell$

When $w = 144$ kg, $\ell = 1200$ mm

$144 = k \times 1200$

$k = \dfrac{144}{1200}$

$= \dfrac{3}{25}$

When $\ell = 750$ mm,

$w = \dfrac{3}{25} \times 750$

$= 90$ kg

19. FS Driving, 2UG 2015 HSC 30d

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

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

$= 30.555\ldots$ m/sec

♦ *Mean mark 34%.*

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.)

20. Algebra, 2UG 2004 HSC 28a

(i) $R = \dfrac{w}{h^2}$

When $w = 72$ and $h = 1.5$ m

$$R = \frac{72}{1.5^2}$$
$$= 32$$

(ii) Find w if $R = 25$ and $h = 1.6$

$$25 = \frac{w}{1.6^2}$$
$$w = 25 \times 1.6^2$$
$$= 64 \text{ kg}$$

$\therefore$ Weight Fred should lose
$$= 72 - 64$$
$$= 8 \text{ kg}$$