Student's Name: ……...

Teacher's Initials: …….

Barker College

AYG*	BHC
ARP	PDJ
RAS	JWH
DXC	WMD
VAB	JZT
KJL	

YEAR 10

PM WEDNESDAY 15TH MAY

TERM 2, 2019

5.3 MATHEMATICS

TOTAL TIME: 90 MINUTES

Semester 1 Examination

245 COPIES

INSTRUCTIONS TO STUDENTS:

Write your name and teacher's initials on the TOP of EVERY marked SHEET of PAPER.

Attempt ALL questions.

Show ALL necessary working.

Calculators can be used throughout the examination.

Marks may not be awarded for careless or badly arranged work.

Diagrams are NOT drawn to scale.

Write your answers in the spaces provided on the paper.

A formula sheet is provided on page 2 for use throughout the examination. Detach this sheet.

This examination consists of SEVEN parts.

PART A: COMMON	**(42 marks)**
PART B: SURDS & INDICES	**(15 marks)**
PART C: INTEREST & DEPRECIATION	**(5 marks)**
PART D: CO-ORDINATE GEOMETRY	**(7 marks)**
PART E: QUADRATIC EQUATIONS & PARABOLAS	**(25 marks)**
PART F: SURFACE AREA & VOLUME	**(10 marks)**
PART G: MIXED QUESTIONS	**(9 marks)**
	TOTAL 113 Marks

FORMULA SHEET

Pythagoras' Theorem

$c^2 = a^2 + b^2$

Simple interest

$I = Prn$

Compound interest

$A = P(1+r)^n$

Depreciation

$A = P(1-r)^n$

Area and Volume

Area of a circle: $A = \pi r^2$

Area of a parallelogram: $A = bh$

Area of a rhombus: $A = \frac{1}{2}.xy$

Area of a trapezium: $A = \frac{1}{2}h(a+b)$

Volume of a prism: $V = Ah$

Volume of a cylinder: $V = \pi r^2 h$

Volume of a pyramid: $V = \frac{1}{3}Ah$

Volume of a cone: $V = \frac{1}{3}\pi r^2 h$

Volume of a sphere: $V = \frac{4}{3}\pi r^3$

Surface area of a closed cylinder: $SA = 2\pi r^2 + 2\pi rh = 2\pi r(r+h)$

Surface Area of a cone: $SA = \pi r^2 + \pi rl$

Surface Area of a sphere: $SA = 4\pi r^2$

Solution of a quadratic equation

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Distance between two points

d = $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Gradient formula

$m = \frac{y_2 - y_1}{x_2 - x_1}$

Gradient – Intercept form

$y = mx + b$

Point – Gradient form

$y - y_1 = m(x - x_1)$

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PART A: COMMON (42 Marks)

Marks

1. Simplify $3x^2 + 2x - x$ **1**

2. Increase \$430 by 12%. **1**

3. Find m if $2^m = 8$. **1**

4. James borrows \$1000. He agrees to repay the loan in \$90 monthly repayments over a year. **2**
How much interest does he end up paying?

5. A square has an area of $36m^2$. **1**
Find the side length of the square.

6. (a) Simplify
$8mn - 2m + mn + 2m$ **1**

(b) Expand & simplify **2**

$2x - (3x + 7) + 17$

7. Fully factorise the following:

(a) $4ab - 16b$ **2**

(b) $2x^2y - 12xyz + 3x^2y^2$ **2**

8. Fully simplify and express your answer with positive indices.

(a) $2x^{-2}$ **1**

(b) $2x^2y^{-1} \times 3x^{-4}y^5$ **2**

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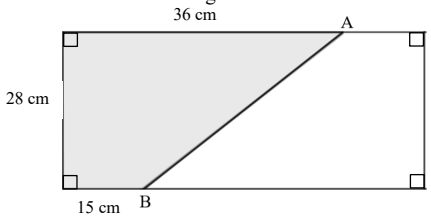
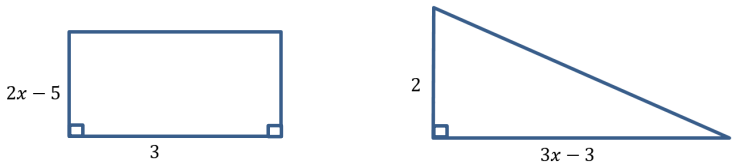
9. (i) Find the area of the shaded region. **2**



(ii) Find the length of the sloping line AB. **2**

10. The area of this rectangle is equal to the area of this right angled triangle.



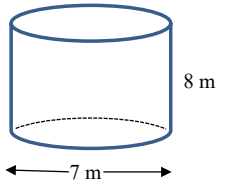
(i) Find an expression for the area of the triangle in terms of x in simplest form. **1**

(ii) Hence find the value of x. **3**

11. Solve for x. **2**

$2x^2 = 50$

12. The diagram shows a closed cylinder with diameter 7m and height 8m.
Calculate the volume of the cylinder to 2 decimal places. **2**



13. Sally borrows $1200 at a simple interest rate of 4% p.a. She pays $288 in interest.
How many years was her loan for? **2**

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14. (i) Fully simplify $\frac{2x}{3} - \frac{x+1}{2}$ **2**

(ii) Hence solve $\frac{2x}{3} - \frac{x+1}{2} = 2$ **2**

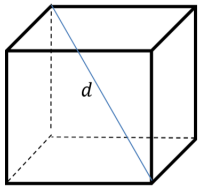
15. Annie invests \$11 250 for 3 years at an interest rate of 2.5% p.a. compounded half yearly.

(i) Calculate the amount of money in Annie's account after 3 years? **2**

(ii) How much interest did Annie receive? **1**

16. Fully simplify $\frac{e^5 + e^0}{e^2 \times e^{-2}}$ **2**

17. The diagonal length d of a cube is $48\ cm$. **3**
Find the surface area of the cube.



End of Part A

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PART B: SURDS & INDICES (15 Marks)

Marks

Question 1

Fully simplify:

(a) $\sqrt{98}$ **1**

(b) $(7xy)^2$ **1**

(c) $\sqrt{50m} \div 5\sqrt{m}$ **2**

Question 2

Express as a single surd $\sqrt{18} + \sqrt{2} - \sqrt{8}$ **3**

Question 3

(a) Simplify fully

$$\frac{4\sqrt{3} \times \sqrt{18}}{\sqrt{12}}$$ **2**

(b) Expand & Simplify: $(4 - 2\sqrt{3})^2$ **2**

Part B: Surds & Indices (continued)

Question 4

Rationalise the denominator, leaving your answer as a single fraction.

$$\frac{\sqrt{5}}{2\sqrt{2}}$$ **2**

Question 5

Fully simplify, expressing your answer with **positive** indices.

$(5c^{-1}d^3)^{-1} \times 2c^4d^{-8}$ **2**

End of PART B

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PART C: INTEREST & DEPRECIATION (5 marks) Marks

Question 6

Ariana's car depreciates at a rate of 7.5% p.a. The car was initially bought for $37 770.

Find the value of the car five years later. **2**

Question 7

A business secures a three-year loan for $45 000 with the following conditions: **3**

- No repayments are to be made until the end of the three years.
- The loan must be repaid in full at the end of the three years.
- The interest rate is 3% p.a. compounded annually for the first two years. Then the interest rate decreases by 0.5% p.a. for the last year.

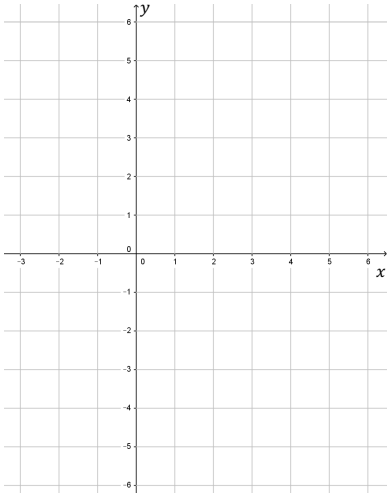
Calculate the total interest that will be paid on this loan.

End of PART C

PART D: CO-ORDINATE GEOMETRY (7 marks) Marks

Question 8

(i) On the number plane draw the line AB given the points $A(-2, -5)$ and $B(3, 5)$. **1**



(ii) Calculate the gradient of AB **1**

(iii) What is the equation of the line AB? **2**

(iv) Find point C, the Midpoint of AB. **1**

(v) What is the equation of the line perpendicular to AB, passing through point C? **2**

End of PART D

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PART E: QUADRATIC EQUATIONS & PARABOLAS (25 marks)

Marks

Question 9

Solve for x:

(a) $x^2 - 37 = -1$ **2**

(b) $(2x - 5)(x + 1) = 0$ **2**

(c) $x^2 + 11x - 42 = 0$ **2**

Question 10

Use the quadratic formula to solve $2x^2 - x - 17 = 0$. **3**

Give your answers in surd form.

Question 11

For the parabola $y = x^2 - 7x + 10$

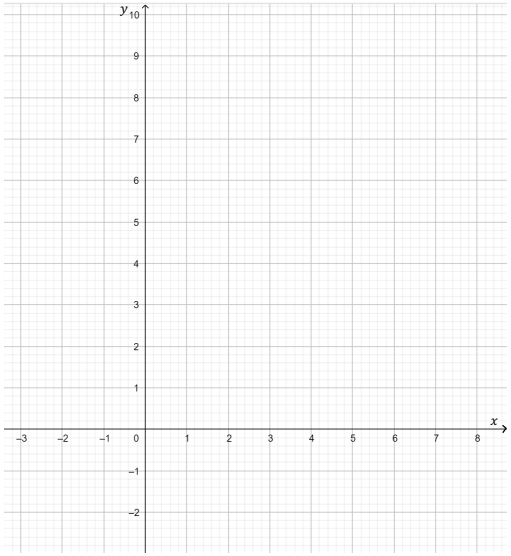
(i) Find the x – intercepts. **2**

(ii) Find the y – intercept. **1**

(iii) Find the equation of the axis of symmetry. **1**

(iv) Find the coordinates of the vertex. **1**

(v) Sketch the parabola on this number plane, showing all the above features. **2**



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Part E: Quadratic Equations & Parabolas (continued)

Question 12

Sam has been asked to **complete the square** for the quadratic equation $2x^2 + 12x - 10 = 0$. **1**

The first lines of Sam's working are shown below:

$$2x^2 + 12x = 10$$
$$2x^2 + 12x + 36 = 10 + 36$$

Explain where Sam has made an error in completing the square.

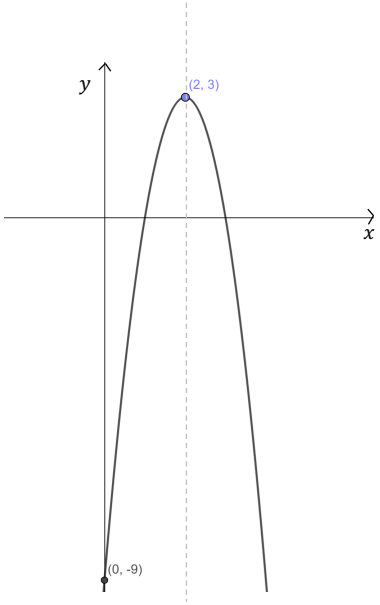
Question 13

Form a quadratic equation with roots $x = 5$ and $x = -2$. **2**
Give your answer in the form $x^2 + bx + c = 0$.

Part E: Quadratic Equations & Parabolas (continued)

Question 14

Find the equation of the parabola shown below. **3**



Question 15

Solve $25^x + 2(5^x) - 35 = 0$ using the substitution $u = 5^x$. **3**

End of PART E

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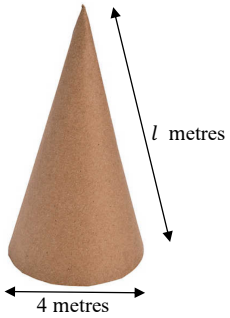
PART F: SURFACE AREA & VOLUME (10 marks)

Marks

Question 16

Find l given the surface area of the open cone (i.e. no circular base) below is $40\pi\ m^2$. **2**



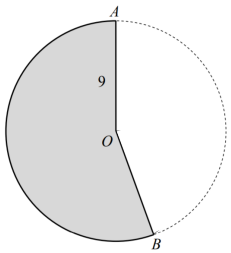
Question 17

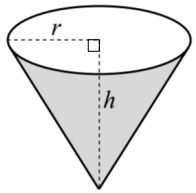
To make the conical cup shown, a sector AOB is cut from a circular piece of paper of radius 9 cm. **3**

The radius of the rim of the cup is r cm, and the height of the cup is h cm.

Find an expression for the volume of the cup in terms of h.

(Leave your answer in terms of π.)





Part F: Surface Area & Volume (continued)

Question 18

A cylinder of wax of volume $\frac{1280}{3}\pi\ cm^3$ is melted down into two candles, one in the shape of a sphere of radius 4 cm and the other in the shape of a cone.
(Assume no wastage of wax in the melting process).

(i) Find the volume of the sphere shaped candle with radius 4 cm. **1**
Leave your answer in terms of π.

(ii) The cone shaped candle has a radius half its height. **2**
Find the volume of the cone shaped candle in terms of r.
Leave your answer in terms of π.

(iii) Hence, calculate the radius of the cone shaped candle. **2**

End of PART F

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PART G: MIXED QUESTIONS (9 marks)

Marks

Question 19

At what annual interest rate does an amount of money double in 10 years, if compounded quarterly? **3**

Give your answer as a percentage to one decimal place.

Question 20

Given that $(3 + 4\sqrt{5})^2 = a + \frac{b}{\sqrt{20}}$, find the value of a and b. **3**

Part G: Mixed Questions (continued)

Question 21

Solve for x **3**

$$\frac{x^{2002} + 4x^{2001}}{4x^{2000}} = 2449.25$$

END OF PAPER

Student's Name: .....

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Year 10 Semester 1 Examination Common Section Solutions

Part A

1.) $3x^2 + 2x - x = 3x^2 + x$

2.) $430 + 12\% \times 430 = 430 + \frac{12}{100} \times 430$

$= \$481.60$

3.) $2^m = 2^3$

so $m = 3$

4) Total repayments

$= 90 \times 12$

$= \$1080$

Interest $= 1080 - 1000$

$= \$80$

5.) $\sqrt{36} = 6$

So side length = 6 metres

6a.) $8mn - 2m + mn + 2m$

$= 9mn - 2m + 2m$

$= 9mn$

b.) $2x - (3x + 7) + 17$

$= 2x - 3x - 7 + 17$

$= -x - 7 + 17$

$= -x + 10$

7a.) $4ab - 16b = 4b(a - 4)$

b.) $2x^2y - 12xyz + 3xy^2$

$= xy(2x - 12z + 3xy)$

8a.) $2x^{-2} = 2 \times x^{-2}$

$= 2 \times \frac{1}{x^2}$

$= \frac{2}{x^2}$

b.) $2x^2y^{-1} \times 3x^{-4}y^5$

$= 6x^{-2}y^4$

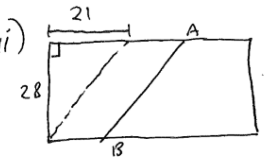
$= \frac{6y^4}{x^2}$

9i) Area of trapezium $= \frac{h}{2}(a+b)$

$= \frac{28}{2} \times (15 + 36)$

$= 714\ cm^2$

ii)



$AB^2 = 21^2 + 28^2$

$= 1225$

$AB = \sqrt{1225}$

$= 35\ cm$

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10 i) Area $= \frac{1}{2}bh$

$= \frac{1}{2} \times (3x - 3) \times 2$

$= 3x - 3$

ii) Area of rectangle $= 3(2x - 5)$

Since the areas are equal,

$3(2x - 5) = 3x - 3$

$6x - 15 = 3x - 3$

$3x - 15 = -3$

$3x = 12$

$x = 4$

11.) $2x^2 = 50$

$x^2 = 25$

$x = \pm\sqrt{25}$

$= \pm 5$

12.) $V = \pi r^2 h$

$r = 3.5$, $h = 8$

$V = \pi \times 3.5^2 \times 8$

$= 307.88\ m^3$ (2 decimal places)

13.) $I = Prn$ (simple interest)

$I = 288$, $P = 1200$, $r = 0.04$

$288 = 1200 \times 0.04 \times n$

$288 = 48n$

$n = \frac{288}{48}$

$= 6$ years.

14.) i) $\frac{2x}{3} - \frac{x+1}{2}$

$= \frac{4x}{6} - \frac{3(x+1)}{6}$

$= \frac{4x - 3(x+1)}{6}$

$= \frac{4x - 3x - 3}{6}$

$= \frac{x - 3}{6}$

ii) $\frac{2x}{3} - \frac{x+1}{2} = 2$

$\frac{x-3}{6} = 2$

$x - 3 = 12$

$x = 15$

15.) i) $A = P(1+r)^n$

$P = 11250$, $n = 3$ years

$= 6$ half years

$r = 2.5\%$ p.a.

$= \frac{2.5\%}{2}$ per half year

$A = 11250\left(1 + \frac{2.5\%}{2}\right)^6$

$= 11250\,(1.0125)^6$

$= \$12\,120.56$ (nearest cent)

ii) Interest $= 12120.56 - 11250$

$= \$870.56$

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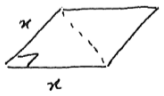
16.) $\frac{e^5+e^0}{e^2 \times e^{-2}} = \frac{e^5+1}{e^2 \times e^{-2}}$

$= \frac{e^5+1}{e^0}$

$= \frac{e^5+1}{1}$

$= e^5+1$

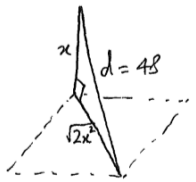
17.) Let x be the side length of the cube.



diagonal base$^2 = x^2 + x^2$

$= 2x^2$

diagonal base $= \sqrt{2x^2}$



$x^2 + \left(\sqrt{2x^2}\right)^2 = 48^2$

$x^2 + 2x^2 = 2304$

$3x^2 = 2304$

$x^2 = 768$

17.) (continued) (3)

x^2 represents the area of one fa

Lo Surface area $= 6 \times x^2$

$= 6 \times 768$

$= 4608\ cm^2$

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Year 10 Semester 1 (1)

Examination

5.3 Solutions

1a.) $\sqrt{98} = \sqrt{49 \times 2}$

$= 7\sqrt{2}$

b.) $(7xy)^2 = 7^2 \times x^2 y^2$

$= 49x^2y^2$

c.) $\frac{\sqrt{50m}}{5\sqrt{m}} = \frac{\sqrt{25 \times 2m}}{5\sqrt{m}}$

$= \frac{5\sqrt{2m}}{5\sqrt{m}}$

$= \frac{\sqrt{2m}}{\sqrt{m}}$

$= \sqrt{\frac{2m}{m}}$

$= \sqrt{2}$

2.) $\sqrt{18} + \sqrt{2} - \sqrt{8}$

$= 3\sqrt{2} + \sqrt{2} - 2\sqrt{2}$

$= 2\sqrt{2}$

$= \sqrt{8}$

3a.) $\frac{4\sqrt{3} \times \sqrt{18}}{\sqrt{12}}$

$= \frac{4\sqrt{3} \times 3\sqrt{2}}{2\sqrt{3}}$

$= \frac{4 \times 3\sqrt{2}}{2}$

$= 2 \times 3\sqrt{2}$

3b.) $(4 - 2\sqrt{3})^2$

$= 16 - 2 \times 8\sqrt{3} + 4 \times 3$

$= 16 - 16\sqrt{3} + 12$

$= 28 - 16\sqrt{3}$

4.) $\frac{\sqrt{5}}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$

$= \frac{\sqrt{10}}{2 \times 2}$

$= \frac{\sqrt{10}}{4}$

5.) $(5c^{-1}d^3)^{-1} \times 2c^4d^{-8}$

$= \frac{1}{5c^{-1}d^3} \times 2c^4d^{-8}$

$= \frac{c}{5d^3} \times \frac{2c^4}{d^8}$

$= \frac{2c^5}{5d^{11}}$

6.) $A = P(1-r)^n$

$P = 37\,770$, $r = 0.075$, $n = 5$

$A = 37\,770(1-0.075)^5$

$= \$25\,577.36$ (nearest cent)

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7.) Value of loan after 2 years

$= 45\,000(1.03)^2$

$= 47\,740.50$

Value of loan after another year

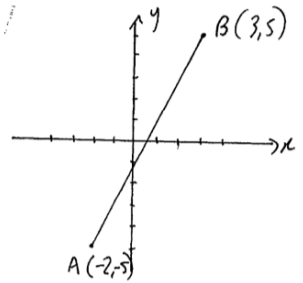
$= 47\,740.50(1.025)$

$= 48\,934.01$

Total Interest $= 48\,934.01 - 45000$

$= \$3934.01$

8i.)



ii) gradient $= \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{5-(-5)}{3-(-2)}$

$= \frac{10}{5}$

$= 2$

iii) $y = mx + b$

$m = 2$

$y = 2x + b$

sub (3,5) into equation

$5 = 2 \times 3 + b$

$5 = 6 + b$

$b = -1 \quad \therefore y = 2x - 1$

8iii) (continued) (2)

Alternative:

$\frac{y - y_1}{x - x_1} = m$

$\frac{y-5}{x-3} = 2$

$y - 5 = 2(x-3)$

$y - 5 = 2x - 6$

$y = 2x - 1$

iv.) midpoint:

$x = \frac{-2+3}{2} \qquad y = \frac{-5+5}{2}$

$= \frac{1}{2} \qquad = 0$

$(\frac{1}{2}, 0)$

v.) gradient of perpendicular line:

$m = -\frac{1}{2}$ point $\rightarrow (\frac{1}{2}, 0)$

$y = mx + b$

$y = -\frac{1}{2}x + b$

sub $(\frac{1}{2}, 0)$

$0 = -\frac{1}{2} \times \frac{1}{2} + b$

$0 = -\frac{1}{4} + b$

$b = \frac{1}{4}$

$y = -\frac{1}{2}x + \frac{1}{4}$

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9a.) $x^2 - 37 = -1$

$x^2 = 36$

$x = \pm 6$

b.) $(2x-5)(x+1) = 0$

$2x - 5 = 0, \quad x + 1 = 0$

$x = \frac{5}{2}, \quad x = -1$

c.) $x^2 + 11x - 42 = 0$

$(x+14)(x-3) = 0$

$x = -14, \; 3$

10.) $2x^2 - x - 17 = 0$

$a = 2 \quad b = -1 \quad c = -17$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$= \frac{-(-1) \pm \sqrt{(-1)^2 - 4 \times 2 \times (-17)}}{2 \times 2}$

$= \frac{1 \pm \sqrt{1 + 136}}{4}$

$= \frac{1 \pm \sqrt{137}}{4}$

11i) $y = x^2 - 7x + 10$

when $y = 0$

$x^2 - 7x + 10 = 0$

$(x-5)(x-2) = 0$

$x = 5, \; x = 2$

11ii) when $x = 0$ (3)

$y = 0^2 - 7 \times 0 + 10$

$= 10$

iii) axis of symmetry:

$x = -\frac{b}{2a}$

$= \frac{-(-7)}{2 \times 1}$

$= \frac{7}{2}$

iv.) when $x = \frac{7}{2}$

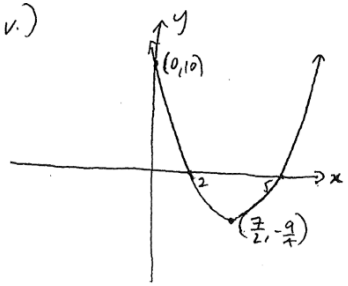
$y = (\frac{7}{2})^2 - 7(\frac{7}{2}) + 10$

$= \frac{49}{4} - \frac{49}{2} + 10$

$= -\frac{9}{4}$

vertex $(\frac{7}{2}, -\frac{9}{4})$

v.)



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12.) To complete the square, Sam needed to first divide every term by the coefficient of x^2 to make it a monic quadratic equation.

ie $2x^2+12x-10=0$

$x^2+6x-5=0$

or $2x^2+12x=10$

$x^2+6x=5$

then Sam can complete the square on x^2+6x.

13.) If the solutions are $x=5$ and $x=-2$, and it's a monic quadratic equation, the equation is $(x-5)(x+2)=0$

$\therefore x^2+2x-5x-10=0$

$x^2-3x-10=0$

14.) Using the equation of the form $y=a(x-h)^2+k$, vertex is $(2,3)$.

So $y=a(x-2)^2+3$

to find a, sub in another point.

Sub $x=0, y=-9$

$-9=a(0-2)^2+3$

$-9=a(4)+3$

14.) (continued)

$4a+3=-9$

$4a=-12$

$a=-3$

$\therefore$ Equation is $y=-3(x-2)^2+3$

15.) $25^x+2(5^x)-35=0$

$(5^2)^x+2(5^x)-35=0$

$(5^x)^2+2(5^x)-35=0$

sub $u=5^x$

$u^2+2u-35=0$

$(u+7)(u-5)=0$

$u=-7$, $u=5$

$\therefore 5^x=-7$, $5^x=5$

$\boxed{x=1}$

↑ no solutions from this one

16.) Open cone surface area $=\pi rl$

$r=2$ S.A. $=40\pi$

$40\pi=\pi\times 2\times l$

$40=2l$

$l=20$ metres.

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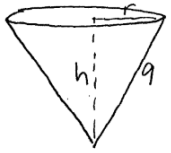
17.)



← the slant height of the cone is the radius of the circle

$V=\frac{1}{3}\pi r^2h$

but $r^2+h^2=9^2$

$r^2+h^2=81$

so $r^2=81-h^2$

So $V=\frac{1}{3}\pi r^2h$

$=\frac{1}{3}\pi(81-h^2)h$

or $V=\frac{1}{3}\pi(81h-h^3)$

18i) $V=\frac{4}{3}\pi r^3$

$r=4$

$V=\frac{4}{3}\pi\times 4^3$

$=\frac{256\pi}{3}$ cm^3

ii)

If the radius of the cone is r, its height is $2r$.

$V=\frac{1}{3}\pi r^2h$

$=\frac{1}{3}\pi r^2(2r)$

$=\frac{2}{3}\pi r^3$

18iii) Volume of sphere + Volume of cone $=\frac{1280\pi}{3}$

$\frac{256\pi}{3}+\frac{2\pi r^3}{3}=\frac{1280\pi}{3}$

$256\pi+2\pi r^3=1280\pi$

$256+2r^3=1280$

$2r^3=1280-256$

$2r^3=1024$

$r^3=512$

$r=8$ cm

19.) $A=P(1+r)^n$

we want to find the quarterly rate r, such that $A=2P$

$n=10$ years

$=40$ quarters

$2P=P(1+r)^{40}$

divide both sides by P

$2=(1+r)^{40}$

$2^{\frac{1}{40}}=1+r$

$r=2^{\frac{1}{40}}-1$

$=0.017479...$

annual rate $=4\times 0.017479...$

$=0.0699...$

$=6.99\%$

$=7.0\%$ (1.d.p.).

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20.)

$(3+4\sqrt{5})^2 = 9 + 24\sqrt{5} + 16\times 5$

$= 9 + 24\sqrt{5} + 80$

$= 89 + 24\sqrt{5}$

$\therefore a = 89$

$\frac{b}{\sqrt{20}} = 24\sqrt{5}$

$b = 24\sqrt{5} \times \sqrt{20}$

$= 24\sqrt{100}$

$= 24 \times 10$

$= 240$

21.) $\frac{x^{2002} + 4x^{2001}}{4x^{2000}} = 2449.25$

$x^{2002} + 4x^{2001} = 2449.25 \times 4x^{2000}$

$x^{2002} + 4x^{2001} = 9797x^{2000}$

divide each term by x^{2000}

$\frac{x^{2002}}{x^{2000}} + \frac{4x^{2001}}{x^{2000}} = \frac{9797x^{2000}}{x^{2000}}$

$x^2 + 4x = 9797$

$x^2 + 4x - 9797 = 0$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

21) (continued) (6)

$x = \frac{-4 \pm \sqrt{4^2 - 4(-9797)}}{2}$

$= \frac{-4 \pm \sqrt{39204}}{2}$

$= \frac{-4 \pm 198}{2}$

$x = \frac{-4+198}{2}$, $x = \frac{-4-198}{2}$

$= 97$, $= -101$