

2021 YEAR 10 (5.1) MATHEMATICS

Written examination

Reading time: 15 minutes

Writing time: 3 hours

2021 version 1

QUESTION BOOK

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	20	20	20
B	10	10	50
C	3	3	30
			Total 100

SECTION A**Instructions for Section A**

Answer **all** questions.

Choose the response that is **correct** for the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

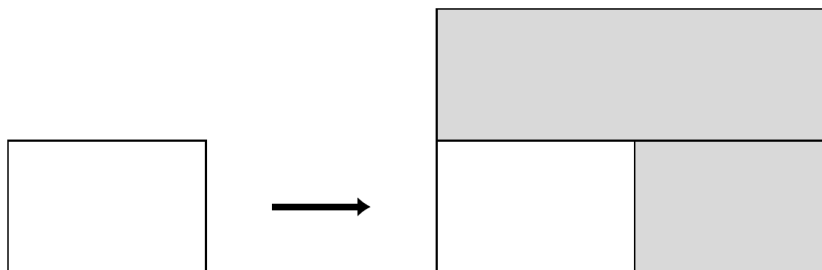
Question 1

$3a^5 \times a^{-5}$ is equal to

- A. 0
- B. 1
- C. 3
- D. $3a^1$
- E. $3a^{10}$

Question 2

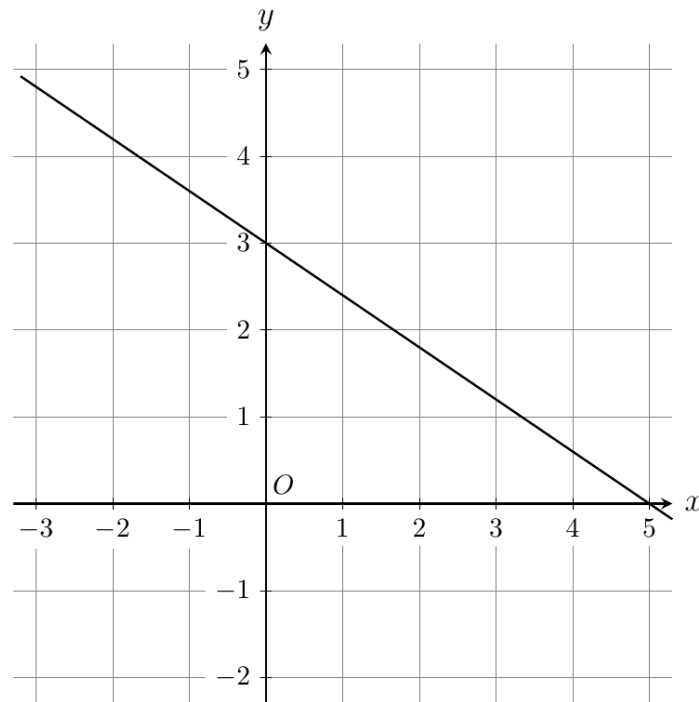
The following diagram shows a rectangle that is enlarged such that both its width and length are doubled.



The area of the enlarged shape is greater than the area of the original rectangle by a factor of

- A. 0.25
- B. 0.5
- C. 2
- D. 3
- E. 4

The following information relates to Questions 6 – 7.



Question 6

The equation of the line above is

- A. $y = 5 - 3x$
- B. $y = 3 - 5x$
- C. $y = 3 - \frac{3}{5}x$
- D. $y = 3 - \frac{5}{3}x$
- E. $y = 5 - \frac{5}{3}x$

Question 7

Which one of the following statements is **true**?

- A. The gradient of the line is parallel to another line with equation $3x + 5y = -25$
- B. The point $(3, 1)$ lies on the line
- C. The line does not lie in the fourth quadrant
- D. The region enclosed by the line and the axes is not a right-angled triangle
- E. The x -intercept of the line is 3

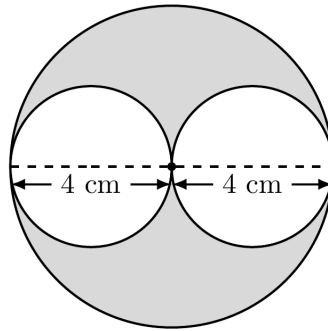
Question 13

Two cars each travel at a constant speed for 15 minutes.

The speed of one car is 65 km per hour and the speed of the other car is 75 km per hour.

The combined total distance travelled by the two cars is

- A. 16.25 km
- B. 18.75 km
- C. 35 km
- D. 975 km
- E. 1,125 km

Question 14

The area of the shaded region in the diagram above is closest to

- A. 18.75 cm^2
- B. 25.1 cm^2
- C. 25.3 cm^2
- D. 37.7 cm^2
- E. 50.3 cm^2

SECTION B**Instructions for Section B**

Answer **all** questions.

In all questions where a numerical answer is required, an **exact** value must be given unless otherwise specified.

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Question 1 (5 marks)

a. Write $\frac{1}{t^{-2}}$ with positive indices only.

1 mark

b. Simplify $\frac{48x^3y}{6xy^2}$.

2 marks

c. Simplify $(-4x^3)^2 + (-2x)^0$.

2 marks

Question 4 (7 marks)

During the 2021-22 financial year, Helen earned \$65,000 from her work.

The amounts of her work-related expenses and donations made are shown in the following table.

Gross income	\$65,000
Work-related expenses	\$1,500
Donations	\$250

Resident tax rates 2021–22

Taxable income	Tax on this income
0 – \$18,200	Nil
\$18,201 – \$45,000	19 cents for each \$1 over \$18,200
\$45,001 – \$120,000	\$5,092 plus 32.5 cents for each \$1 over \$45,000
\$120,001 – \$180,000	\$29,467 plus 37 cents for each \$1 over \$120,000
\$180,001 and over	\$51,667 plus 45 cents for each \$1 over \$180,000

Source: ATO website

a. Calculate Helen's taxable income.

1 mark

b. Use the 2021-22 tax table above to calculate the amount of Helen's tax payable.

2 marks

c. Helen also needs to pay the 2% Medicare levy.

2 marks

Find the amount of tax that Helen needs to pay for the 2021-22 financial year.

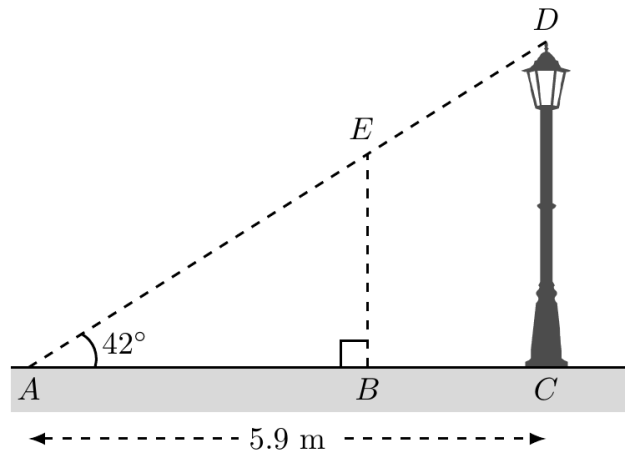
Question 6 (5 marks)

A lamp post stands vertically.

A , B and C are points marked on the ground and D is the top of the lamp post.

The distance between point A and point C is 5.9 m.

C is the base of the lamp post.



a. Which triangle on the diagram is similar to triangle ACD ?

1 mark

b. Find the height of the lamp post.

2 marks

Round your answer to one decimal place.

c. Use Pythagoras' theorem to find the length between points A and D .

2 marks

Round your answer to one decimal place.

SECTION C**Instructions for Section C**

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Question 1 (10 marks)

a. Kay works as a stacker at Coles.

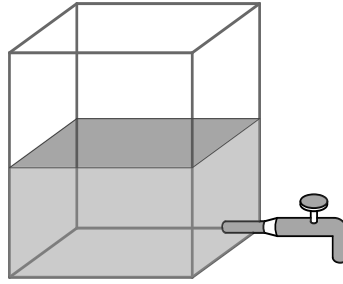
He usually works 38 hours per week at \$22.50 per hour.

i. If Kay works 38 hours per week for the next 3 months, show that his gross income will be \$10,260. 1 mark

ii. When Kay is on holidays, he will be paid 17.5% p.a. leave loading. 2 marks
How much will his holiday pay for one week be?

Question 2 (10 marks)

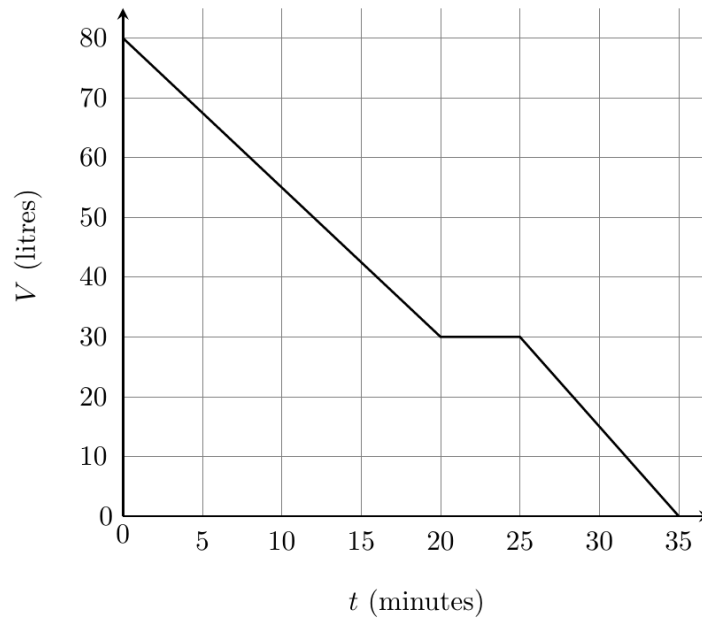
A water tank shown below was drained for cleaning.



The initial volume of water in the water tank was 80 litres.

It took 35 minutes to completely drain the water tank.

The graph below shows the amount of water remaining in the water tank, V litres, after t minutes.



- a.** Show that the water was drained at a rate of 2.5 litres per minute in the first 20 minutes. 2 marks

- b.** Write down the equation relating V and t for the first 20 minutes. 1 mark

SOLUTIONS**SECTION A**

Question	Answer
1	C
2	E
3	C
4	E
5	D
6	C
7	A
8	B
9	A
10	B
11	D
12	E
13	C
14	B
15	D
16	B
17	A
18	C
19	E
20	D

Question 1

$$\begin{aligned} & 3a^5 \times a^{-5} \\ & = 3a^0 \\ & = 3 \end{aligned}$$

Answer is **C**.

Question 2

Suppose that the area of the original rectangle is given by $w \times l$.
The area of the enlarged shaped (a larger rectangle) is $2w \times 2l = 4wl$.

Therefore, the area of the enlarged shape is greater than the area of the original rectangle by a factor of 4.
Answer is **E**.

Question 8

$$4000 \text{ g/month} = 4 \text{ kg/month} = 48 \text{ kg/year}$$

Answer is **B**.

Question 9

Using Pythagoras' theorem

$$\begin{aligned} a &= \sqrt{16^2 + 12^2} \\ &= \sqrt{400} \\ &= 20 \end{aligned}$$

Answer is **A**.

Question 10

$$\begin{aligned} \tan(x) &= \frac{12}{16} \\ x &= 36.86989\dots^\circ \end{aligned}$$

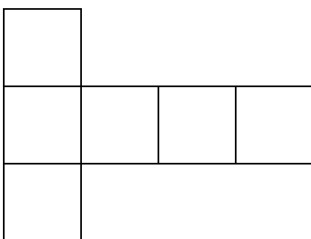
Rounding x to 2 decimal places gives 36.87° .

All other statements are true.

Answer is **B**.

Question 11

The following diagram shows a correct net diagram for a cube.



All of the other diagrams are incorrect.

Answer is **D**.

Question 3 (5 marks)

a. 2 marks
 $(\$1,300 + \$50 + \$30 + \$90 + \$75) \times 12$ (A1)
 $= \$18,540$ (A1)

b. 1 mark
 $\$432 \times 52 = \$22,464$ (A1)

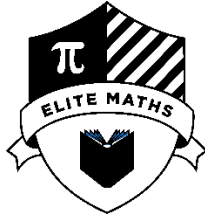
c. 2 marks
 $P = \frac{\$7,500}{0.035 \times 3}$ (A1)
 $\approx \$71,428.57$ (A1)

Question 4 (5 marks)

a. 1 mark
 $\$65,000 - \$1,500 - \$250 = \$63,250$ (A1)

b. 2 marks
 $\$5,092 + 0.325 \times (\$63,250 - \$45,000)$ (A1)
 $= \$11,023.25$ (A1)

c. 2 marks
 $\$11,023.25 + \$63,250 \times 0.02$ (A1)
 $= \$12,288.25$ (A1)



2021 YEAR 10 (5.2) MATHEMATICS

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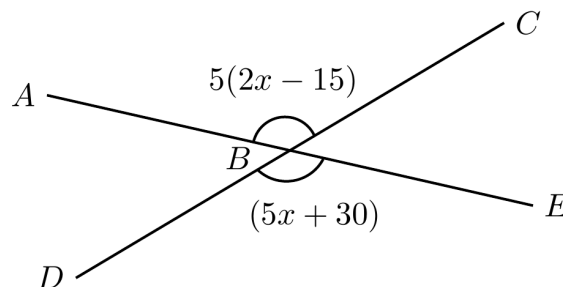
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Question 1

Which one of the following is an irrational number?

- A. 3π
- B. $(2 + 3)^2$
- C. $0.\dot{2}$
- D. 0.653
- E. $\sqrt{2} \times \sqrt{2}$

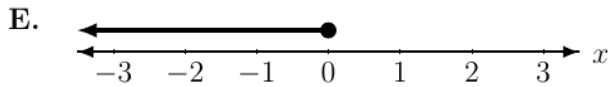
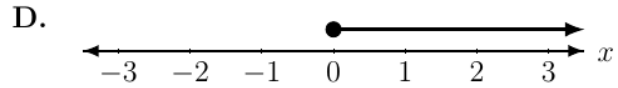
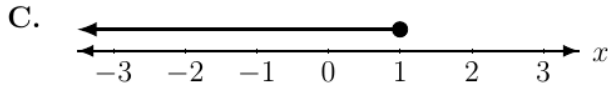
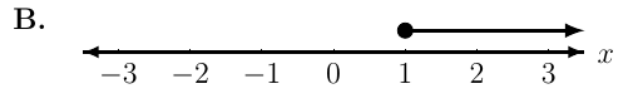
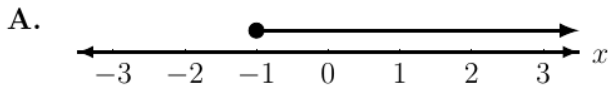
Question 2

The value of x in the diagram above is

- A. 7
- B. 9
- C. 20
- D. 21
- E. 23

Question 3

The solution set of the inequality $\frac{x-6}{2} + 5 \geq 2$ is best represented by



The following information relates to Questions 4 – 5.

Jessica wants to invest \$55,800 into her savings account for the next 3 years. Her bank is offering a compound interest rate of 3.2% per annum, compounding monthly.

Question 4

The total amount of interest that Jessica would earn after 3 years is closest to

- A. \$5,530.05
- B. \$5,614.51
- C. \$5,700.00
- D. \$61,330.05
- E. \$61,414.51

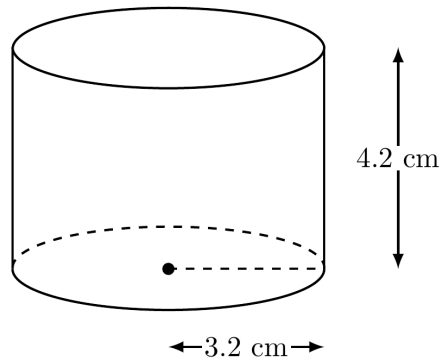
Question 5

Which one of the following statements is **true**?

- A. if the interest is compounded annually at the same rate, Jessica would end up with more total interest after 3 years
- B. the compounding period is not related to how much interest is earned from the principal in general
- C. a simple interest rate of 3.354% per annum would give the same amount of interest as the compound interest above after 3 years, to the nearest dollar
- D. compound interest always earns more interest than simple interest for any investment in general
- E. a simple interest rate of 4.3% per annum would give less interest than the compound interest rate above after 3 years

The following information relates to Questions 11 – 12.

Consider the following closed cylinder.



Question 11

The surface area of the cylinder is closest to

- A. 32.2 cm^2
- B. 64.3 cm^2
- C. 116.6 cm^2
- D. 124.7 cm^2
- E. 148.8 cm^2

Question 12

The cylinder is enlarged by a factor of 4.

The volume of the new cylinder is given by

- A. $\pi(3.2)^2 \times 4.2 \times 4^3 \text{ cm}^3$
- B. $\pi(3.2)^2 \times 4.2 \text{ cm}^3$
- C. $\pi(3.2 \times 4)^2 \times 4.2 \text{ cm}^3$
- D. $\pi(3.2)^2 \times 4.2 \times 4 \text{ cm}^3$
- E. $\pi(3.2)^2 \times 4.2 \times 4^2 \text{ cm}^3$

SECTION B**Instructions for Section B**

Answer **all** questions.

In all questions where a numerical answer is required, an **exact** value must be given unless otherwise specified.

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Question 1 (5 marks)

a. Write the number 2 billion in scientific notation.

1 mark

b. Factorise $-25a - 10a^2$.

2 marks

c. Write $\frac{x+3}{5} - \frac{3x}{2}$ as a single fraction.

2 marks

Question 4 (5 marks)

Let w represent the width of a rectangle.

The length of this rectangle is 6 greater than the width.

The area of the rectangle is 112 cm^2 .

a. Show that $w^2 + 6w - 112 = 0$.

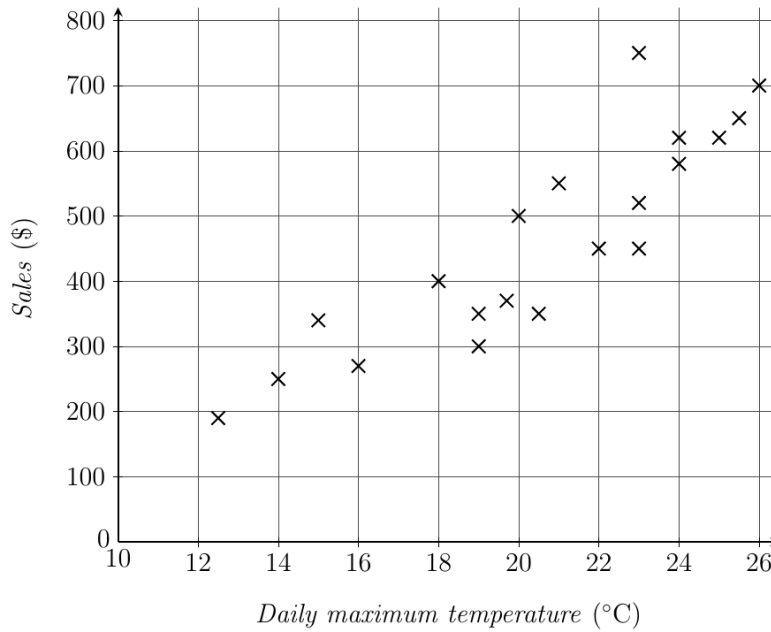
2 marks

b. Solve the quadratic equation in part **a** to find the width of the rectangle.

3 marks

Question 10 (5 marks)

The sales performance at a frozen yogurt shop by daily maximum temperature on twenty randomly selected days is shown on the scatter plot below.



a. State the independent variable and the dependent variable.

1 mark

b. Briefly describe the strength of the correlation between *maximum temperature* and *sales*.

2 marks

c. Are there any outliers in this dataset?
Justify your answer.

2 marks

SECTION C

Instructions for Section C

Answer **all** questions.

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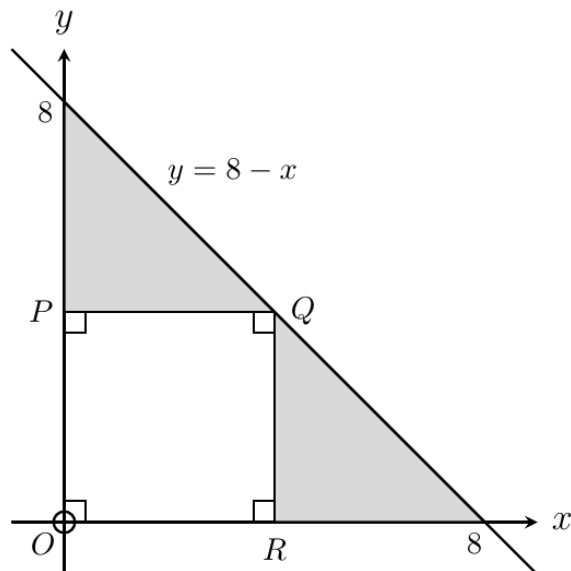
Question 1 (10 marks)

The graph of $y = 8 - x$ is shown below.

Rectangle $OPQR$ is inscribed in the region enclosed by the graph $y = 8 - x$ and the axes.

The shaded part is the region enclosed by the line $y = 8 - x$ and the axes, excluding the rectangle $OPQR$.

Let the length of OR be u .

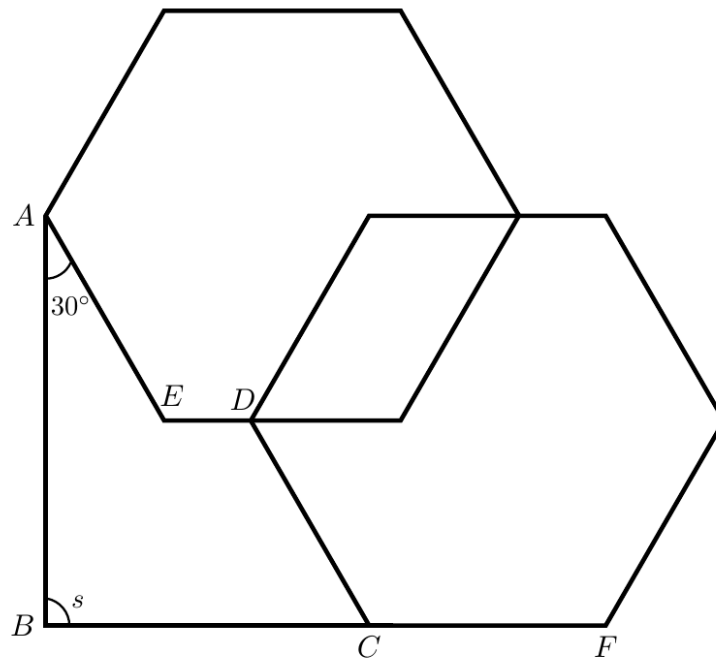


a. Show that the area of the rectangle $OPQR$ is given by $A = 8u - u^2$.

2 marks

- b. Stefan made a tile by joining two regular hexagons and an irregular pentagon, as shown in the diagram below.

Straight lines ED and BF are parallel to each other, $\angle BAE = 30^\circ$ and $\angle ABC = s$.



- i. Show that $\angle AED = 240^\circ$.

1 mark

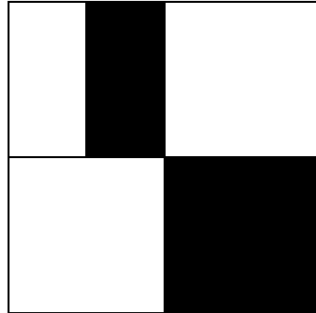
Hint: an interior angle of a regular hexagon is 120° .

- ii. Find the value of s .

4 marks

Question 3 (10 marks)

At a school camp, each child takes a turn throwing darts at the dartboard shown below. The square dartboard is made up of 4 smaller identical squares that have black or white parts. Assume that all darts thrown hit the dartboard in a random location.

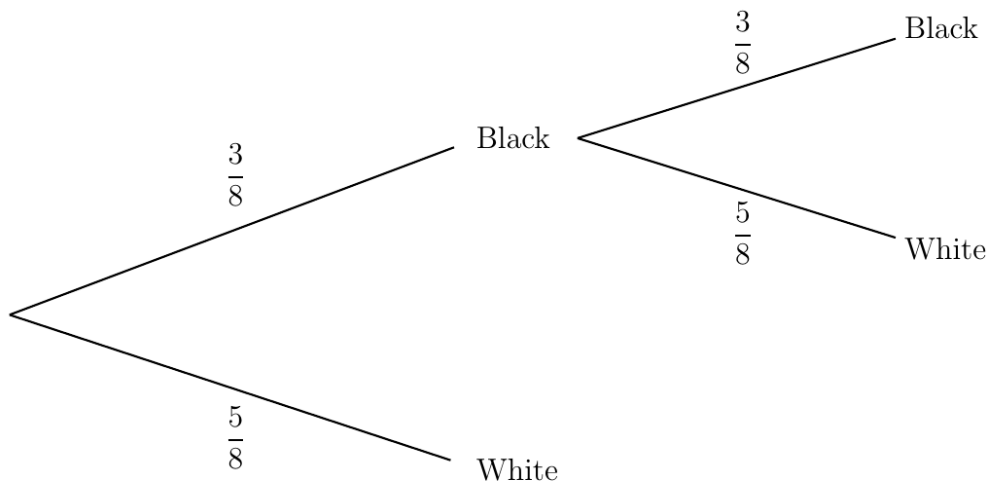


a. Show that the probability that the dart lands on a black region is $\frac{3}{8}$.

2 marks

b. Complete the tree diagram below, showing all outcomes and probabilities.

2 marks



SOLUTIONS**SECTION A**

Question	Answer
1	A
2	D
3	D
4	B
5	C
6	E
7	C
8	B
9	A
10	C
11	E
12	A
13	E
14	D
15	E
16	B
17	C
18	B
19	A
20	E

Question 1

3π is an irrational number.

Answer is **A**.

Question 2

$$5(2x - 15) = 5x + 30$$

$$10x - 75 = 5x + 30$$

$$5x = 105$$

$$x = 21$$

Answer is **D**.

Question 7

The amount uploaded after 4.6 minutes is
 $1200/8 \times 4.6 = 690$ MB.

Answer is **C**.

Question 8

$x + y = 12$ and $x - y = 8$ are the correct equations.

Answer is **B**.

Question 9

$$x^2 + 10x + 9 = (x + 1)(x + 9)$$

Answer is **A**.

Question 10

Since the graph is a circle with radius 3 centred at $(0, 0)$, its equation is given by $x^2 + y^2 = 9$.

Answer is **C**.

Question 11

The surface area of the cylinder is
 $2 \times \pi \times 3.2^2 + 2 \times \pi \times 3.2 \times 4.2 \approx 148.8$ cm².

Answer is **E**.

Question 12

$$\pi(3.2 \times 4)^2 \times (4.2 \times 4) = \pi(3.2)^2 \times 4.2 \times 4^3 \text{ cm}^3$$

Answer is **A**.

Question 13

The bearing of M from H is
 $180^\circ - 042^\circ = 138^\circ$.

Answer is **E**.

Question 8 (5 marks)**a.**

3 marks

$$S = 2\pi R^2 + 2\pi RH \quad (\text{A1})$$

$$= 2\pi R^2 + 4\pi R^2 \quad (\text{A1})$$

$$= 6\pi R^2 \quad (\text{A1})$$

- Award full marks if the correct final expression is obtained without the first step.

b.

2 marks

$$\pi R^2 H = 8R^2 \quad (\text{A1})$$

$$H = \frac{8}{\pi}$$

$$\approx 2.5 \quad (\text{A1})$$

Question 9 (5 marks)**a.**

1 mark

$$65 - 25 = 40 \quad (\text{A1})$$

b.**i.**

2 marks

$$\frac{25}{65} \quad (\text{A1})$$

$$= \frac{5}{13} \quad (\text{A1})$$

ii.

2 marks

$$\frac{38}{78} \quad (\text{A1})$$

$$= \frac{19}{39} \quad (\text{A1})$$

SECTION C**Question 1** (10 marks)**a.**

2 marks

Since $OR = u$, $OP = 8 - u$.

$$A = u \times (8 - u) \quad (\text{A1})$$

$$= 8u - u^2 \quad (\text{A1})$$

b.

3 marks

$$8u - u^2 = 15 \quad (\text{A1})$$

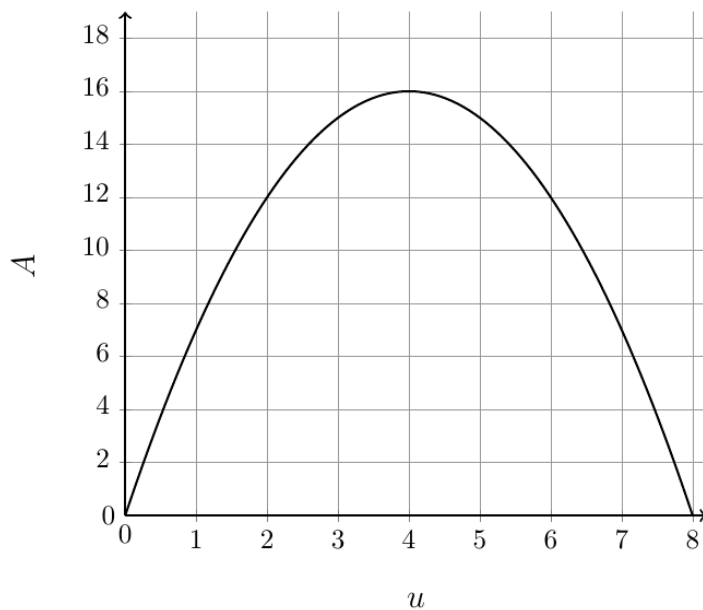
$$u^2 - 8u + 15 = 0$$

$$(u - 5)(u - 3) = 0 \quad (\text{A1})$$

$$u = 3, 5 \quad (\text{A1})$$

c.

3 marks



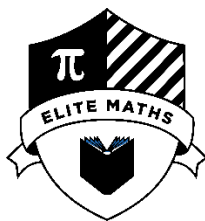
- A parabola is sketched. (A1)
- symmetry about the line $u = 4$. (A1)
- The turning point is at (4,16). (A1)

d.

2 marks

The minimum area of the shaded region would occur when the area of the rectangle $OPQR$ is maximised. (A1)

Therefore, the minimum area is $\frac{1}{2} \times 8 \times 8 - 16 = 16$. (A1)



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Question 1

$\left(\frac{6}{\sqrt{3}}\right)^{-2}$ simplifies to

- A. 2
- B. 4
- C. $\frac{12}{\sqrt{3}}$
- D. $\frac{1}{4}$
- E. $\frac{1}{12}$

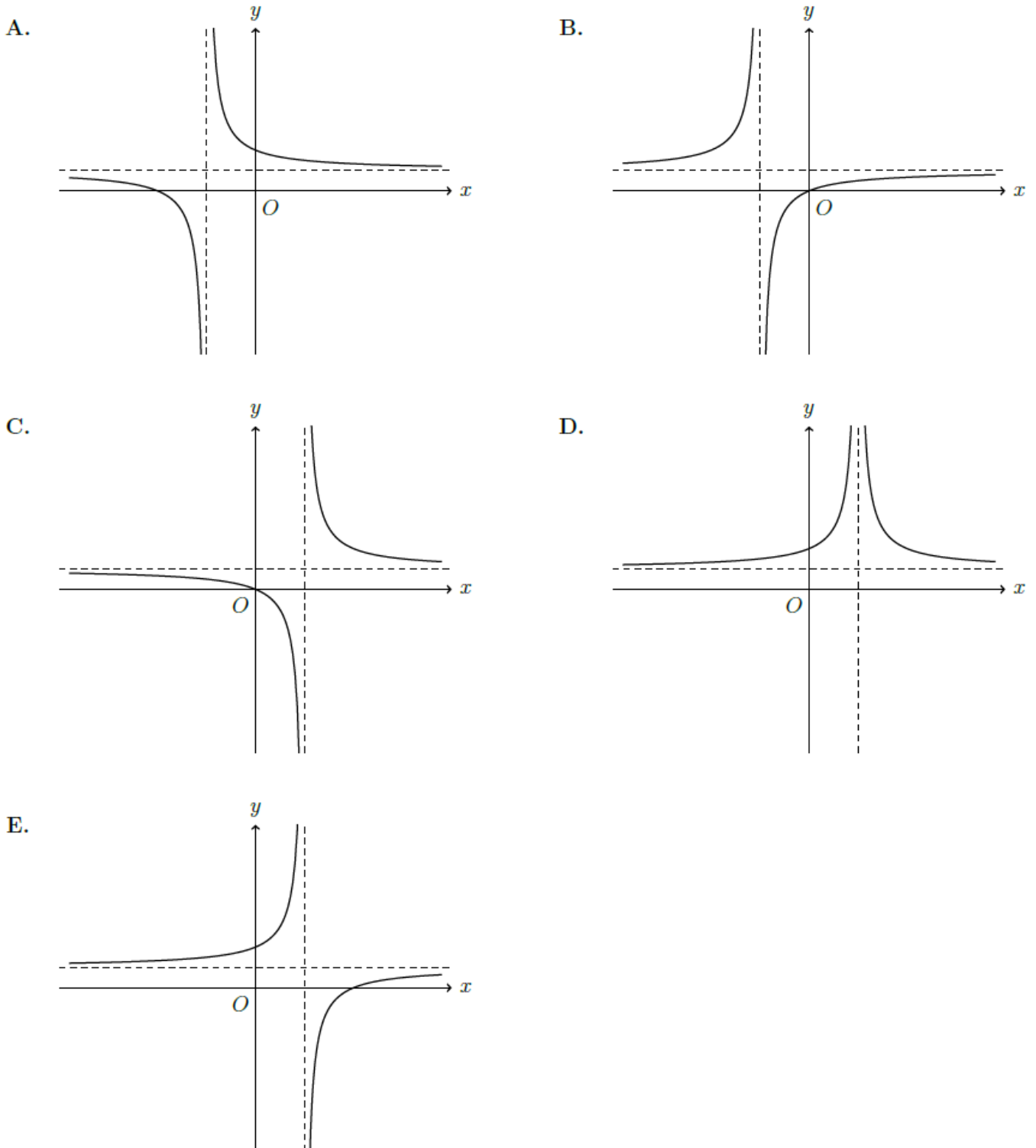
Question 2

Which one of the following statements is **true**?

- A. the solution to the equation $ax = b$ is always $x = \frac{b}{a}$
- B. any irrational number can be written in the form $\frac{c}{d}$, where c and d are integers
- C. a straight line with equation $y = mx + c$, where $m < 0$ and $c < 0$, does not lie in the second quadrant
- D. the product of two irrational numbers could be an integer
- E. the graphs of a parabola and a straight line can intersect up to three times

Question 9

Which one of the following best represents the graph of the equation $y = 2 - \frac{1}{x-2}$?



Question 18

The standard deviation for data set X is σ_X and the standard deviation for data set Y is σ_Y .

Which one of the following gives the best conclusion of $\sigma_X < \sigma_Y$?

- A. the values in data set X are further than their mean than the values in data set Y
- B. data set Y is less reliable than data set X
- C. the mean of data set X is smaller than the mean of data set Y
- D. the sample size of data set X must be smaller than that of data set Y
- E. range of data set X is smaller than the range of data set Y

The following information relates to Questions 19 – 20.

The table below shows the number of hours that eight students spent studying for a particular test (*study time*) and the *number of marks* received in the test, which was out of 50 marks.

<i>Study time</i>	0.5	1	2	3	3.5	4	5	6
<i>Number of marks</i>	28	25	40	32	45	42	39	50

Question 19

The correlation between *study time* and *number of marks* received is best described as

- A. very weak and positive
- B. strong and negative
- C. very strong and negative
- D. moderate and positive
- E. non-linear and weak

Question 20

Using the line of best fit, the estimated *number of marks* received for a student who studied 4.7 hours for the test is

- A. 18
- B. 28
- C. 32
- D. 44
- E. 46

SECTION B**Instructions for Section B**

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Question 1 (4 marks)

a. If $y = \sqrt{3} - 1$, express $(y+1)^3$ in the form $k\sqrt{3}$, where k is an integer.

2 marks

b. Determine which of $\sqrt{6} - \sqrt{3}$ or $\sqrt{12} - \sqrt{6}$ is greater.

3 marks

Question 5 (5 marks)

Consider the polynomial $p(x) = x^3 + ax^2 + bx + 2$, where a and b are constants.

When $p(x)$ is divided by $(x + 1)$, the remainder is 4.

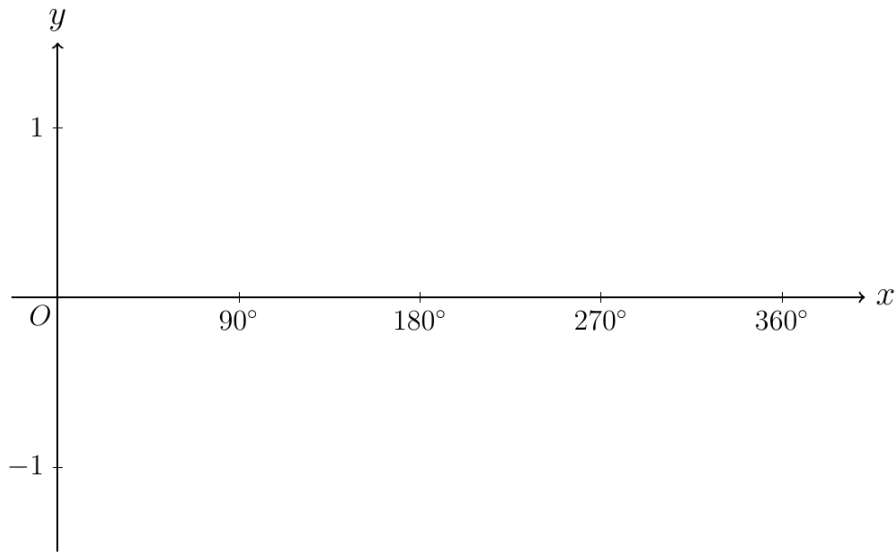
When $p(x)$ is divided by $(x + 3)$, the remainder is -4 .

Find the values of a and b .

Question 6 (5 marks)

a. i. Sketch the graph of $y = \sin(x)$ for $0^\circ \leq x \leq 360^\circ$ on the set of axes below.

3 marks



ii. State the x values for which $\sin(x) < 0$.

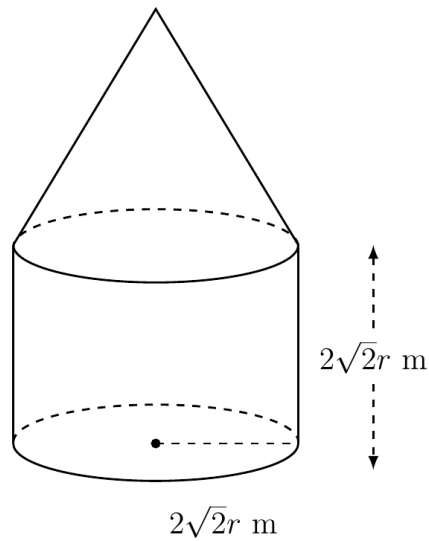
1 mark

b. The cosine graph $y = \cos(x)$ satisfies $\cos(x) = \cos(-x)$.
State what this means graphically.

1 mark

Question 9 (5 marks)

The following diagram shows a composite solid made by joining a cylinder to a right cone, with measurements as shown.



- a. Find the volume of the cylindrical part.
Express your answer in exact form.

2 marks

- b. If the volume of the composite solid is $24\sqrt{2}\pi r^3$ m³, find the height of the conical part in terms of r .
Express your answer in exact form.

3 marks

SECTION C

Instructions for Section C

Answer **all** questions.

In all questions where a numerical answer is required, an **exact** value must be given unless otherwise specified.

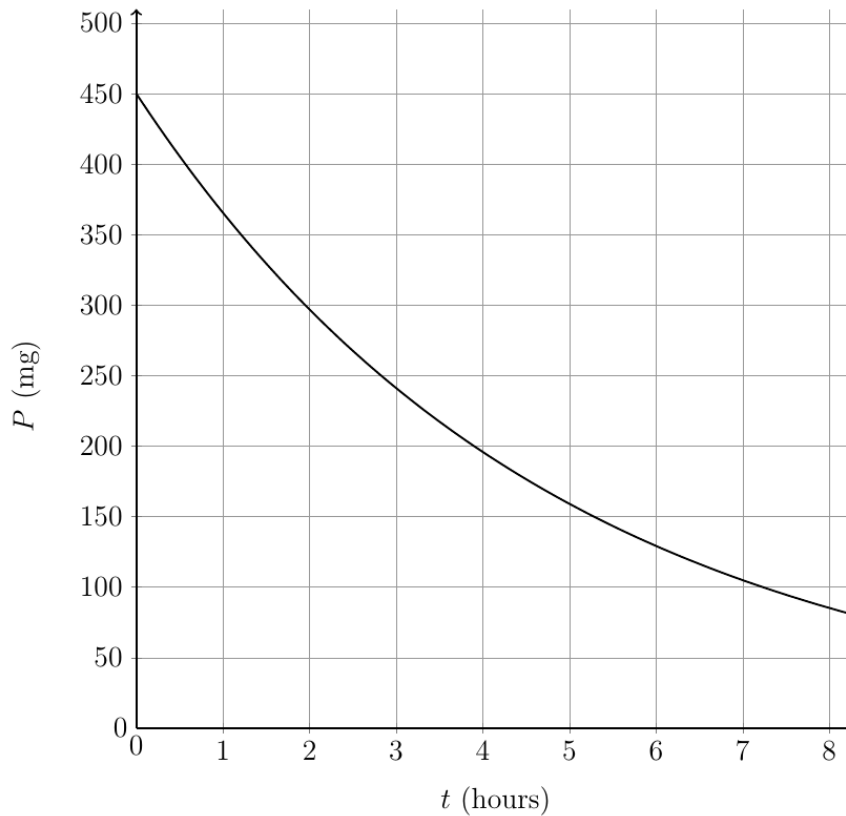
In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 (10 marks)

- a. The amount of a drug, P milligrams, remaining in the bloodstream t hours after it has been injected into patients is given by $P = 450 \times 0.81^t$.

The graph of $P = 450 \times 0.81^t$ is shown below.



- i. Quantify the amount by which P changes each hour.

2 marks

ii. What is the bearing of Alice from Nathan?

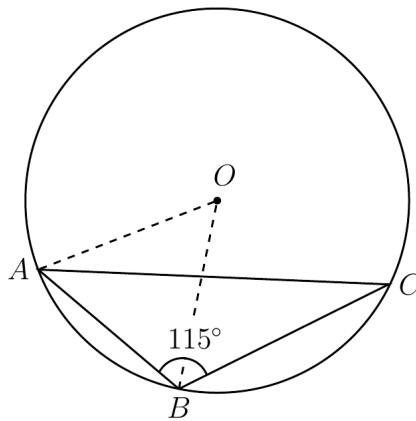
2 marks

b. In the diagram below, O is the centre of the circle.

4 marks

Points A , B and C are on the circumference of the circle and $\angle ABC = 115^\circ$.

The length of the chord AB is the same as the length of the radius of the circle.



Find $\angle CAB$.

Justify your answer with clear geometrical reasoning.

SOLUTIONS**SECTION A**

Question	Answer
1	E
2	D
3	C
4	B
5	A
6	D
7	C
8	E
9	E
10	B
11	C
12	A
13	C
14	E
15	D
16	B
17	B
18	A
19	D
20	D

Question 1

$$\left(\frac{6}{\sqrt{3}}\right)^{-2} = \frac{3}{36} = \frac{1}{12}$$

Answer is **E**.

Question 2

“multiplying two irrational numbers could result in an integer” is a valid statement.

e.g. $\sqrt{2} \times \sqrt{2} = 2$

All of the other statements are false.

For $ax = b$, if $a = 0$, dividing by both sides of the equation by a is undefined,

Answer is **D**.

Question 11

$x + 2\sqrt{x} + 1$ is not a polynomial as the power of the square root term is not an integer.

All of the other expressions are polynomials.

Answer is **C**.

Question 12

From the remainder theorem, one can conclude that “4 is the remainder when $p(x)$ is divided by $x - k$ ”.

Answer is **A**.

Question 13

Using the sine rule

$$\frac{7.2}{\sin(\theta)} = \frac{10.2}{\sin(100^\circ)}$$

$$\sin(\theta) = \frac{\sin(100^\circ)}{10.2} \times 7.2$$

$$\theta = \sin^{-1}\left(\frac{\sin(100^\circ)}{10.2} \times 7.2\right)$$

$$\approx 44.0^\circ$$

Answer is **C**.

Question 14

Since $\sin(\theta) = y$, it follows that $y = 0.5$.

Therefore

$$\begin{aligned} x &= \sqrt{1 - y^2} \\ &= \sqrt{1 - 0.5^2} \\ &= \sqrt{0.75} \\ &= \sqrt{\frac{3}{4}} \\ &= \frac{\sqrt{3}}{2} \end{aligned}$$

Answer is **E**.

Question 3 (5 marks)**a.** 2 marks

$$\$2500 \times (1 - 0.14)^3 \quad (\text{A1})$$

$$= \$1590.14 \quad (\text{A1})$$

b. 3 marks

$$150800 \left(1 + \frac{r}{100}\right)^2 = 157284 \quad (\text{A1})$$

$$\left(1 + \frac{r}{100}\right)^2 = \frac{157284}{150800}$$

$$r = 100 \left(\sqrt{\frac{157284}{150800}} - 1 \right) \quad (\text{A1})$$

$$\approx 2.13 \quad (\text{A1})$$

Question 4 (5 marks)**a.** 3 marks

$$x^2 - 1 = -2x + 2 \quad (\text{A1})$$

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

$$(x + 3)(x - 1) = 0 \quad (\text{A1})$$

$$x = -3, 1 \quad (\text{A1})$$

b. 2 marksFor any k satisfying $k \leq 1$. (A1)This is because the range of the graph of $y = 2^x + 1$ is $y > 1$. (A1)

Question 9 (5 marks)**a.** 2 marks

Volume of the cylindrical part is

$$\pi(2\sqrt{2}r)^2 \times 2\sqrt{2}r \quad (\text{A1})$$

$$= 16\sqrt{2}\pi r^3 \text{ m}^3 \quad (\text{A1})$$

b. 3 marksLet the height of the conical part be h m.

$$16\sqrt{2}\pi r^3 + \frac{1}{3} \times \pi(2\sqrt{2}r)^2 \times h = 24\sqrt{2}\pi r^3 \quad (\text{A1})$$

$$\frac{8}{3} \times \pi r^2 \times h = 8\sqrt{2}\pi r^3 \quad (\text{A1})$$

$$h = 3\sqrt{2}r \quad (\text{A1})$$

Question 10 (5 marks)**a.** 2 marks

$$\sqrt{\frac{(2-16)^2 + (5-16)^2 + \dots + (25-16)^2}{10}} \quad (\text{A1})$$

$$\approx 8.0 \quad (\text{A1})$$

- If the sample standard deviation is taught in class, accept the following.

$$\sqrt{\frac{(2-16)^2 + (5-16)^2 + \dots + (25-16)^2}{9}}$$

$$\approx 8.4$$

b. 2 marks

Trampoline World (A1)

The spread of data values in the back-to-back stem-and-leaf plot is visibly greater than the spread of values for City Bath. (A1)

c. 1 mark

Range (A1)

The range of Trampoline World (35) is greater than that of City Bath (23).

- Accept interquartile range.