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GCSE
Mathematics Revision

Twenty-One Today #1

You have thirty-five minutes to answer 21 questions

Marks Available : 40

GCSE Mathematics
Twenty-One Today

Question 1

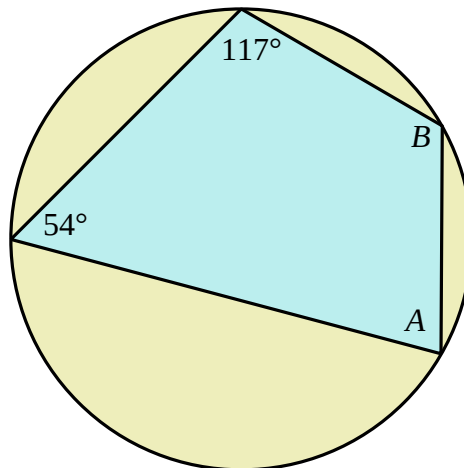
Consider the function;

$$f(x) = \frac{7x^2 + 5}{2}$$

Determine $f(-1)$

[1 mark]

Question 2



A Cyclic Quadrilateral is shown.

Write down the size of;

(i) Angle A

[1 mark]

(ii) Angle B

[1 mark]

Question 3

What distance does a car 'cruising' down the motorway at 70 mph for 1 hour and 20 minutes cover ?

Give your answer in miles, to the nearest mile.

[2 marks]

Question 4

(i) What is “Half of two plus two” ?

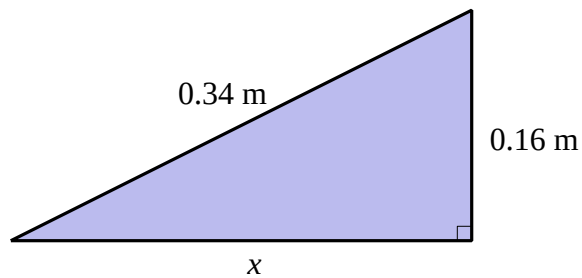
[1 mark]

(ii) What is “Six divided by half” ?

[1 mark]

Question 5

Use the mighty theorem of Pythagoras to calculate the length of the side marked x .
Give your answer in metres.



[2 marks]

Question 6

(i) The point $(4, -7)$ is reflected in the x axis.
What are the coordinates of the reflection ?

[1 mark]

(ii) After reflection in the y -axis, a point has coordinates $(8, 5)$.
What were the coordinates of the point ?

[1 mark]

(iii) Give the coordinates of a point which is its own reflection in the
mirror line with equation $y = 6$

[1 mark]

Question 7

Write down the value of x , y and z that make each of the following equations true,

(i) $9 = 9^x$ (ii) $\frac{1}{9} = 3^y$ (iii) $9 = 81^z$

[3 marks]

Question 8

Write the number 78328 in standard form.

[1 mark]

Question 9

Consider the function;

$$f(x) = 4x - 9$$

Write down an expression for the inverse function, $f^{-1}(x)$

[1 mark]

Question 10

Liza has 7 questions incorrect out of 20 in a mathematics test.

Each question is worth 1 mark.

Express her score as a percentage.

[1 mark]

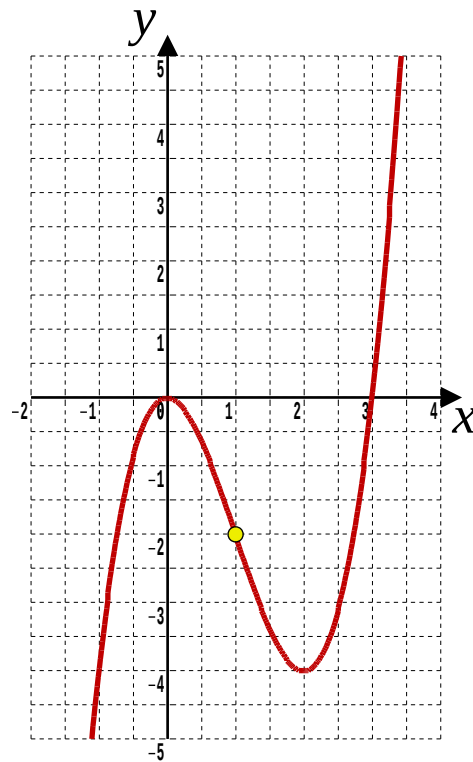
Question 11

Simplify, $\frac{x^2 - 25}{x + 5}$

[1 mark]

Question 12

The curve on the graph below has equation, $y = x^3 - 3x^2$



- (i) Write down an expression for the gradient equation of the curve

[1 mark]

- (ii) Calculate the value of the gradient of the curve at the point (1, - 2)

[1 mark]

- (iii) Determine the equation of the tangent to the curve at the point (1, - 2)

[2 marks]

- (iv) Draw your part (iii) answer of the graph above.

[1 mark]

Question 13

Given that, $f(x) = 2^x$, determine the value of x for which $f(x) = 8$

[1 mark]

Question 14

Consider the straight line;

$$y = 0.5x + 7$$

Write down the coordinates of the point where this line crosses the y -axis.

[1 mark]

Question 15

Consider the following number which is written in standard form;

$$4.76 \times 10^{-5}$$

Write this as an ordinary number.

[1 mark]

Question 16

(i) Factorise, $x^2 + 7x + 10$

[1 mark]

(ii) Hence solve the equation, $x^2 + 7x + 10 = 0$

[1 mark]

Question 17

In the space below sketch the “more is less” graph of inverse proportion, which has equation,

$$y = \frac{1}{x}$$

[1 mark]

Question 18

Simplify, $(100x^6)^{-0.5}$

[2 marks]

Question 19

As an example, 20 when written as a product of primes is $20 = 2 \times 2 \times 5$

(i) What does the word “product” mean ?

[1 mark]

(ii) Write 225 as a product of primes.

[1 mark]

Question 20

Solve the following pair of simultaneous equations:

$$3x - 2y = 2$$

$$x + y = 9$$

[4 marks]

21 Today !

Calculate;

$$1 + 2 + 3 + 4 + 5 + 6 + 7 + \dots + 98 + 99 + 100$$

[2 marks]

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21 Today #1
Brief Answers

GCSE Mathematics
Twenty-One Today

Answer 1

$$f(-1) = \frac{7 \times (-1)^2 + 5}{2} = 6$$

[1 mark]

Answer 2

(i) $A = 63^\circ$ (ii) 126°

[1, 1 marks]

Answer 3

$$D = S \times T = 70 \times 1.3333... = 93 \text{ miles}$$

[2 marks]

Answer 4

(i) 3 (ii) 12

[1, 1 marks]

Answer 5

$$\sqrt{0.34^2 - 0.16^2} = 0.3 \text{ metres}$$

[2 marks]

Answer 6

(i) (4, 7) (ii) (-8, 5) (iii) (anything, 6)

[1, 1, 1 marks]

Answer 7

(i) $x = 1$ (ii) $y = -2$ (iii) $z = 0.5$

[1, 1, 1 marks]

Answer 8

$$7.8328 \times 10^4$$

[1 mark]

Answer 9

$$f^{-1}(x) = \frac{x + 9}{4}$$

[1 mark]

Answer 10

$$\frac{13}{20} \times 100 = 65\%$$

[1 mark]

Answer 11

$$\frac{x^2 - 25}{x + 5} = \frac{(x - 5)(x + 5)}{(x + 5)} = x - 5$$

[1 mark]

Answer 12

(i) $y = x^3 - 3x^2 \Rightarrow \frac{dy}{dx} = 3x^2 - 6x$

[1 mark]

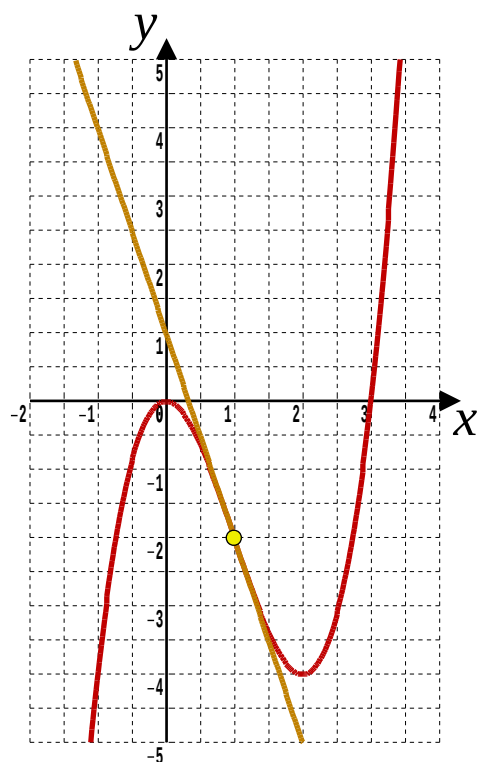
(ii) When $x = 1$, $\frac{dy}{dx} = -3$

[1 mark]

(iii) $y = mx + c \quad \therefore y = -3x + 1$

[2 marks]

(iv)



[1 mark]

Answer 13

If $2^x = 8$, then $x = 3$

[1 mark]

Answer 14

$(0, 7)$

[1 mark]

Answer 15

0.0000476

[1 mark]

Answer 16

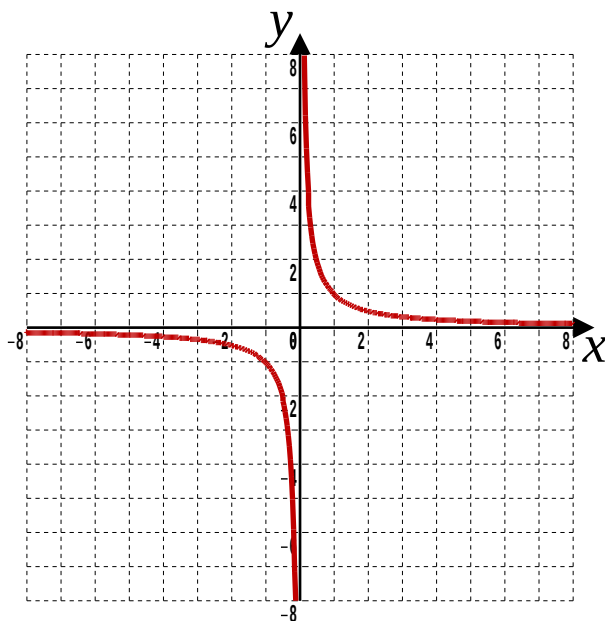
(i) $(x + 5)(x + 2)$

[1 mark]

(ii) Either $x = -5$ or $x = -2$

[1 mark]

Answer 17



[1 mark]

Answer 18

$$\frac{1}{10x^3}$$

[2 marks]

Answer 19

(i) A “product” is a “multiplication”

[1 mark]

(ii) $225 = 3 \times 3 \times 5 \times 5$

[1 mark]

Answer 20

Double second equation...

$$\begin{array}{rcl} 3x - 2y & = & 2 \\ \text{ADD} & & \\ 2x + 2y & = & 18 \\ \hline 5x & = & 20 \quad \therefore x = 4 \text{ and } y = 5 \end{array}$$

[4 marks]

Answer 21

5050

[2 marks]

Twenty-One Today #2

You have thirty-five minutes to answer 21 questions

Marks Available : 40

GCSE Mathematics
Twenty-One Today

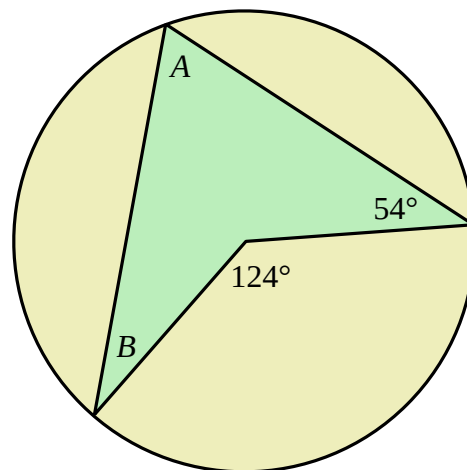
Question 1

Consider the functions, $f(x) = \frac{x^2 + 1}{2}$ $g(x) = 4x + 3$

Determine $fg(2)$

[1 mark]

Question 2



A Quadrilateral is shown with one vertex at the centre of a circle.

(i) Write down the size of angle A

[1 mark]

(ii) Calculate the size of angle B

[1 mark]

Question 3

Solve the equation, $4(3x + 2) - 3(2x + 1) = 29$

[2 marks]

Question 4

(i) Solve the inequality;

$$-5 < 4x + 3 \leq 13$$

[2 marks]

(ii) If x is an integer, list the values of x that satisfy the part (i) inequality.

[1 mark]

Question 5

Write the number 0.00000315 in standard form.

[1 mark]

Question 6

Felix is interested in buying a drone, priced at £425.

When the drone is reduced by 40% in a sale, Felix decides he can't afford not to buy.

What is the reduced cost of the drone ?

[1 mark]

Question 7

You are told the “product of primes” for two numbers;

$$2340 = 2 \times 2 \times 3 \times 3 \times 5 \times 13 \qquad 6615 = 3 \times 3 \times 3 \times 5 \times 7 \times 7$$

What is the Highest Common factor of 2340 and 6615 ?

[1 mark]

Question 8

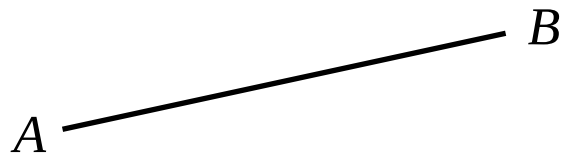
Make c the subject of the formula, $E = mc^2$

[1 mark]

Question 9

Use a compass and a straight edge to construct the perpendicular bisector to the line AB drawn given below.

Do NOT rub out any marks used in the construction.



[3 marks]

Question 10

A supermarket measures the time spent by 100 customers in their store.

Time	N° of Customers (frequency)	Cumulative Frequency
$0 < t \leq 5$	8	
$5 < t \leq 10$	11	
$10 < t \leq 15$	23	
$15 < t \leq 20$	42	
$20 < t \leq 25$	9	
$25 < t \leq 30$	5	
$30 < t \leq 35$	2	

Complete the column headed Cumulative Frequency.

[1 mark]

Question 11

Expand the brackets and simplify; $(3x + 4)(2x - 3)$

[1 mark]

Question 12

Consider the following number which is written in standard form;

$$8.13 \times 10^4$$

Write this as an ordinary number.

[1 mark]

Question 13

- (i) What is the area of a circle of radius 6.4 cm ?
Give your answer to three significant figures.

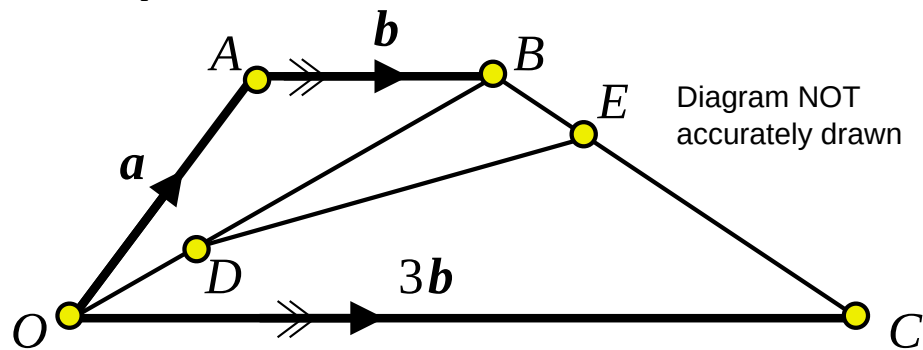
[1 mark]

- (ii) A cylinder has a cross section that is a circle of radius 6.4 cm.
It is 25 cm in length.
What is the volume of the cylinder ?
Give your answer to three significant figures.

[1 mark]

Question 14

$OABC$ is a trapezium.



$$\vec{OA} = \mathbf{a}$$

$$\vec{AB} = \mathbf{b}$$

$$\vec{OC} = 3\mathbf{b}$$

D is the point on OB such that $OD : DB = 2 : 3$

E is the point on BC such that $BE : EC = 1 : 4$

Work out the vector $\vec{DE}$ in terms of $\mathbf{a}$ and $\mathbf{b}$

Give your answer in its simplest form.

[4 marks]

Question 15

9 is a square number.

(i) List the three factors of 9.

[1 mark]

Jack says that all square numbers have exactly three factors.

(ii) Give an example of a square number that proves Jack is wrong.

[1 mark]

Question 16

Two ordinary six faced dice are rolled, one red and one blue.

A **prime roll** is one in which both dice show a prime number.

For example, if the red shows 5 and the blue shows 3 that is a **prime roll**.

Using the grid below to help, determine the probability of a **prime roll**.

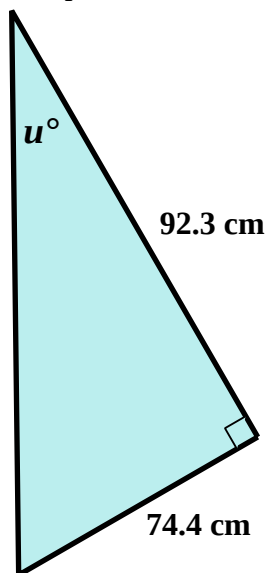
		R E D					
		1	2	3	4	5	6
B L U E	1						
	2						
	3					P	
	4						
	5						
	6						

[3 marks]

Question 17

Calculate the size of angle u in the triangle below.

Give your answer to one decimal place.



[2 marks]

Question 18

Expand the brackets and simplify, $(3x)^2 \times (2x)^3$

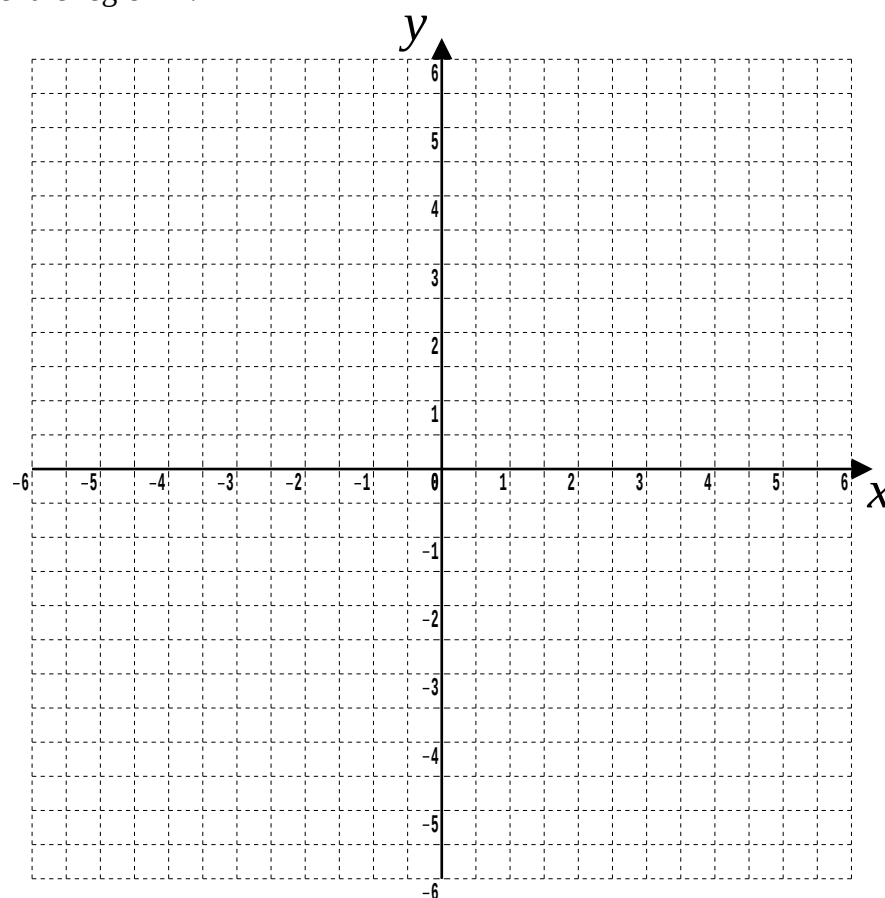
[2 marks]

Question 19

On the grid show, by shading, the region that satisfies all of these inequalities,

$$2y + 4 < x \qquad x < 3 \qquad y < 6 - 3x$$

Label the region **R**.



[3 marks]

Question 20

By first factorising solve the equation $x^2 + 3x - 28 = 0$

[2 marks]

21 Today !

Use the observation that, $1 + 3 = 2^2$, $1 + 3 + 5 = 3^2$, $1 + 3 + 5 + 7 = 4^2$
to calculate: $1 + 3 + 5 + 7 + 9 + 11 + 13 + \dots + 95 + 97 + 99$

[2 marks]

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21 Today #2
Brief Answers

GCSE Mathematics
Twenty-One Today

Answer 1

$$fg(2) = f(11) = 61$$

[1 mark]

Answer 2

(i) 62° (ii) 8°

[1, 1 marks]

Answer 3

$$4(3x + 2) - 3(2x + 1) = 29$$

$$12x + 8 - 6x - 3 = 29$$

$$6x = 24$$

$$x = 4$$

[2 marks]

Answer 4

(i) $-5 < 4x + 3 \leq 13$

$$-8 < 4x \leq 10$$

$$-2 < x \leq 2.5$$

[2 marks]

(ii) $x = -1, 0, 1, 2$

[1 mark]

Answer 5

$$3.15 \times 10^{-6}$$

[1 mark]

Answer 6

$$0.6 \times 425 = \text{£}255$$

[1 mark]

Answer 7

$$45$$

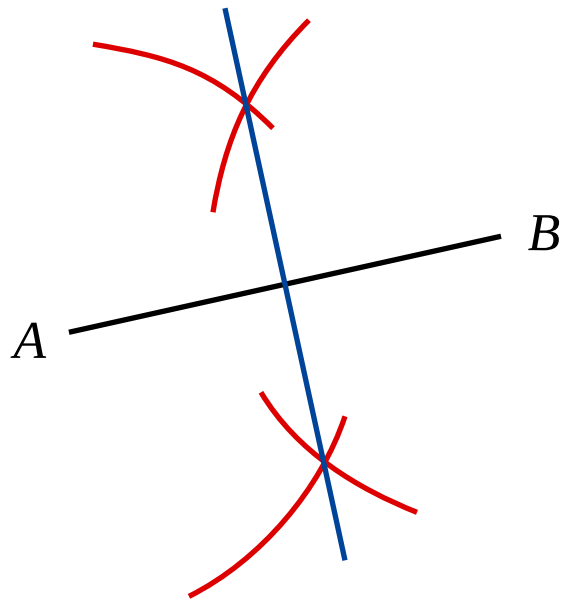
[1 mark]

Answer 8

$$c = \sqrt{\frac{E}{m}}$$

[1 mark]

Answer 9



[3 marks]

Answer 10

Time	N° of Customers (frequency)	Cumulative Frequency
$0 < t \leq 5$	8	8
$5 < t \leq 10$	11	19
$10 < t \leq 15$	23	42
$15 < t \leq 20$	42	84
$20 < t \leq 25$	9	93
$25 < t \leq 30$	5	98
$30 < t \leq 35$	2	100

[1 mark]

Answer 11

$$\begin{aligned}(3x + 4)(2x - 3) &= 6x^2 - 9x + 8x - 12 \\ &= 6x^2 - x - 12\end{aligned}$$

[1 mark]

Answer 12

81300

[1 mark]

Answer 13

(i) 129 cm^2 (ii) 3220 cm^3

[1, 1 marks]

Answer 14

$$\begin{aligned}
 \overrightarrow{DE} &= \overrightarrow{DB} + \overrightarrow{BE} \\
 &= \frac{3}{5} \overrightarrow{OB} + \frac{1}{5} \overrightarrow{BC} \\
 &= \frac{3}{5} (\overrightarrow{OA} + \overrightarrow{AB}) + \frac{1}{5} (\overrightarrow{BA} + \overrightarrow{AO} + \overrightarrow{OC}) \\
 &= \frac{3}{5} (\mathbf{a} + \mathbf{b}) + \frac{1}{5} (-\mathbf{b} - \mathbf{a} + 3\mathbf{b}) \\
 &= \frac{3}{5} \mathbf{a} + \frac{3}{5} \mathbf{b} - \frac{1}{5} \mathbf{b} - \frac{1}{5} \mathbf{a} + \frac{3}{5} \mathbf{b} \\
 &= \frac{2}{5} \mathbf{a} + \mathbf{b}
 \end{aligned}$$

[4 marks]

Answer 15

(i) 1, 3, 9

[1 mark]

(ii) The most obvious answer is 16 which has 5 factors.
Other answers include, 27 (4 factors) and 32 (6 factors)

[1 mark]

Answer 16

All possible prime rolls are indicated on the following diagram,

		RED					
		1	2	3	4	5	6
B L U E	1						
	2		P	P		P	
	3		P	P		P	
	4						
	5		P	P		P	
	6						

$$p(\text{prime roll}) = \frac{9}{36} = \frac{1}{4}$$

[3 marks]

Answer 17

$$u = \arctan\left(\frac{74.4}{92.3}\right) = 38.9^\circ$$

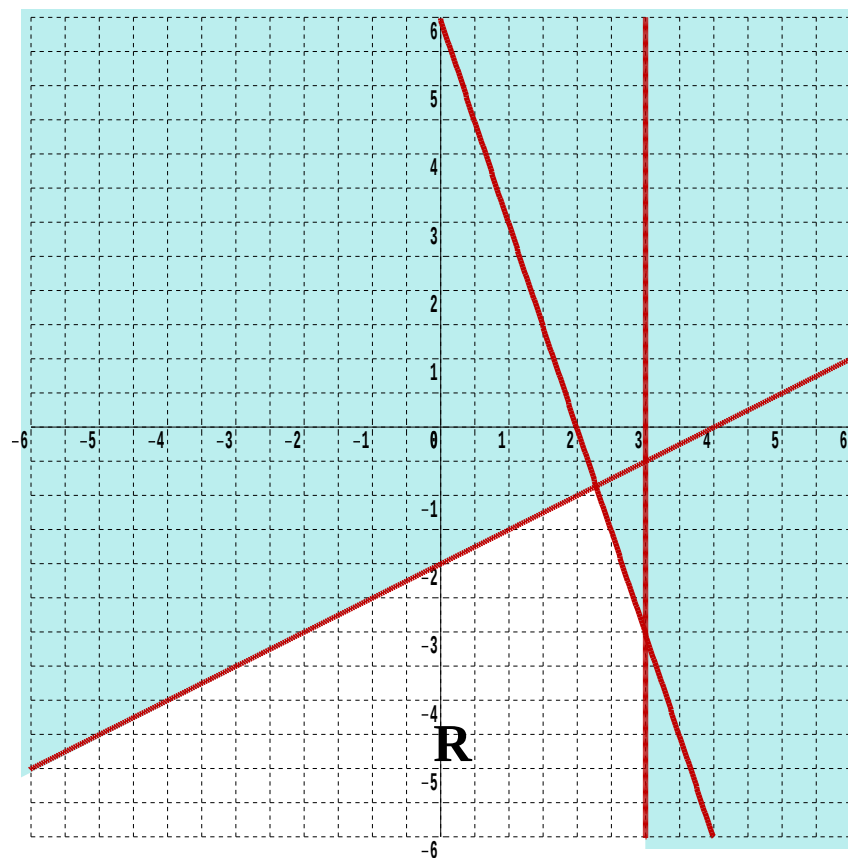
[2 marks]

Answer 18

$$(3x)^2 \times (2x)^3 = 9x^2 \times 8x^3 = 72x^5$$

[2 marks]

Answer 19



[3 marks]

Answer 20

$$x^2 + 3x - 28 = 0$$

$$(x + 7)(x - 4) = 0$$

Either $x = -7$ or $x = 4$

[2 marks]

Answer 21

$$50^2 = 2500$$

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Twenty-One Today #3

You have thirty-five minutes to answer 21 questions

Marks Available : 40

GCSE Mathematics
Twenty-One Today

Question 1

The diagram shows a square $ABCD$ with sides of length 20 cm

It also shows a semicircle and an arc of a circle.

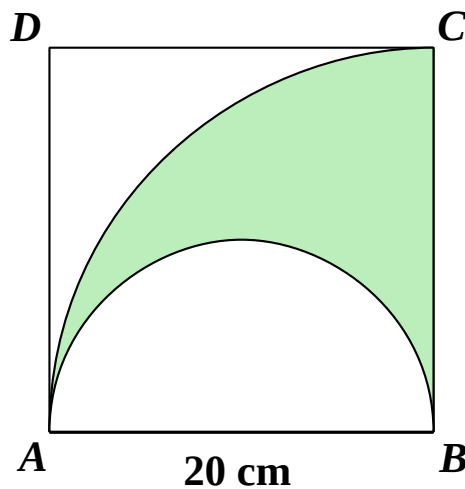


Diagram NOT
accurately drawn

AB is the diameter of the semicircle.

AC is an arc of a circle with centre B

Show that,

$$\frac{\text{area of shaded region}}{\text{area of square}} = \frac{\pi}{8}$$

[4 marks]

Question 2

If you have thirty-five minutes in which to answer 21 questions, how long does that give you, on average, to answer each question ? Give your answer in minutes and seconds.

[1 mark]

Question 3

Solve the following pair of simultaneous equations:

$$3x - y = 7$$

$$4x + 3y = 31$$

[3 marks]

Question 4

Expand the brackets and simplify ;

$$(2x + 3)(5x + 1)(x + 1)$$

[3 marks]

Question 5

If x is an integer and $\sqrt{50} < x \leq \sqrt{100}$ list the possible values of x .

[1 mark]

Question 6

The algebraic equation $y = 3x + 2$ can be thought of as the description of a straight line.

When thought of in this way,

(i) What is the gradient of this straight line ?

[1 mark]

(ii) What are the coordinates of the point where this line crosses the y -axis ?

[1 mark]

(iii) What are the coordinates of the point where this line crosses the x -axis ?

[1 mark]

Question 7

Solve $\frac{5 - x}{2} = 2x - 7$

[3 marks]

Question 8

Write $x^2 + 6x - 7$ in the form $(x + a)^2 + b$ where a and b are integers.

[2 marks]

Question 9

Find the Highest Common Factor of 30 and 42

[1 mark]

Question 10

Find the Lowest Common Multiple of 12 and 20

[1 mark]

Question 11

Freddie buys an iPad for £850

He then sells it for £697

Calculate his percentage loss.

[1 mark]

Question 12

$$f(x) = \frac{2x^2 + 1}{x^2 - 5}$$

Find the two values of x for which $f(x) = 3$

[3 marks]

Question 13

Liv and Maddie share a tube of Smarties in the ratio 2 : 3.

If Liv then has 26 Smarties, how many Smarties were in the tube ?

[1 mark]

Question 14

In a bag there are only red counters, blue counters, green counters and pink counters.

A counter is going to be taken at random from the bag.

The table shows the probabilities of taking a red or a blue counter.

Colour	red	blue	green	pink
Probability	0.05	0.15	...	...

The probability of taking a green counter is 0.2 more than the probability of taking a pink counter.

(a) Complete the table.

[1 mark]

There are 18 blue counters in the bag.

(b) Work out the total number of counters in the bag.

[2 marks]

Question 15

Write down one set of five integers that has a mode of 5 and a median of 3.

[1 mark]

Question 16

Given that y is directly proportional to the square of x and that y is 200 when x is 5, write down an equation connecting y and x which is of the form $y = kx^2$, where k is the constant of the proportionality which is to be determined.

[1 mark]

Question 17

One face of a cube has an area of 121cm^2 .

What is the volume of the cube ?

[1 mark]

Question 18

Expand the brackets,

$$(3x - 1)^2$$

[1 mark]

Question 19

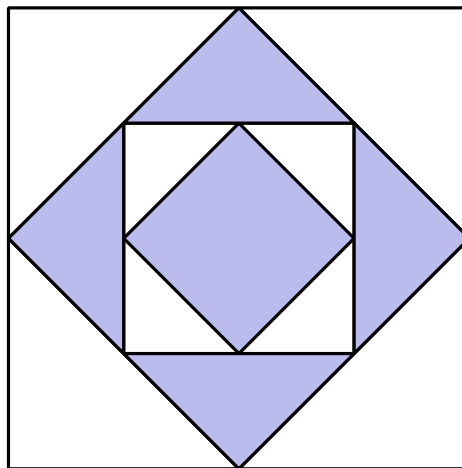
$$f(x) = 2x + 3$$

Find the value of x for which $f(x) = f^{-1}(x)$

[2 marks]

Question 20

What fraction of the area of the larger square is shaded ?



[2 marks]

21 Today !

From a standard pack of 52 playing cards four are randomly chosen, one after the other WITHOUT REPLACEMENT.

What is the probability that all four cards are Aces ?

[2 marks]

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21 Today #3
Brief Answers

GCSE Mathematics
Twenty-One Today

Answer 1

$$\begin{aligned}\text{Area shaded} &= \frac{1}{4} \times \pi \times 20^2 - \frac{1}{2} \times \pi \times 10^2 \\ &= 100\pi - 50\pi \\ &= 50\pi \\ \therefore \frac{\text{area of shaded region}}{\text{area of square}} &= \frac{50\pi}{20 \times 20} \\ &= \frac{\pi}{8} \quad \square\end{aligned}$$

[4 marks]

Answer 2

$$\begin{aligned}\frac{35}{21} &= 1\frac{2}{3} \text{ minutes} \\ &= 1 \text{ minute, 40 seconds}\end{aligned}$$

[1 mark]

Answer 3

Multiply the upper equation by 3 to get,

$$\begin{array}{rcl} & 9x - 3y & = 21 \\ \text{ADD} & 4x + 3y & = 31 \\ \hline & 13x & = 52 \end{array} \quad \therefore x = 4 \text{ and } y = 5$$

[3 marks]

Answer 4

$$\begin{aligned}(2x + 3)(5x + 1)(x + 1) &= (10x^2 + 17x + 3)(x + 1) \\ &= 10x^3 + 17x^2 + 3x \\ &\quad + 10x^2 + 17x + 3 \\ &= 10x^3 + 27x^2 + 20x + 3\end{aligned}$$

[3 marks]

Answer 5

$$\begin{aligned}\sqrt{50} &< x \leq \sqrt{100} \\ 7.07... &< x \leq 10 \\ x &= 8, 9, 10\end{aligned}$$

[1 mark]

Answer 6

(i) Gradient, $m = 3$ (ii) $(0, 2)$ (iii) $\left(-\frac{2}{3}, 0\right)$

[1, 1, 1 marks]

Answer 7

$$\frac{5-x}{2} = 2x - 7$$

$$5 - x = 4x - 14$$

$$5x = 19$$

$$x = \frac{19}{5} \quad (\text{As a decimal, } x = 3.8)$$

[3 marks]

Answer 8

$$\begin{aligned} x^2 + 6x - 7 &= [x^2 + 6x] - 7 \\ &= [(x + 3)^2 - 9] - 7 \\ &= (x + 3)^2 - 16 \end{aligned}$$

[2 marks]

Answer 9

$$hcf \{30, 42\} = 6$$

[1 mark]

Answer 10

$$\begin{aligned} lcm \{12, 20\} &= \frac{12 \times 20}{hcf \{12, 20\}} \\ &= \frac{12 \times 20}{4} \\ &= 60 \end{aligned}$$

[1 mark]

Answer 11

$$\begin{aligned} \text{Percentage loss} &= \frac{850 - 697}{850} \times 100 \\ &= 18\% \end{aligned}$$

[1 mark]

Answer 12

$$\begin{aligned} \frac{2x^2 + 1}{x^2 - 5} &= 3 \\ 2x^2 + 1 &= 3x^2 - 15 \\ x^2 &= 16 \\ x &= \pm 4 \end{aligned}$$

[3 marks]

Answer 13

Two parts are 26 Smarties

So one part is 13, and so there are $5 \times 13 = 65$ Smarties in the tube.

[1 mark]

Answer 14

(a)

Colour	red	blue	green	pink
Probability	0.05	0.15	0.5	0.3

[1 mark]

(b) 15% is 18 counters

$$\therefore 100\% = \frac{18}{15} \times 100 = 120 \text{ counters in the bag}$$

[2 marks]

Answer 15

1, 2, 3, 5, 5

[1 mark]

Answer 16

$$y = kx^2$$

$$200 = k \times 5^2$$

$$k = 8 \quad \text{Equation : } y = 8x^2$$

[1 mark]

Answer 17

1331 cm^3

[1 mark]

Answer 18

$$(3x - 1)^2 = 9x^2 - 6x + 1$$

[1 mark]

Answer 19

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

$$4x + 6 = x - 3$$

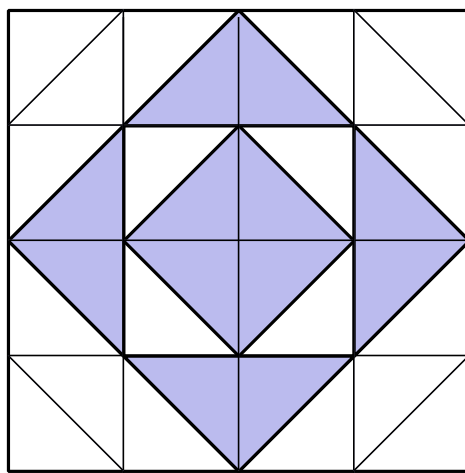
$$3x = -9$$

$$x = -3$$

[2 marks]

Answer 20

One way to “see” the answer is to chop up the diagram into congruent shapes.



The fraction shaded is then,

$$\frac{12}{32} = \frac{3}{8}$$

[2 marks]

Answer 21

$$\begin{aligned} p(A_{\clubsuit}A_{\diamondsuit}A_{\heartsuit}A_{\spadesuit}) &= \frac{4}{52} \times \frac{3}{51} \times \frac{2}{50} \times \frac{1}{49} \\ &= \frac{1}{270725} \quad (\text{Approximately } 0.0004\% \text{ likely}) \end{aligned}$$

[2 marks]

Twenty-One Today #4

You have thirty-five minutes to answer 21 questions

Marks Available : 40

GCSE Mathematics
Twenty-One Today

Question 1

- (i) What is the area of a semi-circle of **diameter** 9.6 cm ?
Give your answer to three significant figures.

[1 mark]

- (ii) What is the perimeter of a semi-circle of **diameter** 9.6 cm ?
Give your answer to three significant figures.

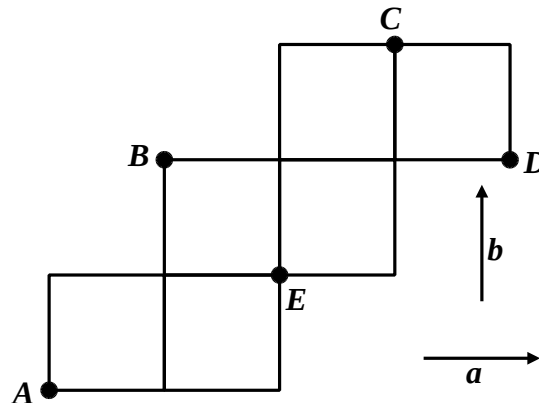
[1 mark]

Question 2

If, between two point on a line, $\Delta y = 49$ and $\Delta x = 14$, what is the gradient ?

[1 mark]

Question 3



Write down in terms of **a** and **b**;

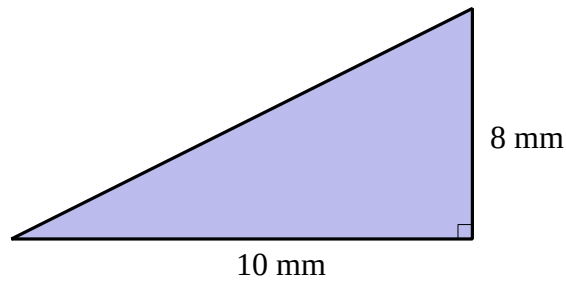
(i) $\overrightarrow{BD}$ (ii) $\overrightarrow{AE}$

(iii) $\overrightarrow{CD}$ (iv) $\overrightarrow{DA}$

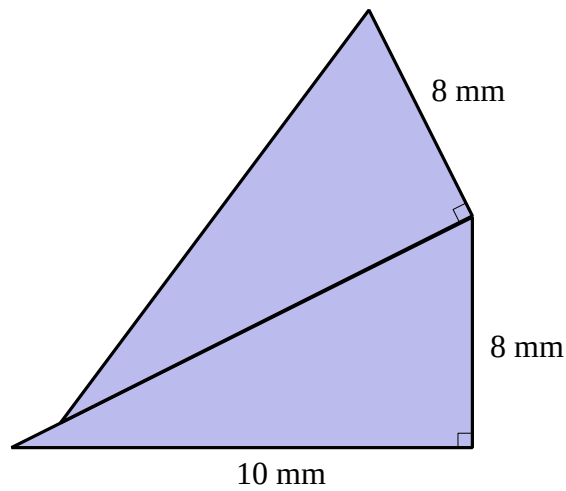
[2 marks]

Question 4

Here is a right-angled triangle,



The shaded shape below is made from two of these triangles,



Work out the perimeter of the shaded shape.
Give your answer correct to 3 significant figures.

[2 marks]

Question 5

When a six faced standard cubical dice is rolled what is the average number of pips that are rolled ?

[1 mark]

Question 6

In a maths test, 11 students scored the following percentage marks;

78 45 63 56 51 48 45 52 58 80 55

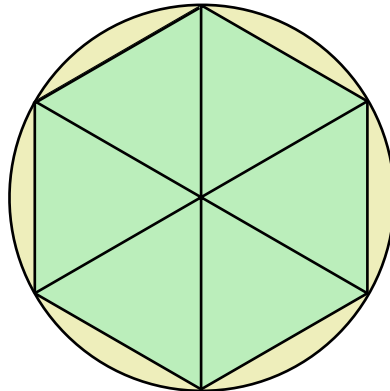
Determine the interquartile range.

[2 marks]

Question 7

Use the formula, $\text{Area } \Delta = \frac{1}{2} a b \sin C$

to work out the area of a hexagon drawn inside a circle of radius 10 cm



[3 marks]

Question 8

In a school there are 16 teachers and 220 students.

Of these students 120 are girls and 100 are boys.

One teacher, one girl and one boy are going to be chosen to represent the school.

Work out the number of different ways there are to choose one teacher, one girl and one boy.

[2 marks]

Question 9

Solve $\frac{3x - 2}{4} - \frac{2x + 5}{3} = \frac{1 - x}{6}$

[4 marks]

Question 10

Given that, y is directly proportional to the square root of x and that y is 100 when x is 400, write down an equation connecting y and x which is of the form $y = k\sqrt{x}$, where k is the constant of the proportionality to be found.

[2 marks]

Question 11

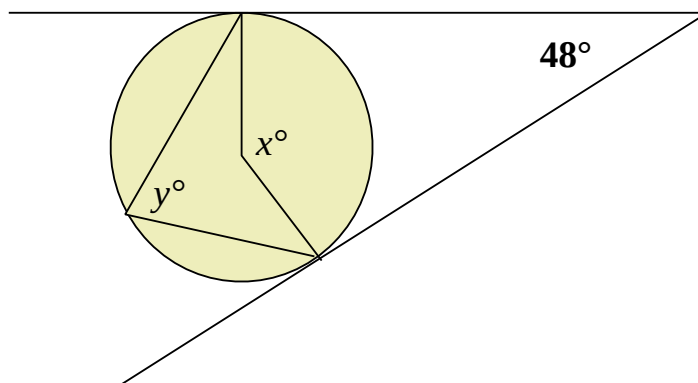
£30 000 is to be split between Peter, Paul and Mary in the ratio 3 : 5 : 7

How much more does Mary receive than Peter ?

[2 marks]

Question 12

Two lines, tangential to a circle, meet in an angle of 48° .



- (i) State the size of angle x

[1 mark]

- (ii) State the size of angle y

[1 mark]

Question 13

The speed of sound is about 340 m s^{-1}

- (i) How long, to the nearest second does it take sound to travel 1 km ?

[1 mark]

- (ii) If there is a gap of 6 seconds between a person seeing a lightening flash, and hearing the resulting thunder, how far away is the lightening ?
(You may assume that the light travels so fast it is instantaneous)

[1 mark]

Question 14

$$f(x) = \frac{16}{x^2}, \quad x \neq 0$$

Determine the value of $fff(2)$

[2 marks]

Question 15

Solve the equation $3x^2 = 108$

[1 mark]

Question 16

Kay invests £200000 in a savings account for 4 years.

The account pays compound interest at a rate of 1.5% per annum.

Calculate the total amount of interest Kay will get at the end of 4 years.

[2 marks]

Question 17

In June 2022 the *Frontier* supercomputer installed at America's Oak Ridge National laboratory was the world's fastest operational supercomputer.

It has a sustained processing rate of 1 102 000 000 000 000 floating point instructions per second.

(i) Write this number in standard form.

[1 mark]

(ii) Most personal laptops are around 10 million times slower than the *Frontier*. Suppose you ran a program on your laptop that took one year to complete. How long would it take the *Frontier* ? Give your answer in seconds.

[1 mark]

Question 18

A circle is centred on the origin.

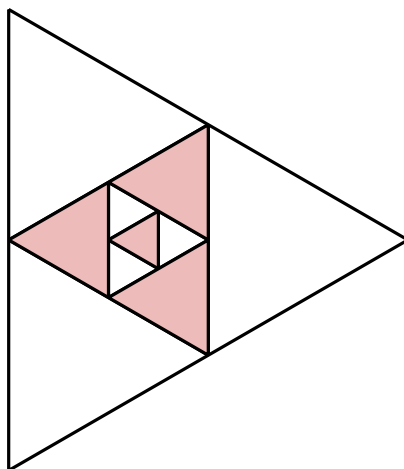
The point (24, 7) is on the circumference of the circle.

What is the radius of the circle ?

[1 mark]

Question 19

What fraction of the area of the larger triangle is shaded ?



[2 marks]

Question 20

Given any function $f(x)$ which has an inverse function $f^{-1}(x)$,
what is $f(f^{-1}(x))$?

[1 mark]

21 Today !

From a standard pack of 52 playing cards four are randomly chosen, one after the other WITHOUT REPLACEMENT.

What is the probability that all four cards are Hearts ?
Give your answer as a decimal fraction.

[2 marks]

21 Today #4
Brief Answers

GCSE Mathematics
Twenty-One Today

Answer 1

(i) $\text{Area} = \frac{1}{2} \times \pi \times \left(\frac{9.6}{2}\right)^2 = 36.2 \text{ cm}^2$

[1 mark]

(ii) $\text{Perimeter} = \frac{1}{2} \times 2 \times \pi \times \left(\frac{9.6}{2}\right) + 9.6 = 24.7 \text{ cm}$

[1 mark]

Answer 2

$$m = \frac{\Delta y}{\Delta x} = \frac{49}{14} = 3.5$$

[1 mark]

Answer 3

(i) $\vec{BD} = 3a$

(ii) $\vec{AE} = 2a + b$

(iii) $\vec{CD} = a - b$

(iv) $\vec{DA} = -4a - 2b$

[2 marks]

Answer 4

$$H = \sqrt{10^2 + 8^2} = \sqrt{164} = 12.8 \text{ mm}$$

$$\text{Perimeter} = 10 + 8 + 8 + 12.8 + (12.8 - 10) = 41.6 \text{ mm}$$

[2 marks]

Answer 5

$$\text{Average (mean)} = \frac{1 + 2 + 3 + 4 + 5 + 6}{6} = 3.5 \text{ pips}$$

[1 mark]

Answer 6

Get the data in order !

45 45 48 51 52 55 56 58 63 78 80

$$\frac{11 + 1}{4} = 3$$

45 45 48 51 52 55 56 58 63 78 80

$$IQR = 63 - 48 = 15$$

[2 marks]

Answer 7

The hexagon is constructed from 6 equilateral triangles, each with three 60° angles.

$$\text{Area Hexagon} = 6 \times \frac{1}{2} \times 10 \times 10 \times \sin 60 = 260 \text{ cm}^2$$

[3 marks]

Answer 8

$$16 \times 120 \times 100 = 192000 \text{ ways}$$

[2 marks]**Answer 9**

$$\frac{3x - 2}{4} - \frac{2x + 5}{3} = \frac{1 - x}{6}$$

Multiply through by 12

$$3(3x - 2) - 4(2x + 5) = 2(1 - x)$$

$$9x - 6 - 8x - 20 = 2 - 2x$$

$$3x = 28$$

$$x = \frac{28}{3}$$

[4 marks]**Answer 10**

$$y = k\sqrt{x}$$

$$100 = k\sqrt{400}$$

$$100 = 20k$$

$$k = 5 \quad \Rightarrow y = 5\sqrt{x}$$

[2 marks]**Answer 11**

$$\frac{30000}{15} = \text{£}2000 \text{ for each part}$$

Mary gets 4 more parts than Peter so Mary gets £8000 more

[2 marks]**Answer 12**

$$(i) \quad x = 132^\circ \quad (ii) \quad y = 66^\circ$$

[2 marks]**Answer 13**

$$(i) \quad \text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{1000}{340} = 3 \text{ seconds}$$

[1 mark]

$$(ii) \quad \text{About 2 km}$$

[1 mark]**Answer 14**

$$fff(2) = ff(4) = f(1) = 16$$

[2 marks]**Answer 15**

$$3x^2 = 108 \Leftrightarrow x^2 = 36 \Leftrightarrow x = \pm 6$$

[1 mark]

Answer 16

$$200000 \times 1.015^4 = \text{£}212272.71 \text{ in the account after 4 years}$$

$$\therefore \text{Total interest} = \text{£}12272.71$$

[2 marks]**Answer 17**

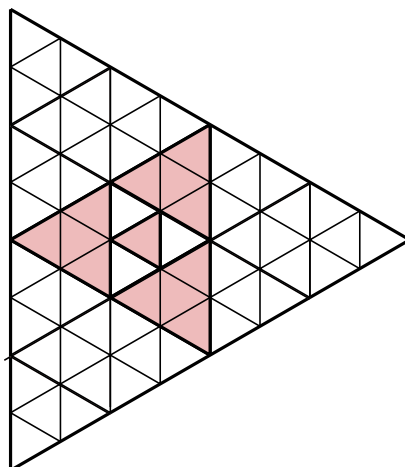
(i) 1.102×10^{18} (This is 1.102 ExaFlops)

[1 mark]

(ii) $\frac{365 \times 24 \times 60 \times 60}{10\,000\,000} = 3.15 \text{ seconds}$

[1 mark]**Answer 18**

$$\text{Radius} = \sqrt{24^2 + 7^2} = 25$$

[1 mark]**Answer 19**

$$\text{Fraction shaded} = \frac{13}{64}$$

[2 marks]**Answer 20**

$$f(f^{-1}(x)) = x$$

[1 mark]**Answer 21**

$$\frac{13}{52} \times \frac{12}{51} \times \frac{11}{50} \times \frac{10}{49} = \frac{11}{4165} \text{ (About 0.00264)}$$

[2 marks]

Twenty-One Today #5

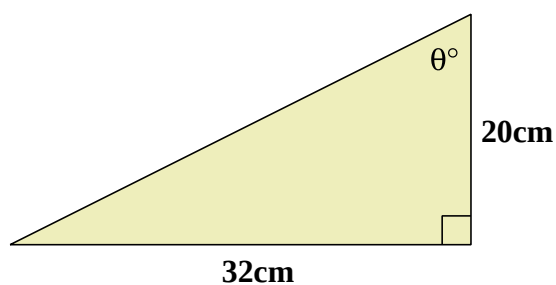
You have thirty-five minutes to answer 21 questions

Marks Available : 40

GCSE Mathematics
Twenty-One Today

Question 1

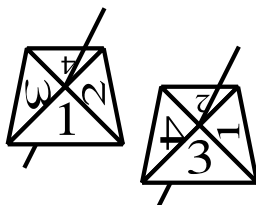
What is size of the angle, θ° , in the following triangle ?



[1 mark]

Question 2

Two four sided spinners are spun, and the numbers given by each added together.



(i) Complete the probability state space diagram to show all possible outcomes.

+	1	2	3	4
1				
2				
3				
4				

[1 mark]

(ii) What is the probability of spinning the most likely score ?

[1 mark]

Question 3

A 3.6 kg catering tin of baked beans has a height of 20 cm.

(That's a lot of beans !)

It is similar to a smaller, 450 g, tin of baked beans.

What is the height of the smaller tin ?

[2 marks]

Question 4

(i) Expand the brackets of $(x + 6)^2$

[1 mark]

(ii) Hence solve the following pair of simultaneous equations,

$$y = (x + 6)^2$$

$$y = x^2$$

[2 marks]

Question 5

What is the gradient of the line $y - 5x = 8$?

[1 mark]

Question 6

Make k the subject of the formula,

$$t = \frac{8 - 3k^2}{5}$$

[2 marks]

Question 7

A warship fires a sea skimming missile.

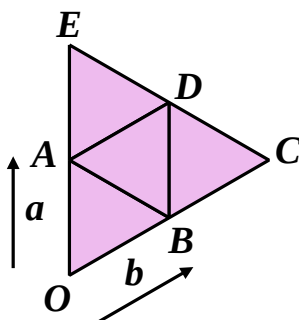
The missile travels at a constant 400 m/s towards a target 5 km away.

(i) What time elapses between missile launch and target impact ?

[1 mark]

(ii) Would the target be able to hear the missile coming ?

[1 mark]

Question 8

Write down in terms of a and b ;

(i) $\overrightarrow{OE}$

(ii) $\overrightarrow{DA}$

(iii) $\overrightarrow{CE}$

(iv) $\overrightarrow{BE}$

[2 marks]

Question 9

A sum of money is to be split between Amy, Mia and Rachael in the ratio 3 : 5 : 7

If Amy gets £225, what is the sum of money being split ?

[1 mark]

Question 10

Given that $p = 6$, $q = -9$ and $r = \frac{1}{3}$ calculate the following,

(i) pqr

(ii) $\frac{pq}{r}$

(iii) $\frac{p - q}{pr^2}$

[2 marks]

Question 11

A class of twenty pupils were asked how much they enjoyed working on the “21 today” revision papers.
Here are the results:

*** ** ** ***** * *** ** *****

***** *** ** ** ***** *** *** *****

*** ** *** ***

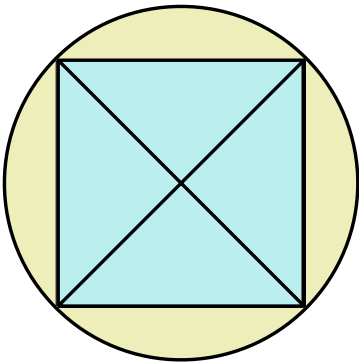
Number of stars	*	**	***	*****	*****
Frequency					

- (i) Fill in the frequency row of the table.
- [1 mark]
- (ii) Calculate the average (mean) star rating of the “21 today” revision papers.

[2 marks]

Question 12

Work out the area of a square drawn inside a circle of diameter 10 cm



[2 marks]

Question 13

Given that y is inversely proportional to the square of x and that y is 48 when x is 5, write down an equation connecting y and x which is of the form $y = \frac{k}{x^2}$ where k is the constant of the proportionality which is to be found.

[1 mark]

Question 14

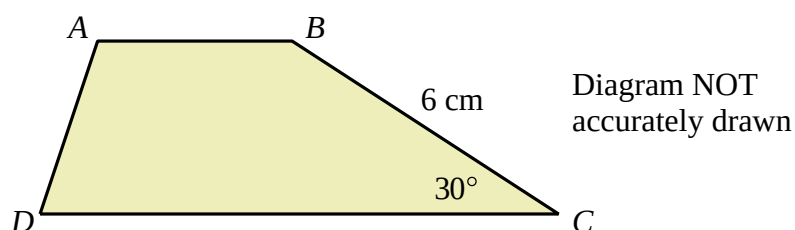
Given that x is an integer, solve the inequality,

$$7 \leq x^2 + 3 < 28$$

[2 marks]

Question 15

Here is a trapezium $ABCD$,



The area of the trapezium is 66 cm^2

the length of AB : the length of $CD = 2 : 3$

Find the length of AB

[4 marks]

Question 16

Solve the equation $x^2 = 16x - 48$

[2 marks]

Question 17

Write without any brackets, $\left(\frac{2\sqrt{x}}{3y^3} \right)^2$

[1 mark]

Question 18

A bag contains 5 red and 7 blue marbles.

First one, and then a second marble is removed from the bag.

What is the probability that both marbles are the same colour ?

[2 marks]

Question 19

George and Mildred buy a house.

The annual rate of house price inflation over the following year is 8%.

At the end of that first year George and Mildred's house is valued at £400000

What did they pay for it when they bought it ?

[1 mark]

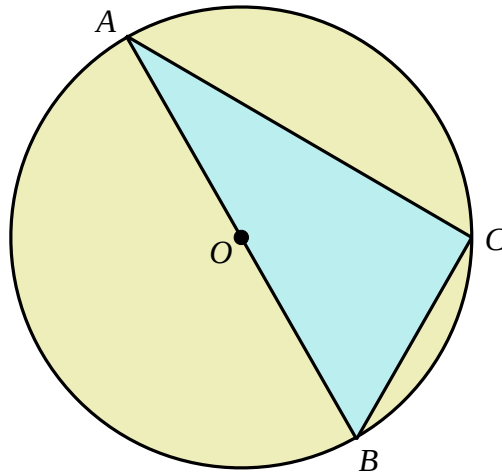
Question 20

From a standard pack of 52 playing cards four are randomly chosen, one after the other WITHOUT REPLACEMENT.

What is the probability that all four cards are picture cards (King, Queen or Jack) ?

[1 mark]

21 Today !



A , B and C are points on the circumference of a circle, centre O
 AOB is a diameter of the circle.

Prove that angle ACB is 90°

You must **not** use any circle theorems in your proof.

[3 marks]

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Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

21 Today #5
Brief Answers

GCSE Mathematics
Twenty-One Today

Answer 1

$$\tan \theta = \frac{32}{20} \Rightarrow \theta = 58^\circ$$

[1 mark]

Answer 2

(i)

+	1	2	3	4
1	2	3	4	5
2	3	4	5	6
3	4	5	6	7
4	5	6	7	8

[1 mark]

(ii) $p(5) = \frac{4}{16} = \frac{1}{4}$

[1 mark]

Answer 3

$$vsf = \frac{450}{3600} = \frac{1}{8} \Leftrightarrow lsf = \frac{1}{2} \quad \text{So height of small can is 10 cm}$$

[2 marks]

Answer 4

(i) $(x + 6)^2 = x^2 + 12x + 36$

[1 mark]

(ii) $(x + 6)^2 = x^2$

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

$$12x + 36 = 0$$

$$x = -3$$

[2 marks]

Answer 5

$$y - 5x = 8 \Leftrightarrow y = 5x + 8 \Rightarrow m = 5$$

[1 mark]

Answer 6

$$t = \frac{8 - 3k^2}{5}$$

$$5t = 8 - 3k^2$$

$$3k^2 = 8 - 5t$$

$$k^2 = \frac{8 - 5t}{3}$$

$$k = \pm \sqrt{\frac{8 - 5t}{3}}$$

[2 marks]**Answer 7**

(i) $\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{5000}{400} = 12.5 \text{ seconds}$

[1 mark]

(ii) You would not hear it coming as the speed of sound is 340 m/s which is less than the 400 m/s the missile is travelling at.

[1 mark]**Answer 8**

(i) $\overrightarrow{OE} = 2\mathbf{a}$ (ii) $\overrightarrow{DA} = -\mathbf{b}$
 (iii) $\overrightarrow{CE} = -2\mathbf{b} + 2\mathbf{a}$ (iv) $\overrightarrow{BE} = -\mathbf{b} + 2\mathbf{a}$

[2 marks]**Answer 9**

Amy's three parts are £225. Each part is worth £75. The 15 parts total is £1125.

[1 mark]**Answer 10**

(i) $pqr = 6 \times (-9) \times \frac{1}{3} = -18$
 (ii) $\frac{pq}{r} = 6 \times (-9) \div \frac{1}{3} = -54 \times 3 = -162$
 (iii) $\frac{p - q}{pr^2} = \frac{6 - (-9)}{6 \times \frac{1}{9}} = \frac{15 \times 3}{2} = 22.5$

[2 marks]**Answer 11****(i)**

Number of stars	*	**	***	****	*****
Frequency	1	6	8	3	2
	1	12	24	12	10

(ii) $\text{mean} = \frac{1 + 12 + 24 + 12 + 10}{20} = \frac{59}{20} = 2.95 \text{ stars}$

[1, 2 marks]

Answer 12

$$\text{Area } \Delta = \frac{1}{2} \times \text{Base} \times \text{Height}$$

$$\text{Area } \square = 4 \times \frac{1}{2} \times 5 \times 5 = 50 \text{ cm}^2$$

[2 marks]**Answer 13**

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

$$48 = \frac{k}{5^2}$$

$$k = 1200 \Rightarrow y = \frac{1200}{x^2}$$

[1 mark]**Answer 14**

$$7 \leq x^2 + 3 < 28$$

$$4 \leq x^2 < 25$$

$$x = \pm 2, \pm 3, \pm 4$$

[2 marks]**Answer 15**

Get the perpendicular distance between the parallel sides, h ,

$$h = 6 \sin 30^\circ$$

$$= 3$$

Let the parallel sides have lengths of $2k$ and $3k$.

$$\text{Area Trapezium} = \frac{1}{2} \text{ sum of parallel sides} \times \text{distance in between}$$

$$66 = \frac{1}{2} (2k + 3k) \times 3$$

$$44 = 5k$$

$$k = 8.8$$

$$\text{length } AB = 2$$

$$= 17.6 \text{ cm}$$

[4 marks]**Answer 16**

$$x^2 = 16x - 48$$

$$x^2 - 16x + 48 = 0$$

$$(x - 4)(x - 12) = 0$$

$$\text{Either } x = 4 \text{ or } x = 12$$

[2 marks]

Answer 17

$$\left(\frac{2\sqrt{x}}{3y^3} \right)^2 = \frac{4x}{9y^6}$$

[1 mark]

Answer 18

$$\begin{aligned} p(\text{same colour pair}) &= p(\text{red, red}) + p(\text{blue, blue}) \\ &= \frac{5}{12} \times \frac{4}{11} + \frac{7}{12} \times \frac{6}{11} \\ &= \frac{20}{132} + \frac{42}{132} \\ &= \frac{62}{132} \\ &= \frac{31}{66} \quad (\text{About } 0.470) \end{aligned}$$

[2 marks]

Answer 19

Let the purchase price of the house be x pounds.

$$x \times 1.08 = 400000$$

$$x = \text{£}370370$$

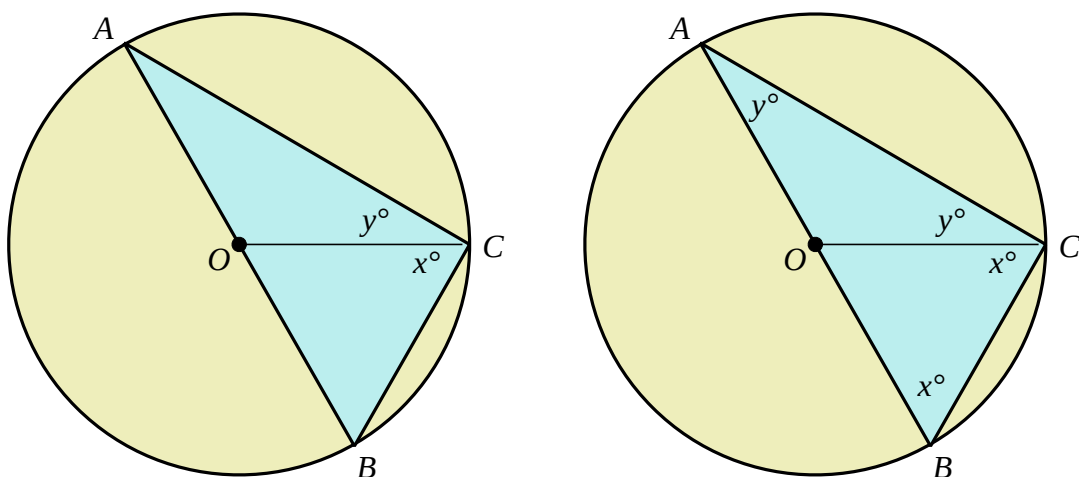
[1 mark]

Answer 20

$$\frac{12}{52} \times \frac{11}{51} \times \frac{10}{50} \times \frac{9}{49} = \frac{99}{54145} \quad (\text{About } 0.00183)$$

[1 mark]

Answer 21



Let $\angle OCB$ be x° and let $\angle OCA$ be y° as shown above, left.

As $\triangle OCB$ and $\triangle OCA$ are isosceles

$\angle OBC$ is x° and $\angle OAC$ is y° as shown, above right.

At the centre $\angle BOC$ is $180 - 2x$ and $\angle AOC$ is $180 - 2y$

Now, angles about a line must sum to 180° and so,

$$180 - 2x + 180 - 2y = 180$$

$$180 = 2x + 2y$$

$$x + y = 90^\circ$$

$$\angle ACB = 90^\circ \quad \square$$

[3 marks]