Name: _____ Class _____ Index Number _____

OUTRAM SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
2022

ESTD 1906

Subject : **Mathematics**

Paper No. : **1**

Level (Stream) : **Secondary Two Express**

Date : **6 October 2022**

Duration : **1 hour 30 minutes**

Marks : **50**

READ THESE INSTRUCTIONS FIRST

Candidates answer on the Question Paper.

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use
50

This document consists of **10** printed pages, including this cover page.

Setter: Ms Chua Yi Ping

Answer **all** the questions.

1 Expand and simplify the following expressions.

(a) $(a-c)(3a+2c)$,

Answer _____ [2]

(b) $(2m+n)^2$.

Answer _____ [1]

---

2 **(a)** Make b the subject of the formula $a=\dfrac{2b-3a}{5-b}$.

Answer _____ [2]

(b) Find the value of b when $a=-1$.

Answer _____ [1]

---

3 **(a)** Factorise $2x^2 - 11x - 21$ completely.

Answer _____ [2]

(b) By factorising $3p^2 + 3p - 6$ completely, explain whether there is any integer p such that $3p^2 + 3p - 6$ is a prime number.

Answer _____

_____ [2]

---

4 It is given that y^2 is inversely proportional to x and $y = 4$ when $x = \frac{1}{2}$.

(a) Find the equation connecting y and x.

Answer _____ [2]

(b) Find the value of x when $y = 6$.

Answer _____ [1]

---

5 3 people can fold 360 pieces of t-shirts in 3 hours.

(a) How long does it take 1 person to fold 480 pieces of t-shirts?

Answer _____ hours [2]

(b) State the assumption that you have made for your answer in part (a).

Answer _____ [1]

---

6 Simplify the following expressions.

(a) $\frac{2xz^3}{x^2-1} \times \frac{3(x-1)}{2x+8xy}$,

Answer _____ [2]

(b) $\frac{5}{(x-6)} - \frac{7}{x^2-4x-12}$.

Answer _____ [3]

---

7 Given that $a-b=5$ and $ab=3$, evaluate a^2+b^2 using algebraic identities.

Answer _____ [2]

---

8 Alina and Chloe were asked to solve the equation $2x(4x+5)=4x(x+1)$. The following showed the partial workings presented by Alina and Chloe:

Alina's partial working:	Chloe's partial working:
$2x(4x+5)=4x(x+1)$	$2x(4x+5)=4x(x+1)$
$8x^2+10x=4x^2+4x$	$8x^2+10x=4x^2+4x$
$4x^2+6x=0$	$4x^2=-6x$
	$4x=-6$

(a) Whose partial working is correct?

Answer _____ [1]

(b) Complete the working for the one you have chosen in part (a) and solve equation to find the value(s) for x.

Answer _____ [2]

---

9 It is given that 3 cm on a map represents 4.5 km on the ground.

(a) Express the scale of the map in the form $1 : n$, where n is an integer.

Answer _____ [1]

(b) The actual length of a road is 12 km. Calculate the length of this road on the map.

Answer _____ cm [1]

(c) On the map, a football field has an area of 6 cm^2. Calculate, in km^2, the actual area of the football field.

Answer _____ km^2 [2]

10 Solve the simultaneous equations.

$$4x - 3y = -7,$$
$$15x - 2y = 20.$$

Answer $x =$ _____ , $y =$ _____ [3]

---

11 There are n balls in a bag. 8 are blue, 4 are green and the rest are yellow.
The probability of drawing a yellow ball is $\frac{1}{3}$.

(a) Find the number of balls in the bag.

Answer _____ [2]

(b) Find the probability of getting either a green or yellow ball.

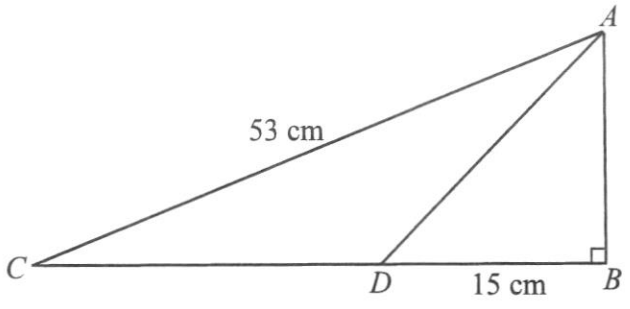
Answer _____ [1]

(c) Find the probability of getting a black ball

Answer _____ [1]

---

12 In triangle ABC, angle $ABC = 90°$. D is a point on BC such that BD is $\frac{1}{3}$ of BC. BD is 15 cm.



(a) Find the length of AB.

Answer _____ cm [2]

(b) Find angle ACB.

Answer _____ ° [2]

(c) Find the area of the triangle ACD.

Answer _____ cm [1]

(d) Find the shortest length from D to AC.

Answer _____ cm [1]

13 A group of swimmers took part in the 50 m freestyle heats. The stem-and-leaf diagram shows the time taken, in seconds, taken by this group of swimmers to complete the heats.

21	8 9 9
22	1 3 3 3 4 5 6 6 7
23	2 6 6 7 7
24	1 5 6

Key: 21 | 8 means 21.8 seconds

(a) Find the number of swimmers who took part in the heats.

Answer _____ swimmers [1]

(b) Find the mean time taken by this group of swimmers.

Answer _____ seconds [2]

(c) Find the median time taken by this group of swimmers.

Answer _____ seconds [1]

(d) Write down the time taken by the fastest swimmer to complete the heats.

Answer _____ seconds [1]

(e) Top 40% of the swimmers will be selected to enter the finals. Write down the timing taken by the last swimmer who qualifies for the finals.

Answer _____ seconds [2]

Name: _____ Class | Index Number

ESTD 1806

OUTRAM SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
2022

Subject	:	**Mathematics**
Paper No.	:	**2**
Level (Stream)	:	**Secondary Two Express**
Date	:	**10 October 2022**
Duration	:	**1 hour 30 minutes**
Marks	:	**50**

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For Examiner's Use
50

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Setter: Mr Charles Yip

[Turn over

Answer **all** the questions.

1 **(a)** List all the prime numbers that satisfy $-4 \leq x < 10$.

Answer ..... [1]

(b) Given that a and b are integers such that $-2 < a \leq 3$ and $1 < b < 6$, find the smallest possible value of ab.

Answer ..... [1]

2 **(a)** Solve $3 - 4x = 24$.

Answer $x =$ ..... [1]

(b) **(i)** Solve the inequality $\frac{9-2x}{2} > \frac{x+1}{4}$.

Answer ..... [2]

(ii) Represent the solution in **(b)(i)** on the number line below.

[1]

3 Factorise completely

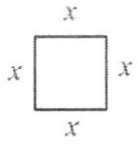
(a) $12pq-3pr+8q-2r$,

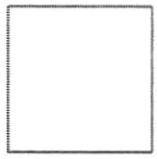
Answer ..... [2]

(b) $4-25y^2$.

Answer ..... [2]

4 An 80 cm string is cut into two pieces of different lengths.
Each of the two strings is used to form a square.
The length of the smaller square is x cm.





(a) Find the length of the larger square in terms of x.

Answer ..... cm [1]

(b) The total area of the two squares is 250 cm^2.

(i) Form an equation in x to represent the information and show that it reduces to $x^2 - 20x + 75 = 0$. [2]

(ii) Solve the equation $x^2 - 20x + 75 = 0$.

Answer $x =$ ..... or ..... [2]

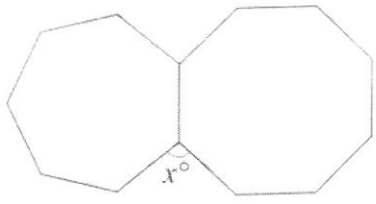
(iii) Hence, find the area of the smaller square.

Answer ..... cm^2 [1]

5 **(a)** Each interior angle of an n-sided polygon is 156°.
Find the number of sides of the n-sided polygon.

Answer ..... [2]

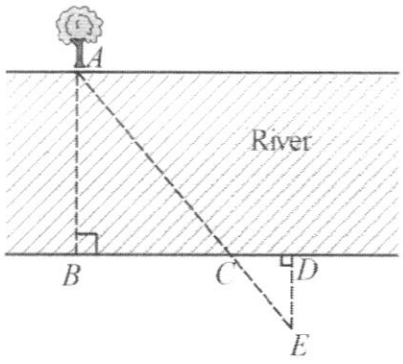
(b) The figure is made up of a heptagon and an octagon of equal sides.



Find x.

Answer ..... [3]

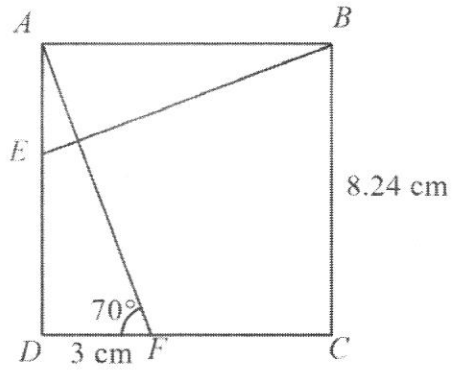
6 (a)



Point B is directly opposite a tree at point A.
You walked 18 paces from point B to point C along the river bank.
You then walked 6 paces from point C to point D.
You walked a further 5 paces back from the river bank to reach point E so that that A, C and E form a straight line. Triangle ABC is similar to triangle EDC.
If each pace is 30 cm, find the width, AB, of the river bank.

Answer ..... cm [3]

(b)



ABCD is a square of side 8.24 cm.
Triangle *ADF* is congruent to triangle *BAE*.
Angle $AFD = 70°$ and $DF = 3$ cm.
Find

(i) angle *ABE*,

Answer ..... [2]

(ii) the length of *ED*,

Answer ..... cm [1]

(iii) the area of triangle *ABE*.

Answer ..... cm^2 [1]

7 **(a)** If $540k$ is a perfect square, find the integer value of k.

Answer ..... [2]

(b) Two numbers p and q are written as the product of their prime factors.

$$p = 2^3 \times 3 \times 7$$

$$q = 2^2 \times 3^2 \times 5$$

Find

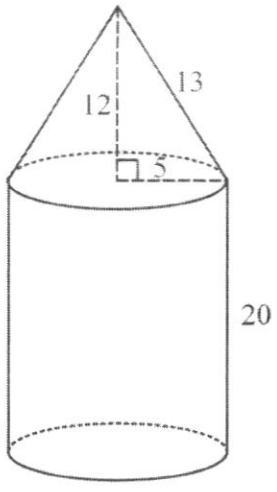
(i) the highest common factor of p and q,

Answer ..... [1]

(ii) the lowest common multiple of p and q.

Answer ..... [1]

8



The diagram shows a solid made from a cone and a cylinder.
The height of the cone is 12 cm and the height of the cylinder is 20 cm.
The cone and cylinder have a radius of 5 cm. The slant height of the cone is 13 cm.
Find

(a) the volume of the solid,

Answer ..... cm^3 [3]

(b) the total surface area of the solid.

Answer ..... cm^2 [3]

9 Kent threw a basketball at a basketball hoop.
The height, h m, of the ball from the ground after t seconds can be modelled by the equation

$$h = 2 + 6t - 5t^2 .$$

Some corresponding values of t and h are given in the following table.

t	0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.5
h	2	3	3.6	3.8	3.6	3	2	a	–0.25

(a) Find the value of a.

Answer ..... [1]

(b) On the grid on the next page, draw the graph of $h = 2 + 6t - 5t^2$ for $0 \le t \le 1.5$. [3]

(c) **Use your graph** to find

(i) the height the ball after 1.1 seconds,

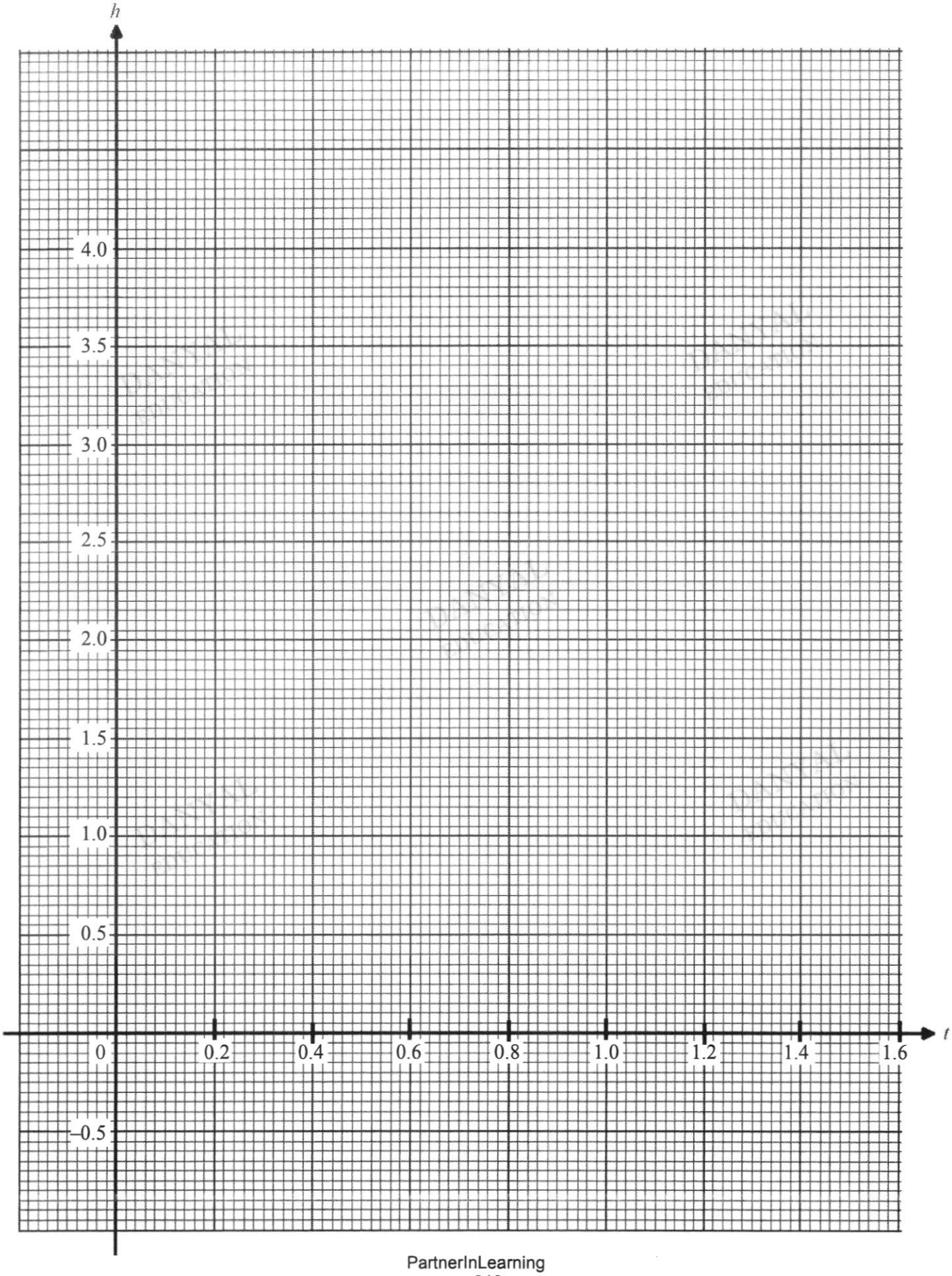
Answer ..... m [1]

(ii) the time when the ball reached the ground,

Answer ..... s [1]

(iii) the equation of the line of symmetry.

Answer ..... [1]


h
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
t
–0.5

10 Kimberly purchased the following products from a supermarket.

2-litre cooking oil
Usual Price $5.90

Special offer
Buy 2 and get $1.80 off

5-kg Rice
Usual Price $8.50

Special offer
Special price: $6.80 Now

All prices are inclusive of 7% GST.
Enjoy a further 10% discount using any credit card.

Kimberly bought the following quantity from the supermarket using a credit card.

Product	**Quantity**
2-litre cooking oil	8
5-kg rice	3

(a) Which product offers a greater percentage in discount?
Show your workings clearly.

Answer ..... [3]

(b) Find the amount charged to her credit card.

Answer $ ..... [2]

--- End of Paper ---

(b) Find the amount charged to her credit card.

Answer $ ..... [2]

--- End of Paper ---

16

Answer **all** the questions.

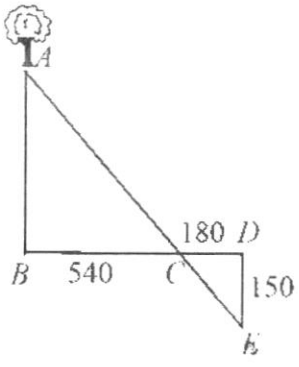
1a	2, 3, 5, 7	[B1]
b	-5	[B1]

2a	$3-4x=24$ $-4x=21$ $-x=5.25$ $x=-5.25$	[M1] [A1]
bi	$\frac{9-2x}{2}>\frac{x+1}{4}$ or $\frac{18-4x}{4}>\frac{x+1}{4}$ $36-8x>2x+2$ or $18-4x>x+1$ $34>10x$ $17>5x$ $x<3.4$ $x<3.4$	[M1] [A1]
bii		[B1] (ecf)

3a	$12pq-3pr+8q-2r$ $=3p(4q-r)+2(4q-r)$ $=(3p+2)(4q-r)$	[M1] [A1]
b	$4-25y^2$ $=(2+5y)(2-5y)$	[B2]

4a	Length of longer piece $=80-4x$ Length of each side of larger square $=\frac{80-4x}{4}$ $=20-x$	[B1 no need to simplify]
bi	$x^2+(20-x)^2=250$ $x^2+400-40x+x^2=250$ $2x^2-40x+150=0$ $x^2-20x+75=0$	[M1] ecf [M1 – expanding correctly] [minus 1m if never simplify]
bii	$x^2-20x+75=0$ $(x-15)(x-5)=0$ $x=5$ *or* $x=15$	[B2]
biii	$5^2=25$	[B1]

5a	$ext\angle = 180 - 156$ $= 24$ $n = \frac{360}{24}$ $= 15$ $(n-2)\times 180 = 156n$ $180n - 360 = 156n$ $24n = 360$ $n = \frac{360}{24}$ $= 15$	M1 A1 – accept guess and check
b	$\frac{(7-2)\times 180}{7} = 128.6$ $\frac{(8-2)\times 180}{8} = 135$ $x = 360 - 128.6 - 135$ $= 96.4°$	M1 for either 128.6 or 135 M1 for 360 minus the 2 angles A1

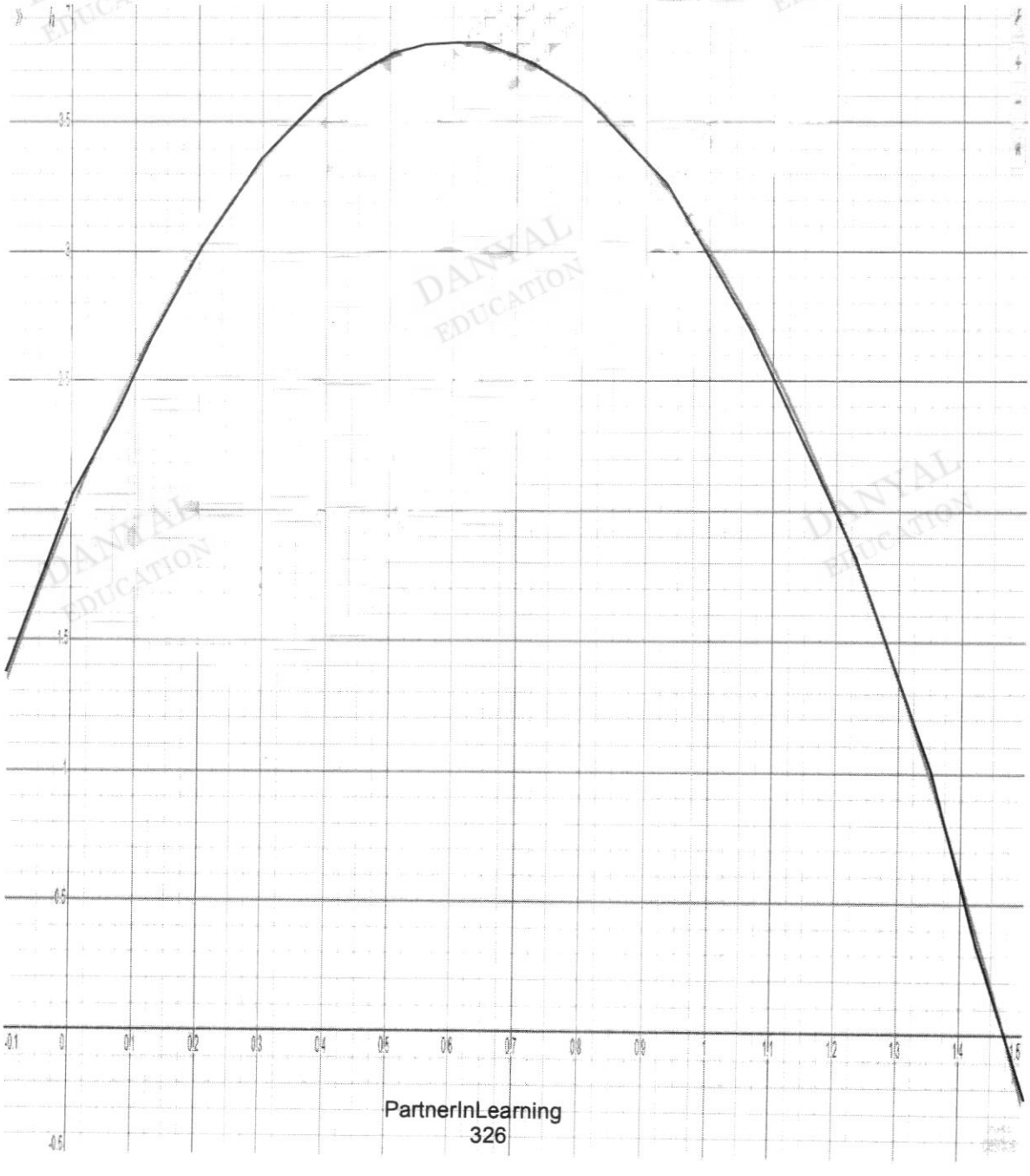
6(a)	$\frac{AB}{150}=\frac{540}{180}$ $AB=450$ *or* $\frac{AB}{5}=\frac{18}{6}$ $AB=15$ paces 15×30 $=450$ cm  	M1 – 150, 540, 180 M1 – Ratio A1 OR M1 M1 – multiply by 30 A1
(bi)	$\angle ABE=180-90-70$ $=20°$ Accepts $\tan\angle ABE=\frac{3}{8.24}$ $\angle ABE=20.0°$	M1 A1
(bii)	6 cm	B1
(biii)	$Area=\frac{1}{2}\times3\times9$ $=13.5$	 B1

7a	$540=2^2\times3^3\times5$ $k=3\times5$ $=15$	[M1] [A1]
b	$p=2^3\times3\times7$ $q=2^2\times3^2\times5$ $HCF=2^2\times3$ $=12$ $LCM=2^3\times3^2\times5\times7$ $=2520$	 [B1] [B1] – minus 1m if either or both leave as index form

8a	$Vol=\frac{1}{3}\pi(5)^2(12)+\pi(5)^2(20)$ $=314.159+1570.796$ $=1884.96$ *or* 1880	[M2] [A1]

b	$A = \pi(5)(13) + 2\pi(5)(20) + \pi(5)^2$ $= 204.2035 + 628.3185 + 78.5398$ $= 911$	[M2] for cone and cylinder. Minus 1 mark if no area of circle [A1]

9(a)	$a = 0.6$	B1
(b)	8 correct points 2m 7 correct points 1m Smooth curve	B2 B1
(ci)	$h = 2.55 \pm 0.05$	B1
(cii)	$t = 1.47 \pm 0.03$	B1
(ciii)	$t = 0.6$	B1 – accept $x = 0.6$ but highlight error



10a	Cooking oil original price = 5.90×2 $= \$11.80$ After discount = $11.80 - 1.80$ $= \$10$ percentage discount = $\frac{11.8-10}{11.8} \times 100\%$ $= 15.25\%$ Rice percentage discount = $\frac{8.50-6.80}{8.50} \times 100\%$ $= 20\%$ Rice has a higher percentage in discount.	[M1] for 15.25% [M1] for 20% [A1] ecf based on the two %
b	8 cooking oil = $(5.90 \times 8) - 4(1.80)$ $= \$40$ 3 rice = (6.80×3) $= \$20.40$ Amount charged = $(40 + 20.40) \times 0.9$ $= \$54.36$	[M1] for multiplying 0.9 or equivalent. It is okay to get (40+20.40) wrong A1

--- End of Paper ---

Name: Mark Scheme. Class Index Number

OUTRAM SECONDARY SCHOOL
END-OF-YEAR EXAMINATION
2022

ESTD 1905

Subject	:	**Mathematics**
Paper No.	:	1
Level (Stream)	:	**Secondary Two Express**
Date	:	6 October **2022**
Duration	:	**1 hour 30 minutes**
Marks	:	**50**

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Setter: Ms Chua Yi Ping

Answer **all** the questions.

1 Expand and simplify the following expressions.

(a) $(a-c)(3a+2c)$,

$= 3a^2 + 2ac - 3ac - 2c^2$ (m1)

$= 3a^2 - ac - 2c^2$

Answer $3a^2 - ac - 2c^2$ [2]

(b) $(2m+n)^2$.

Answer $4m^2 + 4mn + n^2$ [1]

---

2 **(a)** Make b the subject of the formula $a = \frac{2b-3a}{5-b}$.

$a(5-b) = 2b - 3a$.

$5a - ab = 2b - 3a$

$5a + 3a = 2b + ab$

$8a = b(2+a)$

$\frac{8a}{(2+a)} = b$

Answer $b = \frac{8a}{(2+a)}$ [2]

(b) Find the value of b when $a = -1$.

$b = \frac{8(-1)}{(2+(-1))}$

$b = \frac{-8}{1}$

$b = -8$

Answer -8 [1]

---

3 (a) Factorise $4x^2 - 22x - 42$. $2x^2 - 11x - 21$ completely. 3

	x	-7
$2x$	$2x^2$	$-14x$
3	$3x$	-21

Answer $(x-7)(2x+3)$ [2]

(b) By factorising $3p^2+3p-6$, fully explain whether there is any integer p such that $3p^2+3p-6$ is a prime number.

$3p^2+3p-6 = 3(p^2+p-2)$

$= 3(p+2)(p-1)$

Answer There is no integer p such that $3p^2+3p-6$ is a prime number because $3p^2+3p-6$ is always a multiple of 3. [2]

4 It is given that y^2 is inversely proportional to x and $y=4$ when $x=\frac{1}{2}$.

(a) Find the equation connecting y and x.

$y^2 = \frac{k}{x}$ where k is a constant

$4^2 = \frac{k}{\frac{1}{2}}$

$8 = k$

Answer $y^2 = \frac{8}{x}$ [2]

(b) Find the value of x when $y=6$.

$(6)^2 = \frac{8}{x}$

$x = \frac{8}{36}$

Answer $\frac{2}{9}$ [1]

5 3 people can fold 360 pieces of t-shirts in 3 hours.

(a) How long does it take 1 person to fold 480 pieces of t-shirts?

3 people → 360 → 3 hours.

1 person → 120 → 3 hours. (M1)

1 person → 480 → 12 hours.

Answer 12 hours. [2]

(b) State the assumption that you have made for your answer in part (a).

Answer Assume that all of the people have the same folding speed. [1]

6 Simplify the following expressions.

(a) $\frac{2xz^3}{x^2-1} \times \frac{3(x-1)}{2x+8xy}$,

$= \frac{2xz^3}{(x+1)(x-1)} \times \frac{3(x-1)}{2x(1+4y)}$ (M1 - factorising x^2-1 or $2x+8xy$)

$= \frac{3z^3}{(x+1)(1+4y)}$

Answer $\frac{3z^3}{(x+1)(1+4y)}$ [2]

(b) $\frac{5}{(x-6)} - \frac{7}{x^2-4x-12}$

$\frac{5}{(x-6)} - \frac{7}{(x-6)(x+2)}$ → (M1)

$= \frac{5(x+2) - 7}{(x-6)(x+2)}$ (M1)

$= \frac{5x+10-7}{(x-6)(x+2)}$

$= \frac{5x+3}{(x-6)(x+2)}$

Answer $\frac{5x+3}{(x-6)(x+2)}$ (A1) [3]

7 Given that $a-b=5$ and $ab=3$, evaluate a^2+b^2 using algebraic identities.

$(a-b)^2 = a^2-2ab+b^2$ (M1)

$5^2 = a^2+b^2-2(3)$

$31 = a^2+b^2$

Answer 31 (A1) [2]

---

8 Alina and Chloe were asked to solve the equation $2x(4x+5)=4x(x+1)$. The following showed the partial workings presented by Alina and Chloe:

Alina's partial working:
$2x(4x+5)=4x(x+1)$
$8x^2+10x=4x^2+4x$
$4x^2+6x=0$

Chloe's partial working:
$2x(4x+5)=4x(x+1)$
$8x^2+10x=4x^2+4x$
$4x^2=-6x$
$4x=-6$

(a) Whose partial working is correct?

Answer Alina's [1]

(b) Complete the working for the one you have chosen in part (a) and solve equation to find the value(s) for x.

$4x^2+6x=0$

$2x(2x+3)=0$

$2x=0$ or $(2x+3)=0$

$x=0$ or $x=-\frac{3}{2}$

Answer $x=0$ or $x=-\frac{3}{2}$ (B2) [2]

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9 It is given that 3 cm on a map represents 4.5 km on the ground.

(a) Express the scale of the map in the form $1 : n$, where n is an integer.

3 cm : 450 000

1 : 150 000

Answer 1 : 150000 [1]

(b) The actual length of a road is 12 km. Calculate the length of this road on the map.

1 cm : 150 000 cm

8 cm : 1200 000 cm

Answer 8 cm [1]

(c) On the map, a football field has an area of 6 cm^2. Calculate in km^2, the actual area of the football field.

1 cm : 1.5 km

$1\ cm^2 : 2.25\ km^2$

$6\ cm^2 : 13.5\ km^2$

Answer 13.5 km^2 [2]

10 Solve the simultaneous equations.

$4x - 3y = -7, \quad -(1)$

$18x - 2y = 20. \quad -(2)$

Sub $x = 2$ into (1)

$4(2) - 3y = 7$

$4(2) + 7 = 3y$

$15 = 3y$

$5 = y$

(1) × 2 $\Rightarrow 8x - 6y = -14 \quad -(3)$

(2) × 3 $\Rightarrow 45x - 6y = 60 \quad -(4)$

(3) − (4)

$8x - 45x = -14 - 60$

$-37x = -74$

$x = 2.$

Answer $x =$ 2 , $y =$ 5 [3]

11 There are n balls in a bag. 8 are blue, 4 are green and the rest are yellow.
The probability of drawing a yellow ball is $\frac{1}{3}$.

(a) Find the number of balls in the bag.

$\frac{2}{3} = \frac{8+4}{n}$ (M1)

$2n = 3(12)$

$n = 18$

(A1)

Answer 18 [2]

(b) Find the probability of getting either a green or yellow ball.

Yellow = $18 - 8 - 4$

$= 6$

P(green or yellow) = $\frac{4+6}{18}$

$= \frac{10}{18}$

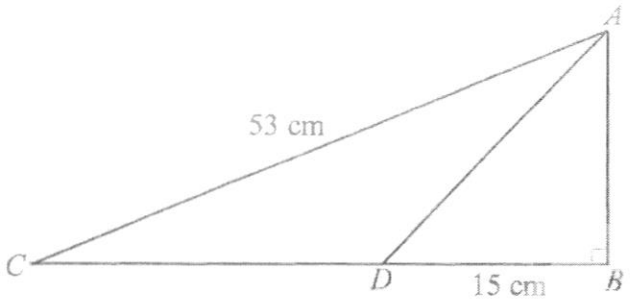
Answer $\frac{5}{9}$ [1]

(c) Find the probability of getting a black ball

$\frac{5}{9}$

Answer 0 [1]

12 In triangle ABC, angle $ABC = 90°$. D is a point on BC such that BD is $\frac{1}{3}$ of BC. BD is 15 cm.



(a) Find the length of AB.

$BC = 45cm$.

$AB^2 = AC^2 - BD^2$ (Pythagoras' thm)

$AB^2 = 53^2 - 45^2$ (M1)

$AB = 28$ cm

Answer 28 cm [2]

(b) Find angle ACB.

$\sin A\hat{C}B = \frac{AB}{AC}$

$\sin A\hat{C}B = \frac{28}{53}$ (M1)

$A\hat{C}B = \sin^{-1}\left(\frac{28}{53}\right)$

$= 31.891$

Answer 31.9° [2]

(c) Find the area of the triangle ACD.

Area of triangle ACD

$= \frac{1}{2} \times$ base $\times$ height

$= \frac{1}{2} \times 30 \times 28$

$= 420$ cm.

Answer 420 cm. [1]

(d) Find the shortest length from D to AC.

$\frac{1}{2} \times AC \times ht = 420$

$\frac{1}{2} \times 53 \times ht = 420$

$ht = 15.849$

$ht = 15.8$ (3sf) cm.

Answer 15.8 cm [1]

13 A group of swimmers took part in the 50 m freestyle heats. The stem-and-leaf diagram shows the time taken, in seconds, taken by this group of swimmers to complete the heats.

21	8 9 9
22	1 3 3 3 4 5 6 6 7
23	2 6 6 7 7
24	1 5 6

Key: 21 | 8 means 21.8 seconds

(a) Find the number of swimmers who took part in the heats

Answer 20 swimmers [1]

(b) Find the mean time taken by this group of swimmers.

(M1) $\{(21.8 + 2(21.9) + 22.1 + 3(22.3) + 22.4 + 22.5 + 2(22.6) + 22.7 + 23.2 + 2(23.6) + 2(23.7) + 24.1 + 24.5 + 24.5) \div 20$

Answer 22.915 seconds [2]

(c) Find the median time taken by this group of swimmers.

Answer 22.6 seconds. [1]

(d) Write down the time taken by the fastest swimmer to complete the heats.

Answer 21.8 seconds [1]

(e) Top 40% of the swimmers will be selected to enter the finals. Write down the timing taken by the last swimmer who qualifies for the finals.

40% x 20 = 8 (M1)

Answer 23.2 seconds [2]

End of Paper