b



| Class | Register Number | Name |
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| | | |

# Bukit Batok Secondary School
# First Semestral Examination 2016
## Secondary 2 Express

## MATHEMATICS
Paper 1

Date 11 May 2016
Time 07 45 – 09 00
1 hour 15 min

Candidates answer on the Question Paper.

**READ THESE INSTRUCTIONS FIRST**

Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a 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.

**Calculators must not be used in this paper.**
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 $\pi$, use either your calculator value or 3.142, unless the question requires the answer in terms of $\pi$.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **40**.

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**ANSWER ALL QUESTIONS ( 40 marks )**

1 Given that $72\,000 = 2^6 \times 3^2 \times 5^3$ and $135\,000 = 2^3 \times 3^3 \times 5^4$, find the largest integer that is a factor of both 72 000 and 135 000.

Answer _____[2]

---

2 Consider the following numbers.

1, $\sqrt{3}$, 2, 3, $\pi$, 5, 23, 51

(a) Identify the prime number(s).

(b) Identify the number(s) that are not rational.

Answer (a) _____[1]

Answer (b) _____[1]



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3 Solve the equation $(x + 3)^2 = 49$.

Answer _____[2]

---

4 The lowest common multiple of 60, 156 and $n$ is 10920. Find the smallest possible value of $n$.

$$60 = 2^2 \times 3 \times 5$$
$$156 = 2^2 \times 3 \times 13$$
$$10920 = 2^3 \times 3 \times 5 \times 7 \times 13$$

Answer $n =$ _____[2]



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5 In a particular factory, a machine takes 5 minutes to churn out a stitched book. How many machines are needed to churn out 50 stitched books in 10 minutes?

Answer _____ machines [2]

6 Using special identities, evaluate $99 \times 101$.

Answer _____ [2]

7 Express each of the following as a fraction with a single denominator.

(a) $\frac{1}{x}+\frac{1}{3x}$

Answer (a)_____[1]



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7 (b) $\frac{2}{x}+2x$

Answer (b)_____[2]

---

8 Solve the equation $x-5=\frac{8-16x}{4x}$.

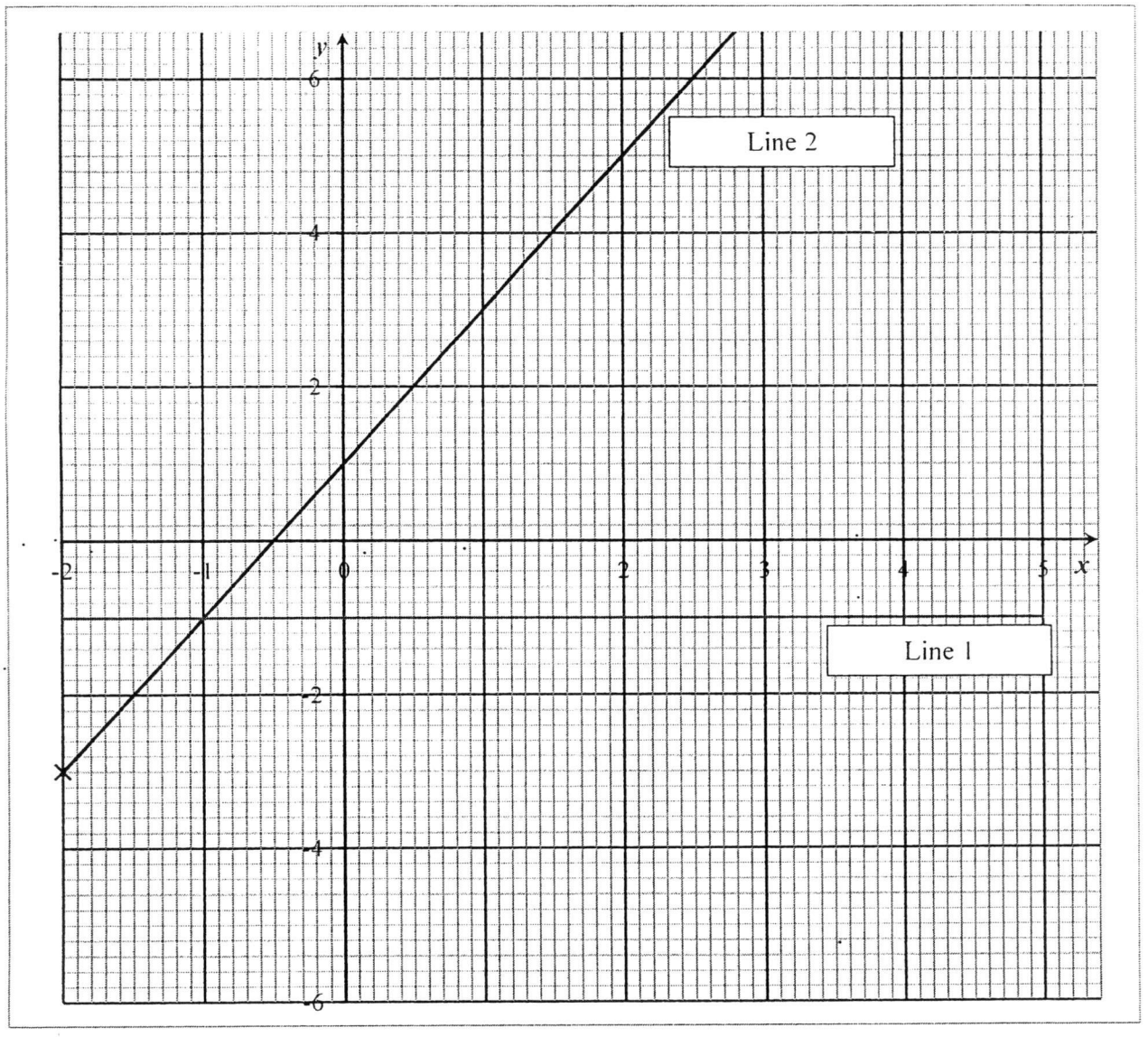
Answer _____[3]



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9 For the following graph, state the equations of




(a) Line 1,

(b) Line 2.

Answer (a) _____[1]

Answer (b) _____[2]



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10 Solve the following pair of simultaneous equations.

$$2x + y = 10$$
$$y - 2x = 12$$

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

---

11 Expand and simplify each of the following expressions.

(a) $(x - 1)(2x - 1)$

(b) $-(4 - y^2) + 2y^2 + 5$

Answer (a) _____ [2]

Answer (b) _____ [2]



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12 If $P$ is inversely proportional to the square root of $Q$ and $P = 2.5$ when $Q = 4$, find

(a) an equation connecting $P$ and $Q$,
(b) the value of $Q$ when $P = 10$.

Answer (a) _____[2]

Answer (b) _____[2]

---

13 Factorise the following expressions completely.

(a) $4x^2 + 2x - 12$

(b) $p^2 - 3p + pq - 3q$

Answer (a) _____[2]

Answer (b) _____[2]



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14 (a) Factorise $x^2 + y^2 + 2xy$.

(b) Hence, simplify $\frac{x^2+y^2-z^2+2xy}{x^2-(y^2+z^2-2yz)}$.

Answer (a) _____[1]

Answer (b) _____[3]

End of Paper 1
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# Bukit Batok Secondary School
# First Semestral Examination 2016
## Secondary 2 Express

## MATHEMATICS
Paper 2

Date 11May 2016
Time 09 45 – 11 15
1 hour 30 min

Additional Material: Writing Paper & Graph Paper

**READ THESE INSTRUCTIONS FIRST**

Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen in the foolscap papers provided.
You may use a 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.

Calculators should be used 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 $\pi$, use either your calculator value or 3.142, unless the question requires the answer in terms of $\pi$.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **60**.

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**Answer all questions (60 marks)**

1 Simplify $\frac{3a^2b}{4c} \div \frac{9ab}{8bc^3}$ [3]

2 (a) The table below shows some values of the variables $M$ and $N$. It is given that $M$ is directly proportional to the cube of $N$. [3]
Find the values of $x$ and $y$.

| | | | |
|---|---|---|---|
| $M$ | 4 | $x$ | 256 |
| $N$ | 2 | 4 | $y$ |

(b) 3 taps are used to fill an aquarium. If one more tap is used, the aquarium can be filled 6 minutes earlier. Assuming that water flows out from all the taps at the same rate, how many more taps should be deployed so that the tank can be filled 15 minutes earlier? [3]

3 Expand and simplify the following expressions.

(a) $(2x + 5y)(3x - 2y) + (x - 2y)^2$ [3]

(b) $2(3a - b)(5a - 2b) - 3a(2a - 3b)$ [3]

4 (a) Solve the following simultaneous equations. [4]

$$3x + y = 3$$

$$\frac{2}{3x+y} = \frac{1}{y}$$

(b) A two-digit number is such that the sum of its digits is $\frac{1}{7}$ of the number. [4]
When the digits of the number are reversed and the number is subtracted from the original number, the result is 36. Find the original two-digit number.



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5 (a) Factorise $x^3 - x^2 - x + 1$ completely. [3]

(b) (i) Factorise $p^2 - 169$. [2]

(ii) Hence, find two factors of 731, other than 1 and 731. [3]

6 (a) A rectangle has a length of $(x + 3)$ m and an area of $(x^2 + x - 6)$ m$^2$. [2]
Find an expression for the breadth of the rectangle and simplify.

(b) For a secondary 2 VIA trip, some form teachers and students walked 500 m from the school to a bus stop (so as to board a bus) at an average speed of $x$ km/h. After the VIA activity, they returned by the same route and walked from the same bus stop back to school, but at an average speed of 5 km/h slower than the earlier trip.

(i) Express, in terms of $x$, the time in hours that the team took for the return journey. [1]

(ii) Given that the difference between the two times was 1 minute, form an equation in $x$ and show that it reduces to $x^2 - 5x - 150 = 0$. [3]

(iii) Solve the equation $x^2 - 5x - 150 = 0$. [2]

(iv) Find the average speed (in km/h) of the return journey from the bus stop to school. [1]

Note: Total Distance = Average Speed × Total Time

7 (a) Express $\frac{5}{(2x-3)(x+2)} - \frac{1}{(x+2)(3x-1)}$ as a fraction in its simplest form. [3]

(b) Solve $\frac{3}{x+3} - \frac{2}{x+2} = \frac{1}{12}$. [4]

(c) Make $t$ the subject of the formula $S = \sqrt{\frac{2t-p}{t-q}}$ [3]



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8 **Answer the whole of this question on a sheet of graph paper.**

The variables $x$ and $y$ are connected by the equation $y = \frac{x^2}{2} - 2x$ and some corresponding values are given in the following table.

| $x$ | −1 | 0 | 0.5 | 1 | 2 | 3 | $a$ | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| $y$ | 2.5 | 0 | −0.9 | −1.5 | −2 | −1.5 | 0 | 2.5 | $b$ |

(a) Calculate the value of $a$ and of $b$. [2]

(b) Taking 2 cm to represent 1 unit on each axis, draw the graph of $y = \frac{x^2}{2} - 2x$ [3]

for values of $x$ in the range $-1 \leq x \leq 6$.

(c) Find, from the graph,

(i) the value of $y$ when $x = 4.7$, [1]

(ii) the values of $x$ when $y = -1$. [1]

(d) On the same axes, draw the graph of the straight line $y = 2 - \frac{x}{2}$ and use your graphs to solve the equation $\frac{x^2}{2} - 2x = 2 - \frac{x}{2}$. [3]

End of Paper



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**ANSWER ALL QUESTIONS ( 40 marks )**

1 Given that $72000 = 2^6 \times 3^2 \times 5^3$ and $135\,000 = 2^3 \times 3^3 \times 5^4$, find the largest integer that is a factor of both 72 000 and 135 000.

HCF $= 2^3 \times 3^2 \times 5^3$ M1

Answer 9000 A1 [2]

---

2 Consider the following numbers.

$1, \sqrt{3}, 2, 3, \pi, 5, 23, 51$

(a) Identify the prime number(s).

(b) Identify the number(s) that are not rational.

Answer (a) 2, 3, 5, 23 B1 [1]

Answer (b) $\sqrt{3}, \pi$ B1 [1]

3 Solve the equation $(x + 3)^2 = 49$.

$x + 3 = \pm 7$ M1

Answer $x = -10$ or $x = 4$ A1 [2]

---

4 The lowest common multiple of 60, 156 and $n$ is 10920. Find the smallest possible value of $n$.

$60 = 2^2 \times 3 \times 5$

$156 = 2^2 \times 3 \times 13$

$10920 = 2^3 \times 3 \times 5 \times 7 \times 13$

Smallest $n = 2^3 \times 7$

Answer $n =$ 56 A1 [2]

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5 In a particular factory, a machine takes 5 minutes to churn out a stitched book. How many machines are needed to churn out 50 stitched books in 10 minutes?

| No. of machine(s) | Time (minutes) | No. of pair(s) of jeans |
|---|---|---|
| 1 | 5 | 1 |
| 1 | 10 | 2 |
| 25 | 10 | 50 |

M1 for working

Answer 25 A1 machines [2]

6 Using special identities, evaluate $99 \times 101$.

$101 \times 99 = (100 + 1)(100 - 1)$ M1

$= 100^2 - 1^2$

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Answer 9999 A1

7 Express each of the following as a fraction with a single denominator.

(a) $\frac{1}{x} + \frac{1}{3x}$

Answer (a) $\frac{4}{3x}$ B1 [1]

(b) $\frac{2}{x} + 2x$

$\frac{2}{x} + 2x = \frac{2}{x} + \frac{2x^2}{x}$ M1

Answer (b) $\frac{2(x^2+1)}{x}$ or $\frac{2x^2+2}{x}$ A1 [2]

8 Solve the equation $x - 5 = \frac{8-16x}{4x}$.

$x - 5 = \frac{8-16x}{4x}$

$x - 5 = \frac{2-4x}{x}$

$x^2 - 5x + 4x - 2 = 0$ M1 (for simplifying to quad. Eqn. i.e. no more fraction)

$x^2 - x - 2 = 0$

$(x - 2)(x + 1) = 0$ M1 (correct factorization)

Answer $x = 2$ A1 or $x = -1$ A1

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9 For the following graph, state the equations of

(a) Line 1,

(b) Line 2.

(b) gradient = 2 **M1**

Answer (a) $y = -1$ **B1** [1]

Answer (b) $y = 2x + 1$ **A1** [2]

---

10 Solve the following pair of simultaneous equations.

$2x + y = 10$ ----------(1)
$y - 2x = 12$ ----------(2)

Eqn (1) – eqn (2)

$4x = -2$ **M1** for first correct elimination/substitution

Answer $x = -0.5$ **A1** $y = 11$ **A1** [3]

11 Expand and simplify each of the following expressions.

(a) $(x - 1)(2x - 1)$

(b) $-(4 - y^2) + 2y^2 + 5$

(a) $(x - 1)(2x - 1) = 2x^2 - x - 2x + 1$ **M1**

(b) $-(4 - y^2) + 2y^2 + 5 = -4 + y^2 + 2y^2 + 5$ **M1**

Answer (a) $2x^2 - 3x + 1$ **A1** [2]

Answer (b) $3y^2 + 1$ **A1** [2]

---

12 If $P$ is inversely proportional to the square root of $Q$ and $P = 2.5$ when $Q = 4$, find

(a) an equation connecting $P$ and $Q$.
(b) the value of $Q$ when $P = 10$.

(a) $P\sqrt{Q} = k$
$k = 2.5 \times \sqrt{4} = 5$ **M1** for $k = 5$

(b) $P\sqrt{Q} = 5$
$10\sqrt{Q} = 5$
$\sqrt{Q} = \frac{1}{2}$ **M1**

Answer (a) $P\sqrt{Q} = 5$ **A1** [2]

Answer (b) $Q = \frac{1}{4}$ **A1** [2]

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13 Factorise the following expressions completely.

(a) $4x^2 + 2x - 12$

(b) $p^2 - 3p + pq - 3q$

(a) $4x^2 + 2x - 12 = 2(2x^2 + x - 6)$

$2x \times -3$

$x \times 2$

$-3x + 4x = x$

(M1 for cross method or multiplication frame)

(b) $p^2 - 3p + pq - 3q = p(p - 3) + q(p - 3)$ M1

Answer (a) $2(2x - 3)(x + 2)$ A1 [2]

Answer (b) $(p - 3)(p + q)$ A1 [2]

14 (a) Factorise $x^2 + y^2 + 2xy$.

(b) Hence, simplify $\frac{x^2+y^2-z^2+2xy}{x^2-(y^2+z^2-2yz)}$.

(a) $x^2 + y^2 + 2xy = (x + y)^2$ B1

(b) $\frac{x^2+y^2-z^2+2xy}{x^2-(y^2+z^2-2yz)} = \frac{(x+y)^2-z^2}{x^2-(y-z)^2}$ M1 (for denomerator)

$= \frac{(x+y-z)(x+y+z)}{[x-(y-z)][x+(y-z)]}$ M1 (for applying identity $a^2 - b^2 = (a - b)(a + b)$)

$= \frac{(x+y-z)(x+y+z)}{(x-y+z)(x+y-z)}$

Answer $\frac{x+y+z}{x-y+z}$ A1

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**ANSWER ALL QUESTIONS** ( 60 marks )

1 Simplify $\frac{3a^2b}{4c} \div \frac{9ab}{8bc^3}$ [3]

$\frac{3a^2b}{4c} \div \frac{9ab}{8bc^3} = \frac{3a^2b}{4c} \times \frac{8bc^3}{9ab}$ M1

$= \frac{2abc^2}{3}$ M1 (working for dividing)

A1 (final answer)

---

2 (a) The table below shows some values of the variables $M$ and $N$. It is given that $M$ is directly proportional to the cube of $N$. Find the values of $x$ and $y$. [3]

| $M$ | 4 | $x$ | 256 |
|---|---|---|---|
| $N$ | 2 | 4 | $y$ |

2 (b) 3 taps are used to fill an aquarium. If one more tap is used, the aquarium can be filled 6 minutes earlier. Assuming that water flows out from all the taps at the same rate, how many more taps should be deployed so that the tank can be filled 15 minutes earlier? [3]

2(a) $M = kN^3$

$4 = k2^3$

$k = 0.5$

$M = 0.5N^3$ M1

$x = 32$ B1 $y = 8$ B1

2(b) Let the number of taps used be $N$ and the time taken to fill the aquarium be T. Let the number of extra taps to be deployed be $x$.

$NT = k$

$3T = 4(T - 6)$ **M1**

$T = 24$

$3 \times 24 = k$

$k = 72$ **M1**

$(3 + x)(24 - 15) = 72$

$x = 5$

The extra number of taps to be deployed is 5. **A1**

---

3 Expand and simplify the following expressions.

(a) $(2x + 5y)(3x - 2y) + (x - 2y)^2$ [3]

(b) $2(3a - b)(5a - 2b) - 3a(2a - 3b)$ [3]

3 (a) $(2x + 5y)(3x - 2y) + (x - 2y)^2$

$= 6x^2 - 4xy + 15xy - 10y^2 + x^2 - 4xy + 4y^2$ M1, M1

$= 7x^2 + 7xy - 6y^2$ A1

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

$= (6a - 2b)(5a - 2b) - 6a^2 + 9ab$ M1 expand right ( )

$= 30a^2 - 12ab - 10ab + 4b^2 - 6a^2 + 9ab$ M1 expand left ( )s

$= 24a^2 - 13ab + 4b^2$ A1

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4 (a) Solve the following simultaneous equations. [4]

$$3x + y = 3$$

$$\frac{2}{3x+y} = \frac{1}{y}$$

(b) A two-digit number is such that the sum of its digits is $\frac{1}{7}$ of the number. When the digits of the number are reversed and the number is subtracted from the original number, the result is 36. Find the original two-digit number. [4]

4 (a) $3x + y = 3$ (1)

$\frac{2}{3x+y} = \frac{1}{y} \longrightarrow 2y = 3x + y$ (2)

From (2) $y = 3x$ (3) M1

Substituting (3) in (1)

$3x + 3x = 3$ M1

$x = \frac{1}{2}$ A1

Substitute $x = \frac{1}{2}$ in (3)

$y = 1\frac{1}{2}$ A1

4(b) Let the original two-digit number be $10x + y$.

$x + y = \frac{1}{7}(10x + y)$ (1)

$10x + y - (10y + x) = 36$ M1 (first correct eqn formed)

$9x - 9y = 36$

$x = y + 4$ (2)

Substitute (2) in (1)

$y + 4 + y = \frac{1}{7}[10(y + 4) + y]$ M1 (first correct substitution/elimination)

$y = 4$

$x = 8$ A1 for both $x$ and $y$

The original two-digit number is 84. A1

---

5 (a) Factorise $x^3 - x^2 - x + 1$ completely. [3]

(b) (i) Factorise $p^2 - 169$. [2]

(ii) Hence, find two factors of 731, other than 1 and 731. [3]

5(a) $x^3 - x^2 - x + 1 = x^2(x - 1) - (x - 1)$ M1

$= (x - 1)(x^2 - 1)$ M1

$= (x - 1)^2(x + 1)$ A1

5(b)(i) $p^2 - 169 = p^2 - 13^2$ M1

$= (p - 13)(p + 13)$ A1

5(b)(ii) let $p^2 - 169 = 731$

$p^2 = 900$ M1

$p = 30$ (we reject $-30$ ∵ for factors, we only take positive values)

$\therefore 731 = (30 - 13)(30 + 13)$ M1

Two factors, other than 1 and 731, are 17 and 43. A1

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6 (a) A rectangle has a length of $(x + 3)$ m and an area of $(x^2 + x - 6)$ m$^2$. Find an expression for the breadth of the rectangle and simplify. [2]

(b) For a secondary 2 VIA trip, some form teachers and students walked 500 m from the school to a bus stop (so as to board a bus) at an average speed of $x$ km/h. After the VIA activity, they returned by the same route and walked from the same bus stop back to school, but at an average speed of 5 km/h slower than the earlier trip.

(i) Express, in terms of $x$, the time in hours that the team took for the return journey. [1]

(ii) Given that the difference between the two times was 1 minute, form an equation in $x$ and show that it reduces to $x^2 - 5x - 150 = 0$. [3]

(iii) Solve the equation $x^2 - 5x - 150 = 0$. [2]

(iv) Find the average speed (in km/h) of the return journey from the bus stop to school. [1]

Note: Total Distance = Average Speed × Total Time

6(a) $x^2 + x - 6 = (x + 3)(x - 2)$ **M1** (for factorisation)

Breadth of rectangle is $x - 2$ m. **A1**

6(b)(i) $\frac{0.5}{x-5}$ h **B1**

6(b)(ii) $\frac{0.5}{x-5} - \frac{0.5}{x} = \frac{1}{60}$ **M1**

$\frac{0.5x-0.5(x-5)}{x(x-5)} = \frac{1}{60}$ **M1**

$60(2.5) = x^2 - 5x$ **M1**

$x^2 - 5x - 150 = 0$ (shown)

6(b)(iii) $(x - 15)(x + 10) = 0$ **M1**

$x = 15$ or $x = -10$ **A1** (do not reject)

6(b)(iv) Average speed of return journey is 10 km/h. **B1**

---

7 (a) Express $\frac{5}{(2x-3)(x+2)} - \frac{1}{(x+2)(3x-1)}$ as a fraction in its simplest form. [3]

(b) Solve $\frac{3}{x+3} - \frac{2}{x+2} = \frac{1}{12}$. [4]

(c) Make $t$ the subject of the formula $s = \sqrt{\frac{2t-p}{t-q}}$ [3]

7(a) $\frac{5}{(2x-3)(x+2)} - \frac{1}{(x+2)(3x-1)} = \frac{5(3x-1)-(2x-3)}{(2x-3)(x+2)(3x-1)}$ **M1**

$= \frac{15x-5-2x+3}{(2x-3)(x+2)(3x-1)}$ **M1**

$= \frac{13x-2}{(2x-3)(x+2)(3x-1)}$ **A1**

7(b) $\frac{3}{x+3} - \frac{2}{x+2} = \frac{1}{12}$

$\frac{3(x+2)-2(x+3)}{(x+3)(x+2)} = \frac{1}{12}$ **M1** (same denominator)

$12(3x + 6 - 2x - 6) = x^2 + 5x + 6$ **M1**

$x^2 - 7x + 6 = 0$

$(x - 6)(x - 1) = 0$ **M1** (factorised form)

$x = 1$ or $x = 6$ **A1** (for both)

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7(c) $s = \sqrt{\frac{2t-p}{t-q}}$

$s^2 = \frac{2t-p}{t-q}$ M1 (for squaring both sides)

$s^2t - s^2q = 2t - p$

$s^2t - 2t = s^2q - p$

$t(s^2 - 2) = s^2q - p$ M1 (for factorizing $t$)

$t = \frac{s^2q-p}{s^2-2}$ A1

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7(c) $s = \sqrt{\frac{2t-p}{t-q}}$

$s^2 = \frac{2t-p}{t-q}$ M1 (for squaring both sides)

$s^2t - s^2q = 2t - p$

$s^2t - 2t = s^2q - p$

$t(s^2 - 2) = s^2q - p$ M1 (for factorizing $t$)

$t = \frac{s^2q-p}{s^2-2}$ A1

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