1 (a) Draw a number line to represent the first 4 natural numbers [3]

(b) Draw a number line to represent the following set of numbers: [3]
$-4 \leq$ numbers divisible by $3 < 15$

2 (a) Evaluate $(-6)^3 \div 3^2 \div [-9-(-8)]^3 \times \sqrt[3]{64}$ [6]

(b) Evaluate $\sqrt{2.75 + 0.7\dot{5} \div \frac{12}{37}}$ [4]

3 (a) Find the HCF and LCM of the following numbers:

63, 105, 420

Leave your answers in index notation form. [4]

(b) Hence or otherwise, evaluate the HCF and LCM of the following:

(i) $63a^2bc$, $105ac^3$, $420a^5b^3c^2$ [2]

(ii) 63, 210, 1260 [2]

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4 (a) Mrs Tan buys a piece of bean curd in the form of a rectangular block of length 112 mm, breadth 98 mm and height 84 mm from the supermarket. She wants to divide it into equal cubes, each of length L mm. What is this largest possible value of L? [3]

(b) Mr Tan has to design a box of the shape of a cube of length d *cm* so as to store rectangular bricks of dimension 45cm by 21cm by 15 cm. To save cost, he must ensure that *the bricks fit exactly into the box, leaving no gaps in between.* What is the smallest possible value of d? [3]

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5 (a) Using prime factorisation, find $\sqrt[3]{2744}$. [3]

(b) Find the smallest natural number N such that $198 \times N$ is a perfect square. [3]

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6 (a) Explain using test of divisibility, whether the number 3876 is divisible by

(i) 3 [1]

(ii) 4 [1]

(iii) 9 [1]

(b) Determine if the number 1859 is a *prime number*, using test of divisibility. Explain your reasons *clearly.* [3]

7 Complete the following sequences by filling in the blanks:

(a) 0, 3, 8, 15, 24, 35, 48, 63, _____, _____, [2]

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(b) 1.23, 2.46, 4.92, 9.84, 19.68, _____, _____. [2]

(c) $1, \frac{2}{3}, \frac{1}{2}, \frac{2}{5}, \frac{1}{3}, \frac{2}{7},$ _____, _____. [2]

8 Select numbers from the table below to complete the various categories given. Numbers can be used more than once.

6	π	-4	0	$4\frac{1}{2}$	$\sqrt[3]{64}$	-5.5	$2.\dot{4}\dot{6}$	$\sqrt{2}$	$-\frac{7}{11}$

(a) Negative Numbers: [2]

(b) Whole Numbers: [2]

(c) Irrational Numbers. [2]

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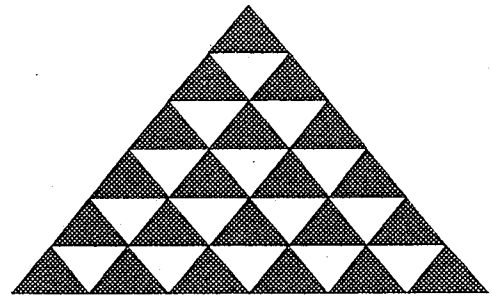

(a) Complete the table below:

Row	Number of Black Triangles	Number of White Triangles	Total Number of Triangles
1	1	0	1
2	2	1	3
3			
4			
5			
6			

[2]

(b) How many black triangles will there be in the 11th row? [1]

(c) How many white triangles will there be in *n*th row? [1]

(d) How many triangles are there together in the first 3 rows? [1]

(e) How many triangles are there together in the first *n* rows? [1]

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10 (a) If $a=4$, $b=-2$ and $c=-3$, evaluate $\dfrac{a-(2b)^2}{2c^2-a}$. [5]

(b) Factorise $yab-yax+ybk-ykx$ completely. [5]

11 (a) Subtract $t-3v$ from the sum of $7t-2u-3v$ and $3t+5u-8v$ [6]

(b) Simplify the following expression, leaving your answer in the factorised form: [6]

$$7a+\{2b-[-3a-(4b-5a)+6b]+7a-8b\}$$

(c) Simplify the following expression, leaving your answer in the factorised form: [8]

$$\frac{1}{2}\left(\frac{11x}{15}+\frac{8}{5}\right)-\frac{2+x}{2}-\frac{2x-3}{5}$$

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12 (a) Write down the next 3 terms in the sequence [3]
5, 10, 7, 14, 11, 22, 19, 38,...

(b) Evaluate $\dfrac{9+12+15+18+21+...+297}{12+16+20+24+28+...+396}$. [3]

(c) Given that $a * b = \dfrac{b+a}{b-a}$,

(i) evaluate the value of $(2 * 7)$. [1]

(ii) Hence, evaluate the value of $(2 * 7) * (1 * 5)$. [3]

Bonus Question

Please note that the bonus question is an additional question on top of the 100 marks total for the first 12 questions.
Bonus question is a 0 or 6 for part (a) and/or 0 or 4 for part (b).

(a) A three-digit number is the product of four prime numbers. The sum of its prime factors is 30. Given that the three digits of the number are all prime and different, find the three-digit number. [6]

(b) Evaluate the unit digit of this three-digit number to the 2008^{th} power. [4]

The End

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Answers

1 (a) Number line representing 1, 2, 3, 4
Additional / Missing numbers — each B3
Missing arrow heads / unequal intervals / crooked line / less than 5 markings -1 -1

(b) Number line representing -3, 0, 3, 6, 9, 12
Additional / Missing numbers — each B3
Missing arrow heads / unequal intervals / crooked line / less than 5 markings -1 -1

2 (a) $(-6)^3 \div 3^2 \div \left[-9-\left(-\sqrt{8}\right)^3\right] \times \sqrt[3]{64} = -216 \div 9 \div (-1)^3 \times 4$ M4

$= -24 \div (-1) \times 4$

$= 24 \times 4$ M1

$= 96$ A1

M4: M1 each for correctly evaluating the 4 terms
M1: (-) divide by (-) = (+)

(b) $\sqrt{2.75 + 0.75 \div \frac{12}{37}} = \sqrt{2\frac{3}{4} + \frac{3}{4} \div \frac{12}{37}}$ B1

$= \sqrt{\frac{11}{4} + \frac{3}{4} \times \frac{37}{12}}$ M1

$= \sqrt{\frac{11}{4} + \frac{37}{16}}$

$= \sqrt{\frac{44}{16} + \frac{37}{16}}$

$= \sqrt{\frac{81}{16}}$

$= \frac{9}{4}$ M1

$= 2\frac{1}{4}$ A1

3 (a) By prime factorization, $63 = 3^2 \times 7$

$105 = 3 \times 5 \times 7$

$420 = 2^2 \times 3 \times 5 \times 7$

Thus, HCF = 3×7 M2

LCM = $2^2 \times 3^2 \times 5 \times 7$ A1

A1

(b) (i) HCF = $21ac$ B1

LCM = $1260a^5b^3c^3$ B1

(ii) We note that $210 = 2 \times 105 = 2 \times (3 \times 5 \times 7)$

$1260 = 3 \times 420 = 3 \times (2^2 \times 3 \times 5 \times 7)$

Hence, HCF of 63, 210, 1260 is the same as that of 63, 105, 420, that is, 21. B1

However, LCM of 63, 210, 1260 $= 2 \times 3 \times 1260 = 7560$ B1

4 (a) For the largest possible value of L, we find the HCF of 112, 98 and 84. M1

2	112, 98, 84
7	56, 49, 42
	8, 7, 6

M1

Thus, the largest possible value of L is $2 \times 7 = 14$. A1

(b) For the smallest value of d, we find the LCM of 45, 21 and 15. M1

3	45, 21, 15
5	15, 7, 5
3	3, 7, 1
7	1, 7, 1
	1, 1, 1

M1

Thus, the largest value of d is $3 \times 3 \times 5 \times 7 = 315$ A1

5 (a) By prime factorization:

2	2744
2	1372
2	686
7	343
7	49
7	7
	1

Thus, $2744 = 2^3 \times 7^3$ M1

Hence, $\sqrt[3]{2744} = 2 \times 7$ M1

$= 14$ A1

(b) By prime factorization, $198 = 2 \times 3^2 \times 11$ M1

Thus, for $198 \times N$ to be a perfect square, it must be at least $2^2 \times 3^2 \times 11^2$ M1

Hence, N must be at least $2 \times 11 = 22$ A1

6 (a) (i) 3876 divisible by 3 since $3 + 8 + 7 + 6 = 24$ is divisible by 3. B1

(ii) 3876 is divisible by 4 since the number formed by the last 2 digits "76" is divisibe by 4. B1

(iii) 3876 is not divisible by 9 since 3 + 8 + 7 + 6 = 24 is not divisible by 9. B1

(b) By inspection, the sum of odd position digits = 1 + 5 = 6
sum of even position digits = 8 + 9 = 17
Difference = 17 – 6 = 11 (divisible by 11) M1

Thus, the number 1859 is divisible by 11. M1

Hence, 1959 cannot be a prime number. A1

7 (a) 0, 3, 8, 15, 24, 35, 48, 63, **80**, **99**. A2

(b) 1.23, 2.46, 4.92, 9.84, 19.68, **39.36**, **78.72**. A2

(c) $1, \frac{2}{3}, \frac{1}{2}, \frac{2}{5}, \frac{1}{3}, \frac{2}{7}, \frac{1}{4}, \frac{2}{9}$. A2

8 (a) $-4, \quad -5.5 \quad \text{and} \quad -\frac{7}{11}$ A2

(b) $0, \quad 6 \quad \text{and} \sqrt[3]{64}$ A2

(c) $\pi \quad \text{and} \sqrt{2}$ A2

9 (a)

Row	Number of Black Triangles	Number of White Triangles	Total Number of Triangles
1	1	0	1
2	2	1	3
3	**3**	**2**	**5**
4	**4**	**3**	**7**
5	**5**	**4**	**9**
6	**6**	**5**	**11**

[2] B2

(b) **11 black triangles** B1

(c) $n-1$ B1

(d) **1 + 3 + 5 = 9** B1

(e) n^2 **triangles** B1

10 (a)
$$\frac{a-(2b)^2}{2c^2-a}=\frac{4-[2(-2)]^2}{2(-3)^2-4}$$
$$=\frac{4-(-4)^2}{2(9)-4}$$
$$=\frac{4-16}{18-4}$$
$$=\frac{-12}{14}$$
$$=-\frac{6}{7}$$

[M1] Correct substitution of a, b and c, with brackets in appropriate places
[M1 each] 16 and 18
[A1] $-\frac{12}{14}$
[A1] $-\frac{6}{7}$

(b) $yab-yax+ybk-ykx$

$=ya(b-x)+yk(b-x)$ [M1, M1]

$=(b-x)(ya+yk)$ [M2]

$=y(b-x)(a+k)$ [M1]

11 (a)
$$(7t-2u-3v)+(3t+5u-8v)-(t-3v)$$
$$=7t-2u-3v+3t+5u-8v-t+3v$$
$$=9t+3u-8v$$

B2
M1
A3

(b) $7a+\{2b-[-3a-(4b-5a)+6b]+7a-8b\}$

$=7a+\{2b-[-3a-4b+5a+6b]+7a-8b\}$

$=7a+\{2b-[2a+2b]+7a-8b\}$

$=7a+\{2b-2a-2b+7a-8b\}$

$=7a+\{5a-8b\}$

$=7a+5a-8b$

$=12a-8b$

$=4(3a-2b)$

M2 for –(4b-5a)=-4b+5a
M1 for correctly simplifying "–[–……]"
M1 for simplifying to 5a-8b
M1 for getting 12a-8b
A1 for factorizing

(c) $\frac{1}{2}\left(\frac{11x}{15}+\frac{8}{5}\right)-\frac{2+x}{2}-\frac{2x-3}{5}$

$=\frac{11x}{30}+\frac{4}{5}-\frac{2+x}{2}-\frac{2x-3}{5}$

$=\frac{11x}{30}+\frac{24}{30}-\frac{30+15x}{30}-\frac{12x-18}{30}$

$=\frac{11x+24-30-15x-12x+18}{30}$

$=\frac{12-16x}{30}$

$=\frac{4(3-4x)}{30}$

$=\frac{2(3-4x)}{15}$

M1 for simplifying $\frac{1}{2}(...)$
M1 for common denominator
M1 each for combining each of the fractions correctly
A2 for simplifying to 12-16x (A1 per term)
M1 for factorising
A1 for final answer.

12 (a) 35, 70, 67. A3

(b) $$\frac{9+12+15+18+21+...+297}{12+16+20+24+28+...+396}$$

$$=\frac{3(3+4+5+...+99)}{4(3+4+5+...+99)}$$ M1

$$=\frac{3}{4}$$ A2

(c) (i)

$$(2*7)=\frac{7+2}{7-2}$$

$$=\frac{9}{5}$$

$$=1\frac{4}{5}$$ B1

(ii)

$$(2*7)*(1*5)=\frac{9}{5}*\frac{5+1}{5-1}$$

$$=\frac{9}{5}*\frac{6}{4}$$ B1

$$=\frac{\frac{6}{4}+\frac{9}{5}}{\frac{6}{4}-\frac{9}{5}}$$ B1

$$=\frac{30+36}{30-36}$$

$$=\frac{66}{-6}$$

$$=-11$$ B1

B (a) Accept any logical method.
Answer is 2 x 2 x 7 x 19 = 532 B6

(b) Accept any logical method.

$2^1=2$

$2^2=4$

$2^3=8$

$2^4=16$

$2^5=32$

$2008\div 4=502$ remainder 0
Thus unit digit is 6 B4