High School
Mathematics Test 2014

Year 9

Surds

Non Calculator

Skills and Knowledge Assessed:

- Define rational and irrational numbers and perform operations with surds and fractional indices (ACMNA264)

Name_____

Section 1 Short Answer Section

Write all working and answers in the spaces provided on this test paper.

1. Circle the irrational numbers in the list below.

$\sqrt{2}$, $\sqrt{25}$, $\sqrt{27}$, $2\sqrt{16}$, $\sqrt{36}$, $\sqrt{42}$.

2. Simplify : $5\sqrt{3} \times 3\sqrt{7}$.

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3. Simplify : $\dfrac{20\sqrt{15}}{5\sqrt{3}}$.

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4. Simplify : $7\sqrt{6} + 4\sqrt{6}$.

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5. Simplify : $16\sqrt{7} - 5\sqrt{7}$.

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6. Simplify : $12\sqrt{5} - 9\sqrt{5} + 4\sqrt{5}$.

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7. Simplify : $\sqrt{150}$.

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8. Simplify : $\sqrt{75} - \sqrt{27}$.

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9. Simplify : $9\sqrt{3} - 5\sqrt{5} + 8\sqrt{3} - 7\sqrt{5}$.

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10. Simplify : $\sqrt{32} - \sqrt{48} + \sqrt{8} + \sqrt{27}$.

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11. Express with a rational denominator : $\frac{5}{\sqrt{5}}$.

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12. Express in simplest form, with a rational denominator : $\frac{5\sqrt{6} - 2}{4\sqrt{6}}$.

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13. Expand and simplify : $\sqrt{5}\,(3\sqrt{6} + 4\sqrt{5})$.

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14. Expand and simplify : $5\sqrt{6}\,(4\sqrt{10} + 7\sqrt{6})$.

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15. Expand and simplify : $2\sqrt{15} - 4 + 2\sqrt{3}\,(8\sqrt{5} + 7\sqrt{3})$.

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16. Expand and simplify : $(\sqrt{5} - 4\sqrt{3})(3\sqrt{5} + 7\sqrt{3})$.

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17. If $3\sqrt{3}\,(2\sqrt{6} - 4) = p\sqrt{2} + q\sqrt{3}$, what are the values of p and q?

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18. Arrange the numbers $4\sqrt{5}$, 9, $6\sqrt{2}$ and $5\sqrt{3}$ in ascending order.

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Section 2 Multiple Choice Section

Mark all your answers on the accompanying multiple choice answer sheet, not on this test paper. You may do any working out on this test paper. Calculators are allowed for this section.

1. $12\sqrt{7} - 15\sqrt{7} = ?$

   A. $-3\sqrt{14}$ B. $-3\sqrt{7}$ C. -3 D. $3\sqrt{7}$

2. Which of the numbers below is an irrational number?

   A. 5 B. $\sqrt{36}$ C. $2\sqrt{25}$ D. $\sqrt{85}$

3. Simplify $2\sqrt{2} - \sqrt{2} + 7\sqrt{2}$.

   A. $-6\sqrt{2}$ B. $-5\sqrt{2}$ C. $8\sqrt{2}$ D. $9\sqrt{2}$

4. $3\sqrt{5} \times 2\sqrt{3} =$

   A. $5\sqrt{8}$ B. $6\sqrt{8}$ C. $5\sqrt{15}$ D. $6\sqrt{15}$

5. $\dfrac{30\sqrt{35}}{6\sqrt{7}} =$

   A. $5\sqrt{5}$ B. $6\sqrt{5}$ C. $24\sqrt{5}$ D. $24\sqrt{22}$

6. Completely simplify $\sqrt{98}$.

   A. $2\sqrt{7}$ B. $7\sqrt{2}$ C. $2\sqrt{49}$ D. $4\sqrt{49}$

7. $3\sqrt{5} + \sqrt{45} - \sqrt{80} = ?$

   A. $-2\sqrt{5}$ B. $-\sqrt{5}$ C. $\sqrt{5}$ D. $2\sqrt{5}$

8. If $6\sqrt{7} = \sqrt{a}$, what is the value of a?

A. 13 B. 42 C. 252 D. 294

9. Which of the following has the largest value?

A. $4\sqrt{8}$ B. $2\sqrt{30}$ C. $5\sqrt{5}$ D. $3\sqrt{14}$

10. When expressed with a rational denominator $\frac{2\sqrt{3}}{\sqrt{5}} =$

A. $\frac{2\sqrt{15}}{15}$ B. $\frac{2\sqrt{5}}{15}$ C. $\frac{2\sqrt{15}}{5}$ D. $\frac{4\sqrt{15}}{5}$

11. Expand and simplify $2\sqrt{3}\,(5 - 3\sqrt{3})$.

A. $10\sqrt{3} - 18$ B. $10\sqrt{6} - 18$

C. $3\sqrt{10} - 18$ D. $18 - 10\sqrt{3}$

12. When expressed with a rational denominator $\frac{5\sqrt{6}}{6\sqrt{3}} = ?$

A. $\frac{5\sqrt{3}}{3}$ B. $\frac{5\sqrt{6}}{2}$ C. $\frac{5\sqrt{2}}{18}$ D. $\frac{5\sqrt{2}}{6}$

13. Expand and simplify $12\sqrt{5} + 4\sqrt{10} - 2\sqrt{5}\,(5 - 3\sqrt{2})$.

A. $2\sqrt{5} - 10\sqrt{10}$ B. $2\sqrt{5} + 10\sqrt{10}$

C. $22\sqrt{5} + 2\sqrt{10}$ D. $22\sqrt{5} - 2\sqrt{10}$

14. Expand and simplify $(2\sqrt{3} - 2\sqrt{2})(\sqrt{3} - 4\sqrt{2})$.

A. $-10 - 6\sqrt{6}$ B. $10 - 10\sqrt{6}$

C. $22 - 10\sqrt{6}$ D. $22 + 10\sqrt{6}$

15. Express $\frac{2\sqrt{7} - \sqrt{6}}{3\sqrt{2}}$ with a rational denominator.

A. $\frac{\sqrt{14} - \sqrt{3}}{3}$ B. $\frac{\sqrt{14} + \sqrt{3}}{3}$

C. $\frac{2\sqrt{14} - \sqrt{3}}{6}$ D. $\frac{\sqrt{14} - 2\sqrt{3}}{6}$

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Calculator Allowed

Name_____

Section 3 Longer Answer Section

Write all working and answers in the spaces provided on this test paper.

Marks

1. a) Express $\dfrac{3\sqrt{2}-4\sqrt{3}}{3\sqrt{2}-\sqrt{3}}$ with a rational denominator. **2**

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b) Simplify the following, giving your answer as a single fraction in simplest form. **3**

$$\frac{2\sqrt{3}-1}{\sqrt{2}}+\frac{1-\sqrt{2}}{\sqrt{3}}=$$

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Multiple Choice Answer Sheet

Name _____

Completely fill the response oval representing the most correct answer.

1.	A ⬭	B ⬭	C ⬭	D ⬭
2.	A ⬭	B ⬭	C ⬭	D ⬭
3.	A ⬭	B ⬭	C ⬭	D ⬭
4.	A ⬭	B ⬭	C ⬭	D ⬭
5.	A ⬭	B ⬭	C ⬭	D ⬭
6.	A ⬭	B ⬭	C ⬭	D ⬭
7.	A ⬭	B ⬭	C ⬭	D ⬭
8.	A ⬭	B ⬭	C ⬭	D ⬭
9.	A ⬭	B ⬭	C ⬭	D ⬭
10.	A ⬭	B ⬭	C ⬭	D ⬭
11.	A ⬭	B ⬭	C ⬭	D ⬭
12.	A ⬭	B ⬭	C ⬭	D ⬭
13.	A ⬭	B ⬭	C ⬭	D ⬭
14.	A ⬭	B ⬭	C ⬭	D ⬭
15.	A ⬭	B ⬭	C ⬭	D ⬭

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ANSWERS

Section 1 (1 mark each)	
	Working and Answers
1.	$\sqrt{2}$, $\sqrt{25}$, $\sqrt{27}$, $2\sqrt{16}$, $\sqrt{36}$, $\sqrt{42}$.
2.	$5\sqrt{3} \times 3\sqrt{7} = 15\sqrt{21}$.
3.	$\frac{20\sqrt{15}}{5\sqrt{3}} = 4\sqrt{5}$.
4.	$7\sqrt{6} + 4\sqrt{6} = 11\sqrt{6}$
5.	$16\sqrt{7} - 5\sqrt{7} = 9\sqrt{7}$
6.	$12\sqrt{5} - 9\sqrt{5} + 4\sqrt{5} = 7\sqrt{5}$
7.	$\sqrt{150} = \sqrt{25} \times \sqrt{6}$ $= 5\sqrt{6}$
8.	$\sqrt{75} - \sqrt{27} = \sqrt{25} \times \sqrt{3} - \sqrt{9} \times \sqrt{3}$ $= 5\sqrt{3} - 3\sqrt{3}$ $= 2\sqrt{3}$
9.	$9\sqrt{3} - 5\sqrt{5} + 8\sqrt{3} - 7\sqrt{5} = 17\sqrt{3} - 12\sqrt{5}$
10.	$\sqrt{32} - \sqrt{48} + \sqrt{8} + \sqrt{27} = 4\sqrt{2} - 4\sqrt{3} + 2\sqrt{2} + 3\sqrt{3}$ $= 6\sqrt{2} - \sqrt{3}$
11.	$\frac{5}{\sqrt{5}} = \frac{5}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ $= \frac{5\sqrt{5}}{5}$ $= \sqrt{5}$

12.	$\frac{5\sqrt{6}-2}{4\sqrt{6}} = \frac{5\sqrt{6}-2}{4\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$ $= \frac{30-2\sqrt{6}}{24}$ $= \frac{15-\sqrt{6}}{12}$
13.	$\sqrt{5}\,(3\sqrt{6}+4\sqrt{5}) = 3\sqrt{30}+20$
14.	$5\sqrt{6}\,(4\sqrt{10}+7\sqrt{6}) = 20\sqrt{60}+35\sqrt{36}$ $= 20 \times 2\sqrt{15}+35 \times 6$ $= 40\sqrt{15}+210$
15.	$2\sqrt{15}-4+2\sqrt{3}\,(8\sqrt{5}+7\sqrt{3}) = 2\sqrt{15}-4+16\sqrt{15}+14\sqrt{9}$ $= 18\sqrt{15}-4+42$ $= 18\sqrt{15}+38$
16.	$(\sqrt{5}-4\sqrt{3})(3\sqrt{5}+7\sqrt{3}) = \sqrt{5} \times 3\sqrt{5}+7\sqrt{3} \times \sqrt{5}-4\sqrt{3} \times 3\sqrt{5}-4\sqrt{3} \times 7\sqrt{3}$ $= 15+7\sqrt{15}-12\sqrt{15}-84$ $= -69-5\sqrt{15}$
17.	$3\sqrt{3}\,(2\sqrt{6}-4) = 6\sqrt{18}-12\sqrt{3}$ $= 6 \times \sqrt{9} \times \sqrt{2}-12\sqrt{3}$ $= 18\sqrt{2}-12\sqrt{3}$ $p\sqrt{2}+q\sqrt{3} = 18\sqrt{2}-12\sqrt{3}$ $\therefore \quad p = 18$ and $q = -12$
18.	$4\sqrt{5} = \sqrt{16} \times \sqrt{5} = \sqrt{80}$ $9 = \sqrt{81}$ $6\sqrt{2} = \sqrt{36} \times \sqrt{2} = \sqrt{72}$ $5\sqrt{3} = \sqrt{25} \times \sqrt{3} = \sqrt{75}$ In order $\sqrt{72}$, $\sqrt{75}$, $\sqrt{80}$, $\sqrt{81}$ $6\sqrt{2}$, $5\sqrt{3}$, $4\sqrt{5}$ and 9.

Section 2 (1 mark each)		
	Working	Answers
1.	$12\sqrt{7} - 15\sqrt{7} = -3\sqrt{7}$	B
2.	$\sqrt{85}$ is irrational.	D
3.	$2\sqrt{2} - \sqrt{2} + 7\sqrt{2} = 8\sqrt{2}$	C
4.	$3\sqrt{5} \times 2\sqrt{3} = 6\sqrt{15}$	D
5.	$\frac{30\sqrt{35}}{6\sqrt{7}} = \left(\frac{30}{6}\right)\left(\sqrt{\frac{35}{7}}\right)$ $= 5\sqrt{5}$	A
6.	$\sqrt{98} = \sqrt{49} \times \sqrt{2}$ $= 7\sqrt{2}$	B
7.	$3\sqrt{5} + \sqrt{45} - \sqrt{80} = 3\sqrt{5} + \sqrt{9} \times \sqrt{5} - \sqrt{16} \times \sqrt{5}$ $= 3\sqrt{5} + 3\sqrt{5} - 4\sqrt{5}$ $= 2\sqrt{5}$	D
8.	$6\sqrt{7} = \sqrt{36} \times \sqrt{7}$ $= \sqrt{252}$ $\therefore \sqrt{a} = \sqrt{252}$ $a = 252$	C
9.	A. $4\sqrt{8} = \sqrt{16} \times \sqrt{8} = \sqrt{128}$ A is the largest. B. $2\sqrt{30} = \sqrt{4} \times \sqrt{30} = \sqrt{120}$ C. $5\sqrt{5} = \sqrt{25} \times \sqrt{5} = \sqrt{125}$ D. $3\sqrt{14} = \sqrt{9} \times \sqrt{14} = \sqrt{126}$	A
10.	$\frac{2\sqrt{3}}{\sqrt{5}} = \frac{2\sqrt{3}}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}}$ $= \frac{2\sqrt{15}}{5}$	C
11.	$2\sqrt{3}(5 - 3\sqrt{3}) = 10\sqrt{3} - 6\sqrt{9}$ $= 10\sqrt{3} - 18$	A

12.	$\frac{5\sqrt{6}}{6\sqrt{3}} = \frac{5\sqrt{6}}{6\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$ $= \frac{5\sqrt{18}}{6\sqrt{9}}$ $= \frac{5 \times 3\sqrt{2}}{18}$ $= \frac{5\sqrt{2}}{6}$	D
13.	$12\sqrt{5} + 4\sqrt{10} - 2\sqrt{5}\,(5 - 3\sqrt{2}) = 12\sqrt{5} + 4\sqrt{10} - 10\sqrt{5} + 6\sqrt{10}$ $= 2\sqrt{5} + 10\sqrt{10}$	B
14.	$(2\sqrt{3} - 2\sqrt{2})(\sqrt{3} - 4\sqrt{2}) = 2\sqrt{3} \times \sqrt{3} - 4\sqrt{2} \times 2\sqrt{3} - 2\sqrt{2} \times \sqrt{3} + 2\sqrt{2} \times 4\sqrt{2}$ $= 6 - 8\sqrt{6} - 2\sqrt{6} + 16$ $= 22 - 10\sqrt{6}$	C
15.	$\frac{2\sqrt{7} - \sqrt{6}}{3\sqrt{2}} = \frac{2\sqrt{7} - \sqrt{6}}{3\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$ $= \frac{2\sqrt{14} - \sqrt{12}}{3\sqrt{4}}$ $= \frac{2\sqrt{14} - 2\sqrt{3}}{6}$ $= \frac{\sqrt{14} - \sqrt{3}}{3}$	A

Section 3 Answers		
1 (a)	$\frac{3\sqrt{2} - 4\sqrt{3}}{3\sqrt{2} - \sqrt{3}} = \frac{3\sqrt{2} - 4\sqrt{3}}{3\sqrt{2} - \sqrt{3}} \times \frac{3\sqrt{2} + \sqrt{3}}{3\sqrt{2} + \sqrt{3}}$ $= \frac{18 + 3\sqrt{6} - 12\sqrt{6} - 12}{18 - 3}$ $= \frac{6 - 9\sqrt{6}}{15}$ $= \frac{2 - 3\sqrt{6}}{5}$	2 marks for correct answer 1 mark for some correct working heading toward an incorrect answer

1 (b)	$\frac{2\sqrt{3}-1}{\sqrt{2}} + \frac{1-\sqrt{2}}{\sqrt{3}} = \frac{\sqrt{3}(2\sqrt{3}-1)}{\sqrt{6}} + \frac{\sqrt{2}(1-\sqrt{2})}{\sqrt{6}}$ $= \frac{6-\sqrt{3}+\sqrt{2}-2}{\sqrt{6}}$ $= \frac{4-\sqrt{3}+\sqrt{2}}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$ $= \frac{4\sqrt{6}-\sqrt{18}+\sqrt{12}}{6}$ $= \frac{4\sqrt{6}-3\sqrt{2}+2\sqrt{3}}{6}$	3 marks for correct answer 2 marks for mostly correct working heading toward an incorrect answer 1 mark for some correct working.

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Multiple Choice Answer Sheet

Name ___Marking Sheet

Completely fill the response oval representing the most correct answer.

1.	A ○	B ●	C ○	D ○
2.	A ○	B ○	C ○	D ●
3.	A ○	B ○	C ●	D ○
4.	A ○	B ○	C ○	D ●
5.	A ●	B ○	C ○	D ○
6.	A ○	B ●	C ○	D ○
7.	A ○	B ○	C ○	D ●
8.	A ○	B ○	C ●	D ○
9.	A ●	B ○	C ○	D ○
10.	A ○	B ○	C ●	D ○
11.	A ●	B ○	C ○	D ○
12.	A ○	B ○	C ○	D ●
13.	A ○	B ●	C ○	D ○
14.	A ○	B ○	C ●	D ○
15.	A ●	B ○	C ○	D ○