Year 11 Mathematics
March 21, 2007
Time 45 minutes

Student _____

Teacher _____

Show all necessary working.
Neatness may be taken into consideration in the awarding of marks.
If you make a mistake, transfer the question on to the last page (blank) of this exam.

1. Evaluate $\dfrac{\pi + \sqrt{6.85}}{60\%}$ to 2 decimal places. (2)

2. The distance from Sun to the Earth is 149 494 000 km . Write this in scientific notation correct to 3 significant figures. (2)

3. A car is sold for $24300, which is a profit of 8% on its cost price. Find its cost price to the nearest dollar. (2)

4. If $x = \sqrt{a}$, find the value of 6a in terms of x. (1)

5. How many times must the number k be added to the number p to give a total of 4p + 3k? (2)

6. Fully factorise these

    i. $4m^2 - 19m + 12$ (2)

    ii. $4x + 12y - xz - 3yz$ (2)

    iii. $48 - 27m^2$ (2)

7. Simplify fully

    i. $(3x - 4)(4x + 2x^2 - 5)$ (2)   ii. $(a + b)^2 - (a - b)^2$ (2)

    iii. $\sqrt{98} + 3\sqrt{18} - 2\sqrt{12}$ (2)   iv. $(2\sqrt{3} + 3\sqrt{2})^2$ (2)

8.   i.   Rationalise the denominator of $\dfrac{3}{3 - \sqrt{2}}$ (2)

    ii.   Hence find **m** and **n** such that $\dfrac{3}{3 - \sqrt{2}} = m + n\sqrt{2}$ (2)

9. Solve these for x :

i. $(x-4)(3-x)(2x+5)=0$ (2)

ii. $5x = 18 - 2x^2$ (2)

iii. $\dfrac{2}{x-3} \cong \dfrac{1}{x+4}$ (2)

iv. $(4+3x) < -\dfrac{5x}{2}$ (2)

v. $\sqrt{1+x^2} = 1+x$ (2)

vi. $|3-4x| = 5x$ (3)

10. Solve $(3x) = 2 + \dfrac{2}{x}$ (leaving your answer in simplest exact form)   (3)

11. Fully simplify these :

i. $\dfrac{k^2 - 1}{1 - k}$ (2)

ii. $\dfrac{6}{x^3 + 125} \div \dfrac{3}{x + 5}$ (2)

iii. $\dfrac{2}{x^2 - 1} + \dfrac{1}{x^2 + x}$ (3)

iv. $\dfrac{\sqrt{x} + \dfrac{1}{\sqrt{x}}}{x^2 - 1}$ (3)

12. Solve these equations simultaneously :

i. $3x = 11 + y$ and $8x + 3y = 18$ (3)

ii. $y = x^2 - 4x$ and $3x - y - 12 = 0$ (3)

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1. Evaluate $\dfrac{\pi + \sqrt{6.85}}{60\%}$ to 2 decimal places. (2)

9.60

1mark:
* 9.6
or * 9.598071865...
* 7.50 (did not use brackets in numerator)

2. The distance from Sun to the Earth is 149 494 000 km . Write this in scientific notation correct to 3 significant figures. (2)

1.49×10^8

1mark
$\square \times 10^8$
↑
anything between 1 and 9.99...

3. A car is sold for $24300, which is a profit of 8% on its cost price. Find its cost price to the nearest dollar. (2)

100%   8%
← $24300 →

1mark
* $225
* $26413

108% = $24300
1% = $225
100% = $22500

4. If $x = \sqrt{a}$, find the value of 6a in terms of x. (1)

$x^2 = a$
∴ $6a = 6x^2$

5. How many times must the number k be added to the number p to give a total of 4p + 3k? (2)

n

$nk + p = 4p + 3k$ ← 1mark
$nk = 3p + 3k$
$n = \dfrac{3p + 3k}{k}$

6. Fully factorise these

i. $4m^2 - 19m + 12$ (2)

$4m \diagdown -3$
$m \diagdown -4$

$(4m-3)(m-4)$

1mark
*(4m-4)(m-3)
or * (4m-3) ----
or * (m-4) ----

ii. $4x + 12y - xz - 3yz$ (2)

$4(x+3y) - z(x+3y)$ ← 1mark
$(x+3y)(4-z)$

or 1mark:
* (x+3y) ---
* (4-z) ---

iii. $48 - 27m^2$ (2)

$3(16 - 9m^2)$
$3(4-3m)(4+3m)$

1mark
* 3(   )
or * (4-3m) ----
or * (4+3m) ---

7. Simplify fully

i. $(3x-4)(4x + 2x^2 - 5)$ (2)

$12x^2 + 6x^3 - 15x - 16x - 8x^2 + 20$
$6x^3 + 4x^2 - 31x + 20$

1mark * correct first line expansion
or * correct simplification

ii. $(a+b)^2 - (a-b)^2$ (2)

$a^2 + 2ab + b^2 - [a^2 - 2ab + b^2]$
$a^2 + 2ab + b^2 - a^2 + 2ab - b^2$
$4ab$

1mark: * $2b^2$ (Ignored brackets)
or * correct simplification

iii. $\sqrt{98} + 3\sqrt{18} - 2\sqrt{12}$ (2)

$\sqrt{49} \times \sqrt{2} + 3\sqrt{9} \times \sqrt{2} - 2\sqrt{4} \times \sqrt{3}$
$7\sqrt{2} + 9\sqrt{2} - 4\sqrt{3}$
$16\sqrt{2} - 4\sqrt{3}$

1mark : * any 2 correct surd simplifications
or * correct simplification

iv. $(2\sqrt{3} + 3\sqrt{2})^2$ (2)

$4\sqrt{9} + 2 \times 2\sqrt{3} \times 3\sqrt{2} + 9\sqrt{4}$
$12 + 12\sqrt{6} + 18$
$30 + 12\sqrt{6}$

1mark:

8. i. Rationalise the denominator of $\dfrac{3}{3-\sqrt{2}} \times \dfrac{3+\sqrt{2}}{3+\sqrt{2}}$ (2)

$\dfrac{9 + 3\sqrt{2}}{9 - 2}$
$= \dfrac{9 + 3\sqrt{2}}{7}$

1mark:
* multiply by $\dfrac{3+\sqrt{2}}{3+\sqrt{2}}$

ii. Hence find integers m and n such that $\dfrac{3}{3-\sqrt{2}} = m + n\sqrt{2}$ (2)

$m = \dfrac{9}{7}$, $n = \dfrac{3}{7}$
(1mark each)

1mark:
m = 9 and n = 3
or correct from (i)

9. Solve these for x :

i. $(x-4)(3-x)(2x+5)=0$ (2)

$x=4 \quad x=3 \quad x=-2.5$

1 mark: * any correct 2 answers

ii. $5x = 18 - 2x^2$ (2)

$2x^2 + 5x - 18 = 0$

$2x \diagdown +9$
$x \diagdown -2$

$(2x+9)(x-2)=0$

$x = -\frac{9}{2}$ or $x = 2$

1 mark:
$(2x+9)(x-2)=0$
Completing the square.
Quadratic formula.

iii. $\frac{2}{x-3} = \frac{1}{x+4}$ (2)

$2(x+4) = 1(x-3)$
$2x+8 = x-3$
$x = -11$

iv. $4+3x < -\frac{5x}{2}$ (2)

$8+6x < -5x$
$11x < -8$
$x < -\frac{8}{11}$

v. $\sqrt{1+x^2} = 1+x$ (2)

$1+x^2 = (1+x)^2$
$1+x^2 = 1+2x+x^2$
$2x = 0$
$x = 0$

vi. $|3-4x| = 5x$ (3)

$3-4x = 5x$
$9x = 3$
$x = \frac{1}{3}$

Test:
$|3-4\times\frac{1}{3}| = 5\times\frac{1}{3}$
$1\frac{2}{3} = 1\frac{2}{3}$
Accept

$3-4x = -5x$
$x = -3$

Test:
$|3-4x-3| = 5x-3$
$15 = -15$
Reject.

* 2 marks: No test
* 1 mark: $x = \frac{1}{3}$

10. Solve $3x = 2 + \frac{2}{x}$ (leaving your answer in simplest exact form) (3)

$3x^2 = 2x+2$
$3x^2 - 2x - 2 = 0$
$x = \frac{2 \pm \sqrt{(2)^2 - 4\times3\times-2}}{2\times3}$
$= \frac{2 \pm \sqrt{28}}{6}$
$= \frac{2 \pm \sqrt{4}\times\sqrt{7}}{6}$
$= \frac{2 \pm 2\sqrt{7}}{6}$

$= \frac{2(1\pm\sqrt{7})}{6}$
$= \frac{1 \pm \sqrt{7}}{3}$

1 mark:
* correct substitution into formula

2 marks :
* $\frac{2 \pm \sqrt{28}}{6}$

11. Simplify these :

i. $\frac{k^2-1}{1-k}$ (2)

$\frac{(k-1)(k+1)}{1-k}$
$= -(k+1)$

1 mark:
* correctly factorise the top.

ii. $\frac{6}{x^3+125} \div \frac{3}{x+5}$ (2)

$\frac{6}{(x+5)(x^2-5x+25)} \times \frac{x+5}{3}$
$= \frac{2}{x^2-5x+25}$

1 mark:
* correctly factorise x^3+125

iii. $\frac{2}{x^2-1} + \frac{1}{x^2+x}$ (3)

$\frac{2}{(x-1)(x+1)} + \frac{1}{x(x+1)}$

$\frac{2x + 1\times(x-1)}{x(x+1)(x-1)}$

$\frac{2x+x-1}{x(x+1)(x-1)}$

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

1 mark
* factorising both denominators

2 marks:
* LCD $x(x+1)(x-1)$

iv. $\frac{\sqrt{x}+\frac{1}{\sqrt{x}}}{x^2-1}$ (3)

$\frac{\frac{x+1}{\sqrt{x}}}{x^2-1}$

$\frac{x+1}{\sqrt{x}} \div \frac{(x-1)(x+1)}{1}$

$\frac{x+1}{\sqrt{x}} \times \frac{1}{(x-1)(x+1)}$

$\frac{1}{\sqrt{x}(x-1)}$

1 mark:
* factorise x^2-1
or * $\frac{x+1}{\sqrt{x}}$ (or equivalent)

2 marks:
* both of above

12. Solve these equations simultaneously :

i. $3x = 11 + y$ and $8x + 3y = 18$ (3)

$y = 3x - 11$
$8x + 3(3x-11) = 18$
$8x + 9x - 33 = 18$
$17x = 51$
$x = 3$
$y = -2$

1 mark:
* correctly substitutes (must be shown) to get 2nd letter
+ correctly eliminates one letter to form an equation.

2 marks:
* $x = 3$
or * $y = -2$

ii. $y = x^2 - 4x$ and $3x - y - 12 = 0$ (3)

sub ① in ②
$3x - (x^2-4x) - 12 = 0$
$3x - x^2 + 4x - 12 = 0$
$x^2 - 7x + 12 = 0$
$(x-4)(x-3)=0$
$x = 4 \quad x = 3$
$y = 0 \quad y = -3$

1 mark
* correctly substitutes (must be shown) to get 2nd letter
or * forms a quadratic

2 marks
* $x = 4, x = 3$
or * $y = 0, y = -3$