**Sirius**
College
" Reach for the stars "

Name: *Marking Guide*                    Marks:

## Question 1

2 marks

Solve for $x$ where $x \in R$.

$$\sqrt[3]{x^2} + \sqrt[3]{x} - 2 = 0$$

$\sqrt[3]{x} = a$

$a^2 + a - 2 = 0$          1 mark to convert to a quadratic eq.

$(a+2)(a-1) = 0$

$a = -2 \quad a = 1$

$\sqrt[3]{x} = -2$          $\sqrt[3]{x} = 1$

$x = -8$          $x = 1$

1 mark for correct $x$ values.

## Question 2

3 marks

For what values of $k$ there will be at least one intersection point between the line $y = x - 3$ and the parabola $y = x^2 - kx - 2$.

$x - 3 = x^2 - kx - 2$

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

$\Delta \geq 0$

$(k+1)^2 - 4 \times 1 \times 1 \geq 0$          1 mark

$k^2 + 2k - 3 \geq 0$

$\begin{array}{c|c|c} & -3 & 1 \\ \hline + & - & + \end{array}$

1 mark

$k \leq -3 \ \cup \ k \geq 1$

1 mark

## Question 3

3 marks

Determine the $x$-intercepts of the cubic graph $x^3 + 4x^2 - 7x - 10$.

$x^3 + 4x^2 - 7x - 10 = 0$

$x = -1$    $(x+1)$ is a factor.

1 mark

$$
\begin{array}{r}
x^2 + 3x - 10 \\
x+1 \overline{\smash{\big)}\ x^3 + 4x^2 - 7x - 10} \\
\underline{-x^3 + x^2} \\
3x^2 - 7x - 10 \\
\underline{- 3x^2 + 3x} \\
-10x - 10 \\
\underline{+ -10x \pm 10} \\
0
\end{array}
$$

1 mark for division.

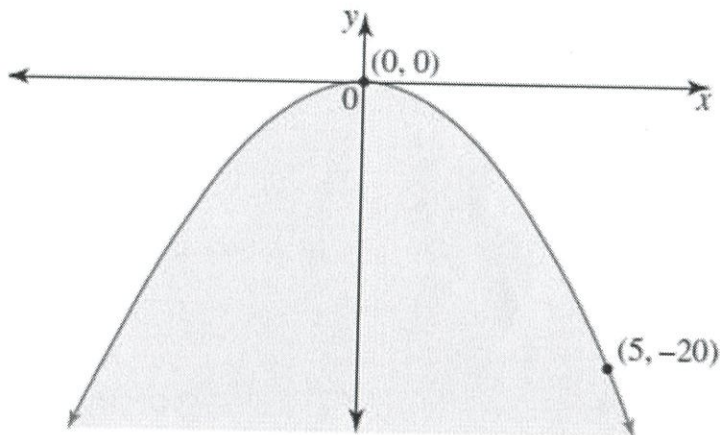$(x+1)(x^2 + 3x - 10) = 0$

$(x+1)(x+5)(x-2) = 0$

$x = -1 \qquad x = -5 \qquad x = 2.$

1 mark for all $x$-intercepts.

## Question 4

2 marks

Determine the rule for the region shaded in the diagram below.



$y = ax^2 \qquad (5, -20)$

$-20 = a \, 25$

$a = -\dfrac{4}{5}$

$y = -\dfrac{4}{5} x^2$    1 mark for correct parabola equation.

$y \leq -\dfrac{4}{5} x^2$    1 mark for correct inequality

Name:                                    Marks – Section 1:               Section 2:

## SECTION 1

### Question 1

The parabola $y = x^2 + 5$ is translated horizontally 3 units to the left and 4 units downwards. The resulting graph has equation:

A    $y = (x-3)^2 + 9$

B    $y = (x+3)^2 - 4$

C    $y = (x+3)^2 + 1$

D    $y = (x-3)^2 - 1$

E    $y = (x-3)^2 + 1$

### Question 2

Select the **correct** statement about the polynomial $P(x) = a\sqrt[n]{x^m} + bx^2 + c$.
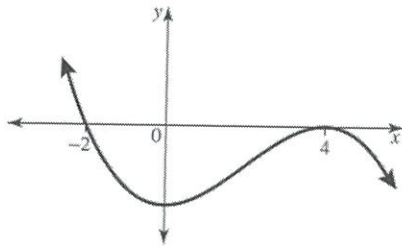
A   $m, b, c \in \mathbb{Z}$

B   $n \in \mathbb{Q}$

C   $n, m, c \in \mathbb{Q}^+$

D   $m = nk, k \in \mathbb{Z}^+$

E   $a, b, c \in \mathbb{Z}^+$

## Question 3

The equation of the graph shown, where $a$ is a positive constant, could be:



A     $y = a(x+2)(x-4)^2$

B     $y = a(x+2)^2(x-4)$

C     $y = a(x+4)^2(x-2)$

D     $y = -a(x+4)(x-2)^2$

E     $y = -a(x+2)(x-4)^2$

## Question 4

Given that the points $(-1,-3), (2,21)$ and $(3,37)$ lie on a parabola with equation $y = ax^2 + bx + c$. Find the values of $a, b$ and $c$.

A     $a = 2, b = 6, c = 1$

B     $a = -2, b = 6, c = 3$

C     $a = -1, b = 3, c = -4$

D     $a = 4, b = -2, c = 1$

E     $a = 6, b = -2, c = 3$

## Question 5

If $P(-3) = 0$, then

A     -3 is the remainder when $P(x)$ is divided by $(x+3)$.

B     $(x+3)$ is a factor of $P(x)$

C     $(x-3)$ is a factor of $P(x)$

D     3 is the remainder when $P(x)$ is divided by $(x+3)$

E     $(x+3)$ is the quotient when $P(x)$ is divided by $(x-3)$

## SECTION 2

**Instructions for Section 2**

Answer **all** questions in the spaces provided.

In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

**Question 1**

Consider $P(x) = 3x^3 + kx^2 + 4$. Given that $(3x + 2)$ is a factor of $P(x)$.
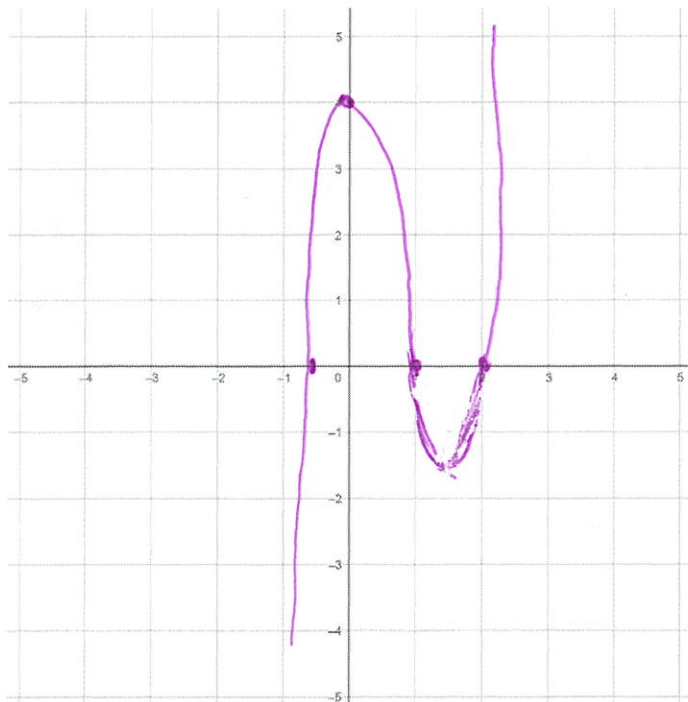
**a.** Find $k$ and hence express $P(x)$ as a product of linear factors.  2 marks

$$P\left(-\frac{2}{3}\right) = 0 \qquad k = -7 \qquad 1 \text{ mark}$$
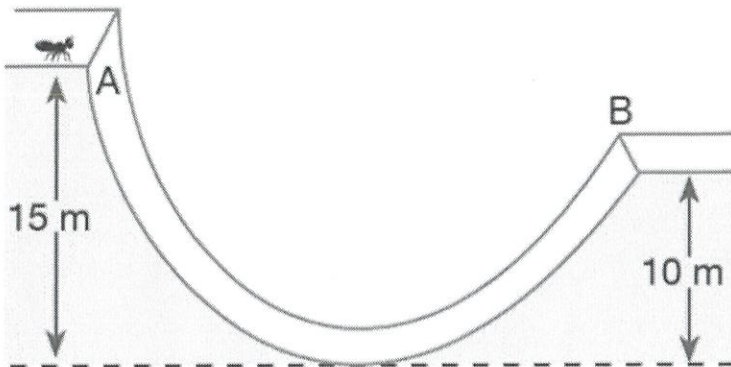
$$P(x) = (3x+2)(x^2 - 3x + 2)$$
$$P(x) = (3x+2)(x-2)(x-1) \qquad 1 \text{ mark}$$

**b.** Sketch the graph of $P(x)$.  1 mark

**Question 2**                                                                                    3 marks

An ant is moving from point A to point B in a parabolic path as shown in the diagram below. The
height of the ant is modelled by $h(t) = t^2 - 6t + p - 2$ meters for $t$ minutes.
How long, in minutes, will it take for ant to reach to the point B?



$h(0) = 15m.$       $p = 17$              1 mark

At point B  $h = 10m.$

$10 = t^2 - 6t + 15$  → 1 mark

$t = 1$   $\boxed{t = 5}$    1 mark for correct $t$ value.
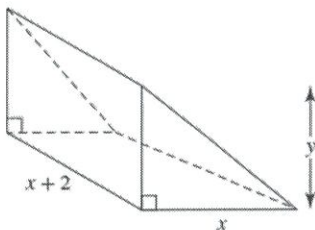
OR

$h(t) = 10$   1 mark

$t = 1$  $\boxed{t = 5}$

1 mark for correct $t$

**Question 3**

The triangular box below consists of sides $x$ mm in length and $x + 2$ mm in width and a height
of $y$ mm. The length, width, and height added together equal 24 mm.



**a.**    Find the volume, $V$, of the box in terms of $x$.                                    2 marks

        (The formula of volume is $V = $ Area of the base x Length of the prism)

$x + 2 + x + y = 24$

$\boxed{2x + y = 22}$
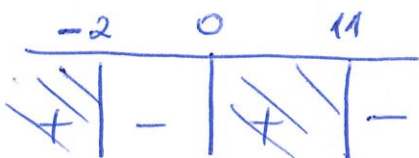
$V = \frac{1}{2} xy(x+2)$      1 mark

$V = \frac{1}{2} x(22 - 2x)(x+2)$

$V = x(11-x)(x+2)$      1 mark

**b.**    Find the possible values of $x$.                                               2 marks



$\boxed{0 < x < 11}$
1 mark

OR
$V(x) > 0$    1 mark

$0 < x < 11$   1 mark

1 mark for sign diagram