(a) 
$$1 \ | 2 \ 3 \ -4 \ -3 \ 2$$
 Remainder = 0  
 $1 \ | 2 \ 5 \ | -2$  So  $(x-1)$  is a factor.  
 $2 \ 5 \ | -2 \ | 2$  So  $(x-1)$  is a factor.  
So  $2x^4 + 3x^3 - 4x^2 - 3x + 2 = (x-1)(2x^3 + 5x^2 + x - 2)$   
(b) Try  $x = 1$ .  $2 + 5 + 1 - 2 \neq 0$ 

(10) (a)

Renainder = 0

$$(x-1)(x+1)(2x^2+3x-2)$$

= (x-1)(x+1)(x+2)(2x-1)

Question			Generic scheme	Illustrative scheme	Max mark
10.	(a)		<ul> <li>use 1 in synthetic division or in evaluation of quartic</li> <li>complete division/evaluation and interpret result</li> </ul>	or $2 \times (1)^4 + 3 \times (1)^3 - 4 \times (1)^2$ $-3 \times (1) + 2$ $1  2  3  -4  -3  2$ $2  5  1  -2$ $2  5  1  -2  0$	2
				2 5 1 -2 0 Remainder = $0$ : $(x-1)$ is a factor or f(1) = 0 : $(x-1)$ is a factor	

### Notes:

- 1. Communication at •2 must be consistent with working at that stage i.e. a candidate's working must arrive legitimately at 0 before  $\bullet^2$  can be awarded.
- 2. Accept any of the following for  $\bullet^2$ :
  - 'f(1) = 0 so (x-1) is a factor'
  - 'since remainder = 0, it is a factor'
  - the '0' from any method linked to the word 'factor' by 'so', 'hence',  $\therefore$ ,  $\rightarrow$ ,  $\Rightarrow$  etc.
- 3. Do not accept any of the following for  $\bullet^2$ :
  - double underlining the '0' or boxing the '0' without comment
  - 'x = 1 is a factor', '... is a root'
  - the word 'factor' only, with no link.

### **Commonly Observed Responses:**

#### Candidate A - grid method $2x^3$ $5x^3$ $2x^4$ $\boldsymbol{x}$ $-2x^{3}$ $2x^3$ $5x^2$ $x^{\overline{2}}$ $2x^4$ $5x^3$

 $-2x^{3}$  $-5x^{2}$ -x2 'with no remainder'

 $\therefore (x-1)$  is a factor

 $\boldsymbol{x}$ 

•<sup>2</sup> ✓

-2x

# Candidate B - grid method

$$\therefore (x-1)(2x^3 + 5x^2 + x - 2) = 2x^4 + 3x^3 - 4x^2 - 3x + 2$$
  
\therefore (x-1) is a factor

Question		n	Generic scheme	Illustrative scheme	
10.	(b)		•³ identify cubic and attempt to factorise	•³ eg -1 2 5 1 -2 -2 3 2  or -2 2 5 1 -2 -4 -2 2 1	4
			• <sup>4</sup> find second factor	•4 eg  -1	
			<ul> <li>• identify quadratic</li> <li>• complete factorisation</li> </ul>	•5 $2x^2 + 3x - 2$ or $2x^2 + x - 1$ •6 $(x-1)(x+1)(2x-1)(x+2)$ stated explicitly	

## Notes:

- 4. Ignore the appearance of = 0.
- 5. Candidates who arrive at  $(x-1)(x+1)(2x^2+3x-2)$  or  $(x-1)(x+2)(2x^2+x-1)$  by using algebraic long division or by inspection, gain  $\bullet^3$ ,  $\bullet^4$  and  $\bullet^5$ .
- 6. Where a candidate only identifies additional factors from a quartic, only 4 is available.
- 7. 3 and 4 may be awarded for applications of synthetic division even when previous trials contain errors. 5 and 6 are available.

Question

# Generic scheme

### Illustrative scheme

Max mark

### 10. (b) (continued)

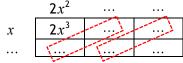
# **Commonly Observed Responses:**

# Candidate C - grid method

(a)

	$2x^3$	$5x^2$	X	-2
x	$2x^4$	$5x^3$	$x^2$	<b>-2</b> <i>x</i>
-1	$-2x^3$	$-5x^{2}$	-x	2

(b)



dad for avidence of the cubic

• 3 is awarded for evidence of the cubic expression (which may be in the grid from part (a) ) AND the terms in the diagonal boxes summing to the second and third terms in the cubic respectively.

$$2x^2 + 3x - 2$$

$$(x-1)(x+1)(2x-1)(x+2)$$

## Candidate D - grid method

(a)

` ′	$2x^3$	$5x^2$	х	-2
$\boldsymbol{x}$	$2x^4$	$5x^3$	$x^2$	<b>-2</b> <i>x</i>
-1	$-2x^{3}$	$-5x^{2}$	-x	2

(b)

	$2x^2$	•••	
x	$2x^3$		
•••	\	سسيناس	

•³ is awarded for evidence of the cubic expression (which may be in the grid from part (a) ) AND the terms in the diagonal boxes summing to the second and third terms in the cubic respectively.

$$2x^2 + x - 1$$

$$(x-1)(x+2)(x+1)(2x-1)$$

•<sup>6</sup> ✓

### Candidate E

 $\left(x-\frac{1}{2}\right)\left(2x^2+6x+4\right)$ •<sup>5</sup>  $\checkmark$ 

$$(2x-1)(x^2+3x+2)$$

(x-1)(2x-1)(x+1)(x+2)

3 / 4 /

Candidate F

$$(x-\frac{1}{2})(2x^2+6x+4)$$

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

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

•³ **✓** •<sup>4</sup> •