Question 1

Question number	Scheme	Marks
(a)	$f(-2)=2.(-2)^3-7.(-2)^2-10.(-2)+24$	M1
	$=0$ so $(x+2)$ is a factor	A1
		(2)
(b)	$\text{f}(x)=(x+2)(2x^2-11x+12)$	M1 A1
	$\text{f}(x)=(x+2)(2x-3)(x-4)$	dM1 A1
		(4)
		6 marks
Notes (a)	**M1** : Attempts $\text{f}(\pm2)$ (Long division is M0) **A1** : is for $=0$ **and conclusion** **Note**: Stating "hence factor" or "it is a factor" or a "√" (tick) or "QED" is fine for the conclusion. **Note** also that a conclusion can be implied from a <u>preamble</u>, eg: "If $\text{f}(-2)=0$, $(x+2)$ is a factor…." (Not just f(-2)=0)	
(b)	**1st M1**: Attempts long division by correct factor or other method leading to obtaining $(2x^2 \pm ax \pm b)$, $a \neq 0$, $b \neq 0$, even with a remainder. Working need not be seen as could be done "by inspection." Or *Alternative Method*: **1st M1**: Use $(x+2)(ax^2+bx+c)=2x^3-7x^2-10x+24$ with expansion and comparison of coefficients to obtain $a=2$ and to obtain values for b and c **1st A1**: For seeing $(2x^2-11x+12)$. [Can be seen here in (b) after work done in (a)] **2nd M1**: Factorises quadratic. (see rule for factorising a quadratic). This is dependent on the previous method mark being awarded and **needs factors** **2nd A1**: is cao and needs all three factors together. Ignore subsequent work (such as a solution to a quadratic equation.) Note: Some candidates will go from $\{(x+2)\}(2x^2-11x+12)$ to $\{x=-2\}$, $x=\frac{3}{2}$, 4, and not list all three factors. Award these responses M1A1M0A0. Finds $x=4$ and $x=1.5$ by factor theorem, formula or calculator and produces factors M1 $\text{f}(x)=(x+2)(2x-3)(x-4)$ **or** $\text{f}(x)=2(x+2)(x-1.5)(x-4)$ **o.e. is full marks** $\text{f}(x)=(x+2)(x-1.5)(x-4)$ **loses last A1**	

Question 2

Question Number	Scheme		Marks
(a)	Either (Way 1) : Attempt $\mathrm{f}(3)$ or $\mathrm{f}(-3)$ $\mathrm{f}(3) = 54 - 45 + 3a + 18 = 0 \Rightarrow 3a = -27 \Rightarrow a = -9$ *	Or (Way 2): Assume $a = -9$ and attempt $\mathrm{f}(3)$ or $\mathrm{f}(-3)$ $\mathrm{f}(3) = 0$ so $(x - 3)$ is factor	M1 A1 * cso (2
	Or (Way 3): $\left(2x^3 - 5x^2 + ax + 18\right) \div (x - 3) = 2x^2 + px + q$ where p is a number and q is an expression in terms of a Sets the remainder $18 + 3a + 9 = 0$ and solves to give $a = -9$		M1 A1* cso (2)
(b)	Either (Way 1): $\mathrm{f}(x) = (x - 3)(2x^2 + x - 6)$ $= (x - 3)(2x - 3)(x + 2)$		M1A1 M1A1 (4
	Or (Way 2) Uses trial or factor theorem to obtain $x = -2$ or $x = 3/2$ Uses trial or factor theorem to obtain both $x = -2$ **and** $x = 3/2$ Puts three factors together (see notes below) Correct factorisation : $(x - 3)(2x - 3)(x + 2)$ or $(3 - x)(3 - 2x)(x + 2)$ or $2(x - 3)(x - \frac{3}{2})(x + 2)$ oe		M1 A1 M1 A1 (4
	Or (Way 3) No working three factors $(x - 3)(2x - 3)(x + 2)$ otherwise need working		M1A1M1A1

Question 3

Question Number	Scheme		Marks
	If there is no labelling, mark (a) and (b) in that order		
(a)	$f(x) = 2x^3 - 7x^2 + 4x + 4$		
	$f(2) = 2(2)^3 - 7(2)^2 + 4(2) + 4$	Attempts $f(2)$ or $f(-2)$	M1
	$= 0$, and so $(x-2)$ is a factor.	$f(2) = 0$ with no sign or substitution errors ($2(2)^3 - 7(2)^2 + 4(2) + 4 = 0$ is sufficient) **and for conclusion.** Stating "hence factor" or "it is a factor" or a "tick" or "QED" or "no remainder" or "as required" are fine for the conclusion **but not = 0 just underlined and not hence (2 or f(2)) is a factor**. Note also that a conclusion can be implied from a preamble, eg: "If $f(2) = 0$, $(x-2)$ is a factor…."	A1
	Note: Long division scores no marks in part (a). The factor theorem is required.		
			[2]
(b)	$f(x) = \{(x-2)\}(2x^2 - 3x - 2)$	M1: Attempts long division by $(x-2)$ or other method using $(x-2)$, to obtain $(2x^2 \pm ax \pm b)$, $a \neq 0$, even with a remainder. Working need not be seen as this could be done "by inspection."	M1 A1
		A1: $(2x^2 - 3x - 2)$	
	$= (x-2)(x-2)(2x+1)$ or $(x-2)^2(2x+1)$ or equivalent e.g. $= 2(x-2)(x-2)(x+\frac{1}{2})$ or $2(x-2)^2(x+\frac{1}{2})$	dM1: Factorises a 3 term quadratic. (see rule for factorising a quadratic in the General Principles for Core Maths Marking). **This is dependent** on the previous method mark being awarded but there must have been no remainder. Allow an attempt to solve the quadratic to determine the factors.	dM1 A1
		A1: cao – needs all three factors **on one line**. Ignore following work (such as a solution to a quadratic equation.)	
	Note $= (x-2)(\frac{1}{2}x - 1)(4x+2)$ would lose the last mark as it is not **fully** factorised		
	For correct answers only award full marks in (b)		
			[4]
			Total 6

Question 4

Question Number	Scheme		Marks
	$f(x) = -4x^3 + ax^2 + 9x - 18$		
(a)	$f(2) = -32 + 4a + 18 - 18 = 0$	Attempts $f(2)$ or $f(-2)$	M1
	$\Rightarrow 4a = 32 \Rightarrow a = 8$	cso	A1
			[2]
(a) Way 2	$f(x) = (x-2)(px^2 + qx + r)$		
	$= px^3 + (q-2p)x^2 + (r-2q)x - 2r$		
	$r = 9 \Rightarrow q = 0$ also $p = -4 \therefore a = -2p = 8$	Compares coefficients leading to $-2p = a$	M1
	$a = 8$	cso	A1
(a) Way 3	$(-4x^3 + ax^2 + 9x - 18) \div (x-2)$		
	$Q = -4x^2 + (a-8)x + 2a - 7$ $R = 4a - 32$	Attempt to divide $\pm f(x)$ by $(x - 2)$ to give a quotient at least of the form $\pm 4x^2 + g(a)x$ and a remainder that is a function of a	M1
	$4a - 32 = 0 \Rightarrow a = 8$	cso	A1
	$f(x) = (x-2)(-4x^2 + 9)$	Attempts long division or other method, to obtain $(-4x^2 \pm ax \pm b)$, $b \neq 0$, even with a remainder. Working need not be seen as this could be done "by inspection."	M1
(b)	$= (x-2)(3-2x)(3+2x)$	dM1: A ***valid*** attempt to factorise their quadratic – see General Principles. **This is dependent** on the previous method mark being awarded	

	or equivalent e.g. $= -(x-2)(2x-3)(2x+3)$ or $= (x-2)(2x-3)(-2x-3)$	method mark being awarded, but there must have been no remainder. A1: cao – must have all 3 factors on the same line. Ignore subsequent work (such as a solution to a quadratic equation.)	dM1A1
			[3]
(c)	$f\left(\frac{1}{2}\right) = -4\left(\frac{1}{8}\right) + 8\left(\frac{1}{4}\right) + 9\left(\frac{1}{2}\right) - 18 = -12$	Attempts $f\left(\frac{1}{2}\right)$ or $f\left(-\frac{1}{2}\right)$ Allow A1ft for the correct numerical value of $\frac{\text{their } a}{4} - 14$	M1A1ft
			[2]
(c) Way 2	$\pm\left(-4x^3 + 8x^2 + 9x - 18\right) \div (2x-1)$		
	$Q = -2x^2 + 3x + 6$ $R = -12$	M1: Attempt long division to give a remainder that is independent of x A1: Allow A1ft for the correct numerical value of $\frac{\text{their } a}{4} - 14$.	M1A1ft
			Total 7

Question 5

Question Number	Scheme	Marks
(a)	$f(-2) = 6(-2)^3 + 13(-2)^2 - 4$ Attempts $f(-2)$.	M1
	$= 0$, and so $(x+2)$ is a factor. $f(-2) = 0$ with no sign or substitution errors and for conclusion.	A1
		[2]
(b)	$f(x) = \{(x+2)\}(6x^2 + x - 2)$	M1 A1
	$= (x+2)(2x-1)(3x+2)$	M1 A1
		[4]

Question 6

Question Number	Scheme	Marks
(a)	Attempt $f(3)$ or $f(-3)$ Use of long division is M0A0 as factor theorem was required.	M1
	$f(-3) = 162 - 63 - 120 + 21 = 0$ so $(x+3)$ is a factor	A1
		(2)
(b)	Either (Way 1): $f(x) = (x+3)(-6x^2 + 11x + 7)$	M1A1
	$= (x+3)(-3x+7)(2x+1)$ or $-(x+3)(3x-7)(2x+1)$	M1A1
		(4)
	Or (Way 2) Uses trial or factor theorem to obtain $x = -1/2$ **or** $x = 7/3$	M1
	Uses trial or factor theorem to obtain both $x = -1/2$ **and** $x = 7/3$	A1
	Puts three factors together (see notes below)	M1
	Correct factorisation : $(x+3)(7-3x)(2x+1)$ or $-(x+3)(3x-7)(2x+1)$ oe	A1
		(4)
	Or (Way 3) No working three factors $(x+3)(-3x+7)(2x+1)$ otherwise need working	M1A1M1A1 (4)