Question Number	Scheme	Marks
6.(a)	Sets $f(3)=0 \rightarrow$ equation in k Eg. $27k-135-96-12=0$ $\Rightarrow 27k=243 \Rightarrow k=9$ * (= 0 must be seen)	M1 A1* **(2)**
(b)	$9x^3-15x^2-32x-12=(x-3)\left(9x^2+12x+4\right)$ $=(x-3)(3x+2)^2$	M1 A1 dM1 A1 **(4)**
(c)	Attempts $\cos\theta=-\frac{2}{3}$ $\theta=131.8°, 228.2°$ (awrt)	M1 A1 **(2)** **(8 marks)**

Notes

(a)

M1 Attempts to set $f(3)=0 \rightarrow$ equation in k Eg. $27k-135-96-12=0$. Condone slips.

Score when you see embedded values within the equation or two correct terms on the lhs of the equation. It is implied by sight of $27k-243=0$ or $27k=135+96+12$.

A1* Completes proof with at least one intermediate "solvable" line namely $27k=243 \Rightarrow k=9$ or $27k-243=0 \Rightarrow k=9$. This is a given answer so there should be no errors.

It is a "show that" question so expect to see

(i) Either $f(3)=0$ explicitly stated or implied by sight of $27k-135-96-12=0$ or $27k-243=0$

(ii) One solvable intermediate line followed by $k=9$

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A candidate could use $k=9$ and start with $f(x)=9x^3-15x^2-32x-12$

M1 For attempting $f(3)=9\times3^3-15\times3^2-32\times3-12$.

Alt attempts to divide $f(x)$ by (*x*-3). See below on how to score such an attempt

A1* Shows that $f(3)=0$ and makes a minimal statement to the effect that "so $k=9$"

If division is attempted it must be correct and a statement is required to the effect that there is no remainder, " so $k=9$"

.....

If candidates have divided (correctly) in part (a) they can be awarded the first two marks in (b) when they start factorsing the $9x^2+12x+4$ term.

(b)

M1 Attempt to divide or factorise out $(x-3)$. Condone students who use a different value of *k*.

For factorisation look for first and last terms $9x^3-15x^2-32x-12=(x-3)\left(\pm9x^2.....\pm4\right)$

For division look for the following line $x-3\overline{)9x^3-15x^2-32x-12}$ with $9x^2+.....$ and $\underline{9x^3-27x^2}$

A1 Correct quadratic factor $9x^2+12x+4$.

You may condone division attempts that don't quite work as long as the correct factor is seen.

Question Number	Scheme	Marks

dM1 Attempt at factorising their $9x^2+12x+4$ Apply the usual rules for factorising

A1 $(x-3)(3x+2)^2$ or $(x-3)(3x+2)(3x+2)$ on one line.

Accept $9(x-3)\left(x+\frac{2}{3}\right)^2$ oe. It must be seen as a product

Remember to isw for candidates who go on to give roots $f(x)=(x-3)(3x+2)^2 \Rightarrow x=....$

.....

Note: Part (b) is "Hence" so take care when students **write down the answer** to (b) without method

If candidates state $x=-\frac{2}{3},3 \Rightarrow f(x)=\left(x+\frac{2}{3}\right)\left(x+\frac{2}{3}\right)(x-3)$ score 0 0 0 0

If candidates state $x=-\frac{2}{3},3 \Rightarrow f(x)=(3x+2)(3x+2)(x-3)$ they score SC 1010.

If candidates state $x=-\frac{2}{3},3 \Rightarrow f(x)=9\left(x+\frac{2}{3}\right)\left(x+\frac{2}{3}\right)(x-3)$ they score SC 1010.

If candidate writes down $f(x)=(3x+2)(3x+2)(x-3)$ with no working they score SC 1010.

If a candidate writes down $(x-3)(3x+2)$ are factors it is 0000

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(c)

M1 A correct attempt to find one value of θ in the given range for their $\cos\theta=-\frac{2}{3}$

(You may have to use a calculator). So if (b) is factorised correctly the mark is for one of the values.

This can be implied by sight of awrt 132 or 228 in degrees or awrt 2.3 which is the radian solution.

A1 CSO awrt $\theta=131.8°, 228.2°$ with no additional solutions within the range $0 \leqslant \theta < 360°$

Watch for correct solutions appearing from $3\cos\theta-2=0 \Rightarrow \cos\theta=\frac{2}{3}$. This is M0 A0

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Answers without working are acceptable.

M1 For one correct answer

M1 A1 For two correct answers with no additional solutions within the range.

Question Number	Scheme	Marks
7.(a)	Attempts to use $31\,500 = 16\,200 + 9d$ to find 'd'	M1
	For 16 200 + their $d = (1700)$ where d has been found by an allowable method	M1
	Year 2 salary is (£)17 900	A1
		(3)
(b)	Attempts to use $31\,500 = 16\,200r^{9}$ to find 'r'	M1
	For 16 2000 × their $r = (1.077)$ where r has been found by an allowable method	M1
	Year 2 salary in the range $17440 \leqslant \mathbb{S} \leqslant 17450$	A1
		(3)
(c)	Attempts $\frac{10}{2}\{16200 + 31500\}$ or $\frac{16200\left(1.077^{10} - 1\right)}{1.077 - 1}$	M1
	Finds $\pm\left(\frac{10}{2}\{16200 + 31500\} - \frac{16200\left('1.077'^{10} - 1\right)}{'1.077' - 1}\right)$	dM1
	Difference = £7480 cao	A1
		(3)
		(9 marks)

Notes

(a)

M1 Attempts to use the AP formula in an attempt to find 'd'

Accept an attempt at $31\,500 = 16\,200 + 9d$ resulting in a value for d.

Accept the calculation $\frac{31500 - 16200}{9}$ condoning slips on the 31500 and 16200

M1 A correct attempt to find the second term by adding 16 200 to their 'd' which must have been found via an allowable method.

Allow d to be found from an "incorrect" AP formula with $10d$ being used instead of $9d$.

Eg $31\,500 = 16\,200 + 10d$ or more likely $\frac{31500 - 16200}{10} = 1530$ usually leading to an answer of 17730

A1 Year 2 salary is (£) 17 900

(b)

M1 Attempts to use the GP formula in an attempt to find 'r'

Accept an attempt at $31\,500 = 16\,200r^{9} \Rightarrow r^{9} = \frac{31500}{16200} \Rightarrow r = ...$ condoning numerical slips.

Accept the calculation $\sqrt[9]{\frac{31500}{16200}}$ or $\sqrt[9]{\frac{35}{18}}$ condoning slips on the 31500 and 16200.

It will most likely be implied by a value of r rounding to 1.08

Accept an attempt at $31\,500 = 16\,200r^{9}$ via logs condoning slips but correct log work must be seen