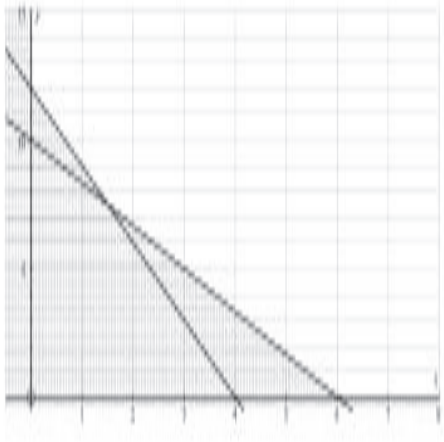
Section A

Question			Answer	Marks	Part Marks and Guidance	
1			For (5, 2) use $x^2 + y^2$ = 29 so inside	**M1** **A1** **A1** **3**	Substitute or use Pythagoras **soi** or $\sqrt{29}$ Conclusion (dependent on M1A1 awarded)	As usual only award A marks if the M mark has been awarded. **Alternative method:** Sub of $x = 5$ or $y = 2$ in $x^2 + y^2 = 30$ to find y or x **M1** $y = \sqrt{5}$ or $x = \sqrt{26}$ **A1**
2			$\frac{dy}{dx} = 3x^2 - 2x - 2$ At $x = 3$ gradient $= 27 - 6 - 2 = 19$ $\Rightarrow y - 9 =$ "their" $19(x - 3)$ $\Rightarrow y = 19x - 48$ oe	**M1** **A1** **A1** **M1** **A1** **5**	Differentiate All three terms correct 19 **isw** (**dep** on first **M1**) Find line using correct point and *their* 19	At least one power decreased by 1. "*their*" 19 means: the value of the derivative Only 3 terms
3	i		eg $\cos P = \frac{8^2 + 7^2 - 9^2}{2.8.7}$ oe $\Rightarrow P = 73.4°$	**M1** **A1** **M1** **A1** **4**	Cosine formula correctly used to find any angle Anything that rounds to 73.4°, 48.2° or 58.4° For identifying correct angle	 Anything that rounds to 73.4°

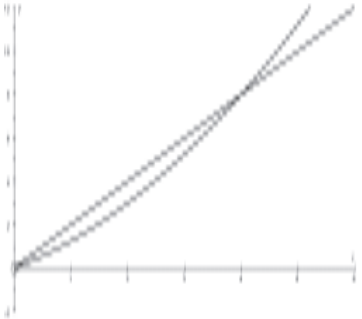
Question			Answer	Marks	Part Marks and Guidance	
3	ii		Area $= \frac{1}{2} \times 7 \times 8 \times \sin(\textit{their angle P})$ $= 26.8$	**M1** **A1** **A1** **3**	Use of formula Correct substitution from *their* **(i)** Anything that rounds to 26.8 Accept complete alternative methods	Can be at any vertex
4			$5\sin 2x = 2\cos 2x$ $\Rightarrow \tan 2x = 0.4$ $\Rightarrow 2x = 21.8,\ 201.8$ $\Rightarrow x = 10.9,\ 100.9$ Also $x = 190.9, 280.9$	**M1** **A1** **A1** **A1** **A1** **5**	Use of tan 0.4 10.9 Any 2nd value 3rd and 4th values (*ignore extra solutions)*	allow tan$x$ = 0.4 for **M1A1** **Alternative method** Use of Pythagoras to get $\sin 2x = \frac{2}{\sqrt{29}}$ or $\cos 2x = \frac{5}{\sqrt{29}}$ **M1A1** *and the last three marks are still available, ignore extra solutions*
5	a		*M is* $\left(\frac{-2+4}{2}, \frac{1+9}{2}\right)$ *which is* $(1,5)$	**B1** **1**		
5	b		Gradient of AC is $\frac{9-1}{4+2} = \frac{4}{3}$ Gradient of BM is $\frac{2-5}{5-1} = -\frac{3}{4}$ $\frac{4}{3} \times -\frac{3}{4} = -1$ oe	**B1** **B1** **B1** **3**	One gradient Second gradient *Their* $m_1 \times m_2 = -1$	 Eg One is the negative reciprocal of the other
5	c	i	Isosceles	**B1** **1**	Allow right-angled isosceles	Accept wrong spelling Do not accept right-angled triangle

Question			Answer	Marks	Part Marks and Guidance	
5	c	ii	$AB^2 = 7^2 + 1^2 = 50$ $BC^2 = 7^2 + 1^2 = 50$ $\Rightarrow$ two sides equal in length	**M1** **A1** **2**	Using Pythagoras on AB and BC Or fully labelled diagram with correct sides shown	Attempt by vectors **AB** and **BC M1** **Alternative** If answer to **(c)(i)** was right-angled, then accept proof that it is (requires all three lengths.) **Alternative:** If **(c)(i)** was equilateral or scalene then **M1** (only) for attempt at all three sides. NB If nothing is written in **(i)** then no credit in this part.
6			$(x \pm 5)(x \pm 7)$ Boundaries $x = 5, x = 7$ $\Rightarrow 5 \le x \le 7$	**M1** **A1** **B2** **4**	Or use of correct formula (allow one error in substitution) or correct shaped graph seen **soi** Accept $x \ge 5$, $x \le 7$ for **B1, B1**	 Condone < or >
7	a	i	Attempt to find f(2) by substitution of 2 = 0, So Yes	**M1** **A1** **2**	Remainder theorem or attempt to divide (justification is sight of $x^3 - 2x^2$) Or: attempt to factorise, justification is sight of $(x^2 \ldots 3)$ Correct working only	
7	a	ii	f(−1) = −1 + 7 + 6 = 12 so no.	**B1** **1**	Sight of 12 or correct evidence, conclusion required	
7	b	i	f(x) = (x − 2)(x^2 +2x −3) = (x − 2)(x + 3)(x − 1)	**M1** **A1** **A1** **3**	Attempt to factorise or use long division (justifications as in **(a)(i)**) Sight of correct quadratic **soi** Answer	**Alternative:** Use of Remainder theorem **M1** Sight of 2nd factor **A1** All correct **A1**
7	b	ii	x = 1, 2, –3	**B1** **1**	**FT** their brackets	Must be three roots

Question			Answer	Marks	Part Marks and Guidance	
8	i			**B1** **B1** **B1** **B1** **B1** **5**	for one line for correct shading for other line for correct shading for correct shading to give $x \geq 0$, $y \geq 0$ NB If intercepts are within 1 small square of the correct points then give the marks for the lines	*If there is work here that is not crossed out, then mark it and ignore anything on Page 18.* Helpful hint: Lines go through (0, 12) and (4,0) (0, 10) and (6, 0) Intersection at (1.5, 7.5) If **B0** for a line allow **B1** for shading if negative gradient and lines intersect
8	ii		$6x + y$ is minimum at (0, 12) *(can be implied by correct answer)* So is 12	**B1** **B1** **2**		
9			$\frac{dy}{dx} = 3x^2 - 2x + 4 \Rightarrow (y) = x^3 - x^2 + 4x + c$ (2,2) satisfies $\Rightarrow 2 = 8 - 4 + 8 + c$ $\Rightarrow c = -10$ $\Rightarrow y = x^3 - x^2 + 4x - 10$	**M1** **A1** **M1** **A1** **4**	Integrate Ignore c (**dep** on 1st **M1** mark) Substitute **cao**	At least one term with power increased by 1. (NB do not accept multiplying throughout by x) (ie must be $y =$ ….)
10			$\sin\theta = \frac{2}{5} \Rightarrow \sin^2\theta = \frac{4}{25} \Rightarrow 0.16 + \cos^2\theta = 1$ $\cos^2\theta = \frac{21}{25}$ $\Rightarrow \cos\theta = \frac{1}{5}\sqrt{21}$ oe	**M1** **A1** **A1** **3**	Use of Pythagoras $\cos^2\theta$ eg $\sqrt{0.84}$ or $\sqrt{\frac{21}{25}}$ **isw**	Sight of a triangle with sides 2, 5, $\sqrt{21}$ acceptable for **M1** Then **A2** for $\cos\theta$ NB **M0** if calculator used to find θ in order to find $\cos\theta$

Section B

Question			Answer	Marks	Part Marks and Guidance	
11	i		$P(0) = (0.95)^6$ $= 0.735(09189\ldots)$	**M1** **A1** **2**	Correct *p* plus correct power	Not 2sf
11	ii		$P(1) = 6 \times (0.95)^5 \times (0.05)^1$ $= 0.232(134281\ldots)$	**M1** **B1** **B1** **A1** **4**	Correct *p* and *q* and powers add to 6 Coefficient **soi** Correct powers for correct *p* and *q* **soi**	Coefficient may be missing
11	iii		$P(1^{st}$ box contains 2 or more eggs) $= 1 -$ (their**(i)** + their **(ii)**) $= 1 - (0.7351 + 0.2321) = 1 -$ $0.9672 = 0.0328$ $P(2^{nd}$ box has any cracked eggs) $= 1 -$ *their* **(i)** $= 0.2649$ P(consignment is rejected) $= 0.0328 + 0.2649 \times$ their **(ii)** $= 0.0328 + 0.0615$ $= 0.0943$	**M1** **A1** **M1** **A1** **M1** **A1** **6**	 Accept anything rounding to 0.033 Accept anything rounding to 0.265 In either method, accept answers which lie between 0.094 and 0.095	Alternative P(accepted) **M1** Ans**(ii)** × Ans**(i)** **A1** 0.1706 **soi** (Accept 0.171) **M1(dep)** Add to this Ans**(i)** **A1** 0.9057 (Accept 0.906) **M1** P(consignment is rejected) $= 1 - 0.9057$ **A1** $= 0.09428$

Question			Answer	Marks	Part Marks and Guidance	
12	a		$s = ut + \frac{1}{2}at^2$ with $u = 0$ and $a = 2$ $\Rightarrow s = t^2$	**M1** **A1** **2**	Constant acceleration formulae or integrate twice – ignore *c*	
12	b		$(v) = \frac{t^2}{4} + t$ $s = \frac{t^3}{12} + \frac{t^2}{2}$ Ignore *c*	**M1** **A1** **M1** **A1** **4**	Integrate Integrate	
12	c	i	$\frac{t^3}{12} + \frac{t^2}{2} = t^2$ $\Rightarrow \frac{t}{12} + \frac{1}{2} = 1$ $\Rightarrow t = 6$	**M1** **A1** **2**	Equate their functions	
12	c	ii	$s = 6^2$ or $s = \frac{6^3}{12} + \frac{6^2}{2}$ Displacement = 36 (m)	**M1** **A1** **2**	Substitute *their non-zero* **(c)(i)** in *their* **(a)** or **(b) soi**	
12	d			**B1** **B1** **2**	One clearly straight line through origin with positive gradient Other clearly a curve through the origin of correct shape with first part below the line as per diagram	Ignore labels

Question			Answer	Marks	Part Marks and Guidance	
13	i		$AO^2 = x^2 + x^2 = 2x^2$ or $AC^2 = (2x)^2 + (2x)^2 = 8x^2$ $h^2 + AO^2 = AE^2 \Rightarrow h^2 + 2x^2 = 25$ $\Rightarrow 2x^2 = 25 - h^2$	**M1** **A1** **2**	Correct application of Pythagoras on the base Algebra must be convincing	 NB Answer is given
13	ii		$V = \frac{1}{3} \times$ base area $\times$ height $= \frac{1}{3} \times 4x^2 h$ $= \frac{50h - 2h^3}{3}$	**M1** **A1** **2**	Formula seen including $4x^2$	Care: the answer is given
13	iii		$\frac{dV}{dh} = \frac{50 - 6h^2}{3}$ $= 0$ when $50 - 6h^2 = 0$ $\Rightarrow h^2 = \frac{25}{3}$ $\Rightarrow h = \sqrt{\frac{25}{3}} = \frac{5}{\sqrt{3}} = \frac{5}{3}\sqrt{3} = 2.89$	**M1** **A1** **M1** **A1** **4**	Differentiation **cao** **dep** Set (numerator) = 0 Any of these answers is acceptable	**SC3** $h = 2.89$ with either $\frac{dV}{dh}$ or $\frac{1}{3}$ missing Numerical value must be 2.89
13	iv		$\frac{d^2V}{dh^2} = -4h$ < 0 so maximum	**M1** **A1** **2**	Or alternatives: Complete method to investigate value of derivative Or: complete method to investigate the value of V either side **and** at the turning point	Accept $-12h$
13	v		At this point sinEAO $= \frac{h}{5} = \frac{1}{3}\sqrt{3}$ $\Rightarrow$ Angle EAO = 35.3°	**M1** **A1** **2**	Use of a correct ratio with *their h* (and/or *x*) Accept 35.2 which comes from $h = 2.88$	

Question			Answer	Marks	Part Marks and Guidance	
14	a	i	Max value = 1	B1 1		Not from any use of 0.2 from graph
14	a	ii	Height = 0.2 (m) or 20 cm	B1 1		
14	b		$x^4 - 4x^3 + 6x^2 - 4x + 1$ $\Rightarrow y = \frac{1}{5}\left(4x - 6x^2 + 4x^3 - x^4\right)$	B2 B1 3	-1 each error **Dep on B2** convincing algebra (means sight of an extra correct step **www**)	An error is signs, powers, coefficients, failure to include the 1 at end
14	c		Area = $\int_0^2 \frac{1}{5}\left(4x - 6x^2 + 4x^3 - x^4\right).dx$ $= \frac{1}{5}\left[2x^2 - 2x^3 + x^4 - \frac{x^5}{5}\right]_0^2$ $= \frac{1}{5}\left(8 - 16 + 16 - \frac{32}{5}\right) = \frac{8}{25}$ $= 0.32$ Area of cross section = $0.32m^2$ = $3200cm^2$	M1 A3 M1 A1 A1 7	Integrate (ignore c) **A2** if one error, **A1** if two errors (**Dep** on 1st **M1**) Deal with limits correctly (Putting $x = 0$ does not need to be seen) Units	**Alternative method:** Integrate original function is OK, but in dealing with limits $x = 0$ must then be seen. Omission of $\frac{1}{5}$ is one error. Multiply by $\frac{1}{5}x$ or $\frac{1}{5x}$, ie integrating $\frac{1}{5}$ gives **A0**