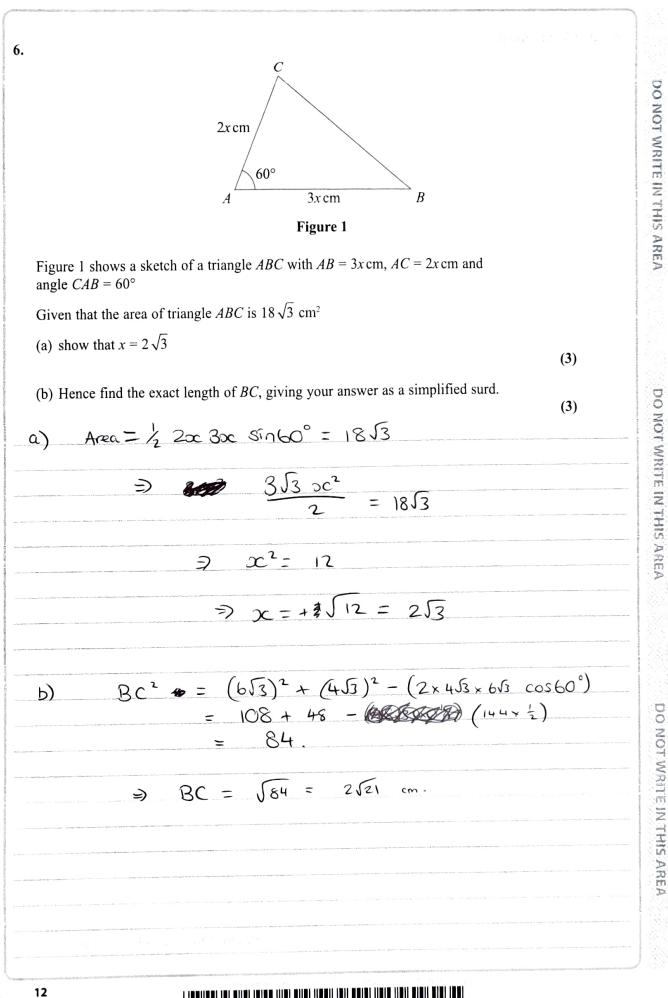
The line l_2 has equation $y = mx + 7$, where m is a	constant.
Given that l_1 and l_2 are perpendicular,	
(a) find the value of m .	
(a) find the value of <i>m</i> .	(2)
The lines l_1 and l_2 meet at the point P.	
(b) Find the x coordinate of P.	
、 、	(2)
a) 20x + 4y - 3=0 => 4y= =>	3 - 2c
	$y = \sqrt{2} - \frac{1}{2} \sqrt{2}$
$= m_{l_2} = 2$.	
	2
b) $y = 2x + 7$, $y = 7$	$-\frac{1}{2}\infty + \frac{3}{4}$
	and the set of the set
$2x_{+} + 7 = \frac{1}{2} x_{+} + \frac{1}{2}$	na serve a transferrar george en en en george a litter a george en en transferrar a blev made a made a made a s
$=) 1_2 \Delta_p - 1_4$	1997 C 1921
$\Rightarrow x = -\frac{5}{2}$	Section 196 and 197 call-point pro-
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	n na statu statu st

2. Find, using algebra, all real solutions to the equation (i) $16a^2 = 2\sqrt{a}$	
	(4)
(ii) $b^4 + 7b^2 - 18 = 0$	(4)
i) $16a^2 = 2\sqrt{a}$.	
$= a^{3/2} = \frac{1}{8} 0.$	(4) (4)
$= 2 a = \frac{1}{4}, 0$	
ii) Let $C = b^2$.	
$c^{2} + 7c - 18 = 0$	
(c + 9)(c - 2) = 0 $\Rightarrow c = -9, 2.$	
$b^2 = -9, 2.$	
$b^2 \neq -9$, so $b^2 = 2$	
$\Rightarrow b = \pm \sqrt{2}$	

3. (a) Given that k is a constant, find	Serveringen aufordet i	
$\int \left(\frac{4}{x^3} + kx\right) dx$		DO
simplifying your answer.	(3)	NOT W
(b) Hence find the value of k such that		RITEI
$\int_{0.5}^{2} \left(\frac{4}{x^3} + kx\right) dx = 8$	(3)	DO NOT WRITE IN THIS AREA
a) $\int \frac{-3}{4x + 2x} dx$		
$= -2x^{2} + \frac{12}{2}x^{2} + C$		D
$= -2 + \frac{1}{2}kx^{2} + C$		ION O
		WRIT
b) \int_{4}^{2}		DO NOT WRITE IN THIS AREA
b) $\int 4x^{-3} + kx dx$		HIS AR
$\int -2 + 2 \int^2$		EA
$= \left[\frac{2}{x^2} + \frac{1}{2}kx^2 \right]_{0.5}$		tanta marana 1995 - 1995 1995 - 1995 - 1995 1995 - 1905 -
$= \left(-\frac{1}{2} + 2k\right) \overline{4} \left(-8 + \frac{1}{8}k\right)$		
		001
$=\frac{15}{2}+\frac{15}{8}k$ = 8.		NOT W
$\Rightarrow \frac{15}{8}k = \frac{1}{2}$		RITEI
$= 2 k = \frac{4}{15}$		DO NOT WRITE IN THIS AREA
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 A tree was planted in the ground. Its height, H metres, was measured t years after planting. 	
Exactly 3 years after planting, the height of the tree was 2.35 metres. Exactly 6 years after planting, the height of the tree was 3.28 metres.	
Using a linear model,	(3)
(a) find an equation linking H with t .	
	(3)
The height of the tree was approximately 140 cm when it was planted.	
(b) Explain whether or not this fact supports the use of the linear model in part (a).	(2)
a) $H = mt + c$	
2.35 = 3m + c	
3.28 = 6m + c	
\Rightarrow $3m = 222$ 0.93	
= 2 m = 0.31	
= 2 C = 1.42.	
→ H = 0-31t + 1.42	
b) $140 \text{ cm} = 1.4 \text{ m}$.	
$1.4 \approx 1.42$, so this supports to model.	he

(3)
(2)
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7. The curve C has equation

$$y = \frac{k^2}{x} + 1 \qquad x \in \mathbb{R}, \ x \neq 0$$

where k is a constant.

(a) Sketch C stating the equation of the horizontal asymptote.

The line *l* has equation y = -2x + 5

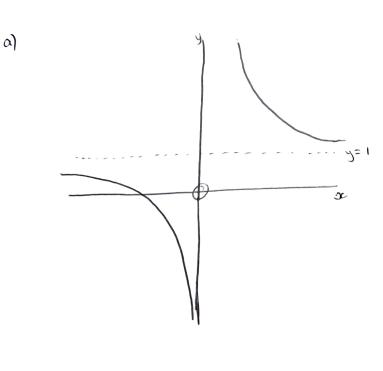
(b) Show that the *x* coordinate of any point of intersection of *l* with *C* is given by a solution of the equation

$$2x^2 - 4x + k^2 = 0$$

(2)

(3)

(3)



(c) Hence find the exact values of k for which l is a tangent to C.

Question 7 continued b) $y = -2x+5 = p^2 \frac{1}{x} + 1$ $= -2x^2 + 5x = k^2 + 3c$ $= 2x^2 - 4x + b^2 = 0$ $b^2 - 4ac = 0$ c) =) 16 - 8k² = 0 $\Rightarrow p^2 = 2$ =) $p_{2} = \pm \sqrt{2}$. (Total for Question 7 is 8 marks) 15 , I DENIDËN DI ËNAT KARTËNE ËNE TREVI KAN KURTËNE ËNITËNI TREVI DEN

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8. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of
$\left(2+\frac{3x}{4}\right)^6$
giving each term in its simplest form. (4)
 (b) Explain how you could use your expansion to estimate the value of 1.925⁶ You do not need to perform the calculation. (1)
a) $(2 + \frac{3}{4}x)^{b} = 2^{b} + (^{b}C_{1} \times 2^{5} \times \frac{3}{4}x) + (^{b}C_{2} \times 2^{4} \times [\frac{3}{4}x]^{2})$
$= 64 + 1440c + 135x^2$.
b) Set $2 + \frac{3}{4}x = 1.925$.
$\frac{3}{4} \propto = -0.075$
$\Rightarrow c = -0.1$
Use $\infty = -0.1$ in the expansion above.



9. A company started mining tin in Riverdale on 1st January 2019. A model to find the total mass of tin that will be mined by the company in Riverdale is given by the equation $T = 1200 - 3(n - 20)^2$ where T tonnes is the total mass of tin mined in the n years after the start of mining. Using this model, (a) calculate the mass of tin that will be mined up to 1st January 2020, (1) (b) deduce the maximum total mass of tin that could be mined, (1) (c) calculate the mass of tin that will be mined in 2023. (2) (d) State, giving reasons, the limitation on the values of *n*. (2) a) $1200 - 3(1-20)^2 = 117$ tonges Ь) 1200 tonnes. c) $(1200 - 3(5-20)^2) - (1200 - 3(4-20)^2)$ 525 - 432= 93 tonnes. The model is only valid for n\$20, the d) total amount mined cannot decrease

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10. A circle C has equation

 $x^2 + y^2 - 4x + 8y - 8 = 0$

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(3)

(a) Find

- (i) the coordinates of the centre of C,
- (ii) the exact radius of C.

The straight line with equation x = k, where k is a constant, is a tangent to C.

(b) Find the possible values for k.

(2) a) (i) $(x-2)^2 - 4 + (y+4)^2 - 16 - 8 = 0$ $\Rightarrow (x-2)^2 + (y+4)^2 = 28.$ Centre at (2, -4). Radius = J28. i) b) $k = 2 \pm \sqrt{28}$

11.

$$f(x) = 2x^3 - 13x^2 + 8x + 48$$

(a) Prove that (x - 4) is a factor of f(x).

(b) Hence, using algebra, show that the equation f(x) = 0 has only two distinct roots.

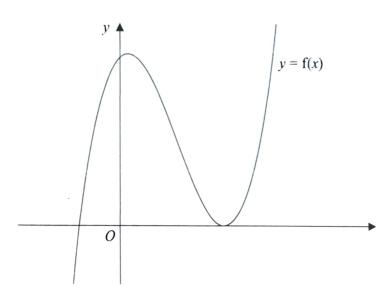


Figure 2

Figure 2 shows a sketch of part of the curve with equation y = f(x).

(c) Deduce, giving reasons for your answer, the number of real roots of the equation

 $2x^3 - 13x^2 + 8x + 46 = 0$

Given that k is a constant and the curve with equation y = f(x + k) passes through the origin,

(d) find the two possible values of *k*.

(2)
a)
$$f(4) = 2(4)^3 - 13(4)^2 + 8(4) + 48$$

 $= 128 - 208 + 32 + 48$
 $= 0$.
 $f(4) = 0 \Rightarrow x - 4$ is a factor.

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(2)

(4)

(2)

Question 11 continued b) $2x^3 - 13x^2 + 8x + 48$ DO NOT WRITE IN THIS AREA $= (3c - 4)(2x^2 - 5x - 12)$ = (x-4)(2x+3)(x-4) $= (2x+3)^2(2x+3),$ $(3c-4)^2(23c+3)=0$ has two roots, x = 4, $-\frac{3}{2}$. c) 3. This equation is $f(\infty) - 2$, so the point x=4 is no longer a stationary point of inflection. Two new solutions are created DO NOT WRITE IN THIS AREA in place of this one. d) $k = 4, -\frac{3}{2}$. DO NOT WRITE IN THIS AREA 25

12. (a) Show that

$$\frac{10\sin^2\theta - 7\cos\theta + 2}{3 + 2\cos\theta} \equiv 4 - 5\cos\theta$$
(4)

(b) Hence, or otherwise, solve, for $0 \le x < 360^{\circ}$, the equation

$$\frac{10\sin^2 x - 7\cos x + 2}{3 + 2\cos x} = 4 + 3\sin x$$
(3)
(3)
(3)

$$\frac{10 - 10\cos^2\theta - 7\cos\theta + 2}{3 + 2\cos\theta}$$

$$10\cos^2\theta - 7\cos\theta + 12$$

$$3 + 2\cos\theta$$

$$\frac{(-5\cos\theta + 4)(2\cos\theta + 3)}{3\pm 2\cos\theta}$$

$$=$$
 4 - 5cos θ

b) $4 - 5\cos \alpha = 4 + 3\sin \alpha$.

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28

$$= -5\cos x = 3\sin x$$
$$= -5$$

$$=) x = 121^{\circ}, 301^{\circ}$$

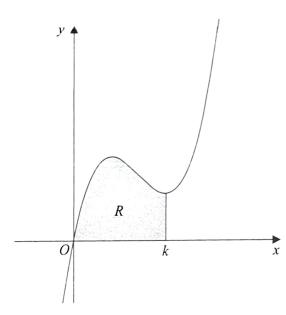




Figure 3 shows a sketch of part of the curve with equation

$$y = 2x^3 - 17x^2 + 40x$$

The curve has a minimum turning point at x = k.

The region R, shown shaded in Figure 3, is bounded by the curve, the x-axis and the line with equation x = k.

Show that the area of *R* is $\frac{256}{3}$

(Solutions based entirely on graphical or numerical methods are not acceptable.)

(7)

$$y = 2x^{3} - 172c^{2} + 40x$$

$$\Rightarrow \frac{dy}{dx} = 6x^{2} - 34xc + 40 = 0$$

$$\Rightarrow 3x^{2} - 17x + 20 = 0$$

$$\Rightarrow (3x - 5x)(x - 4) = 0$$

$$\Rightarrow x = \frac{5}{3}, 4.$$

$$P = x = 4, \text{ as the other turning paint}$$

$$has been considered / passed already.$$

$$32$$

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13.

Question 13 continued
4
$\int_{0}^{0} 2x^3 - 17x^2 + 40x $ disc
4
$= \left[\frac{1}{2}x^{4} - \frac{17}{3}x^{3} + 20x^{2}\right]_{6}^{4}$
$= 128 - \frac{1058}{3} + 320$
$= \frac{256}{3}$.
33

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14. The value of a car, $\pounds V$, can be modelled by the equation

 $V = 15700e^{-0.25t} + 2300 \qquad t \in \mathbb{R}, \ t \ge 0$

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(1)

(1)

(1)

where the age of the car is t years.

Using the model,

(a) find the initial value of the car.

Given the model predicts that the value of the car is decreasing at a rate of £500 per year at the instant when t = T,

(b) (i) show that

 $3925e^{-0.25T} = 500$

(ii) Hence find the age of the car at this instant, giving your answer in years and months to the nearest month.

(Solutions based entirely on graphical or numerical methods are not acceptable.) (6)

The model predicts that the value of the car approaches, but does not fall below, $\pounds A$.

(c) State the value of *A*.

(d) State a limitation of this model.

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-0.25t b) i) dV dt = -500. 3925 e^{-0.256} Ð = SOO

e-0.75E 500 -0.25t= In 500 3925

=) $t = -4 \ln \frac{500}{3925} = 8 years, 3 months.$

c) ± 2300					
-,			arra Ann air an Ann		
d) Other	factors	affect +	ne value	of the co	ar, i.e.
Con	dition, m	ileage, etc.	al a test d'artemant d'ar serge al d'a sera angunta any departé ina agonéais	و می و و و و و و و و و و و و و و و و و و	an y material provincial of the scattering of the antigeness with an every other
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15. Given $n \in \mathbb{N}$, prove that $n^3 + 2$ is not divisible by 8 (4) DO NOT WRITE IN THIS AREA even : 0 n=212: $(2k)^{3} + 2$ $= \frac{8k^3}{4k^2} + 2$ $\frac{1}{8}$ $= \frac{8k^3}{4k^2} + 2$ n odd: n= 2k+1: $(2h+1)^3 + 2$ (211)= $8b^{3} + 12R + 6b + 3$ odd DO NOT WRITE IN THIS AREA even n³+2 is odd for nodd, so it is not divisible by 8. =) n³+2 not divisible by 8. 40

16. (i) Two non-zero vectors, a and b , are such that	t		$1.224 m_{\odot}$
$ \mathbf{a} + \mathbf{b} $	= a + b		
Explain, geometrically, the significance of t	his statement.		(1)
(ii) Two different vectors, m and n, are such that The angle between vector m and vector n is		$\mathbf{n} \mid = 6$	
Find the angle between vector m and vector		answer, in degrees.	
to one decimal place.		,,	(4)
i) a and b mu	st lie in	the same	direction.
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