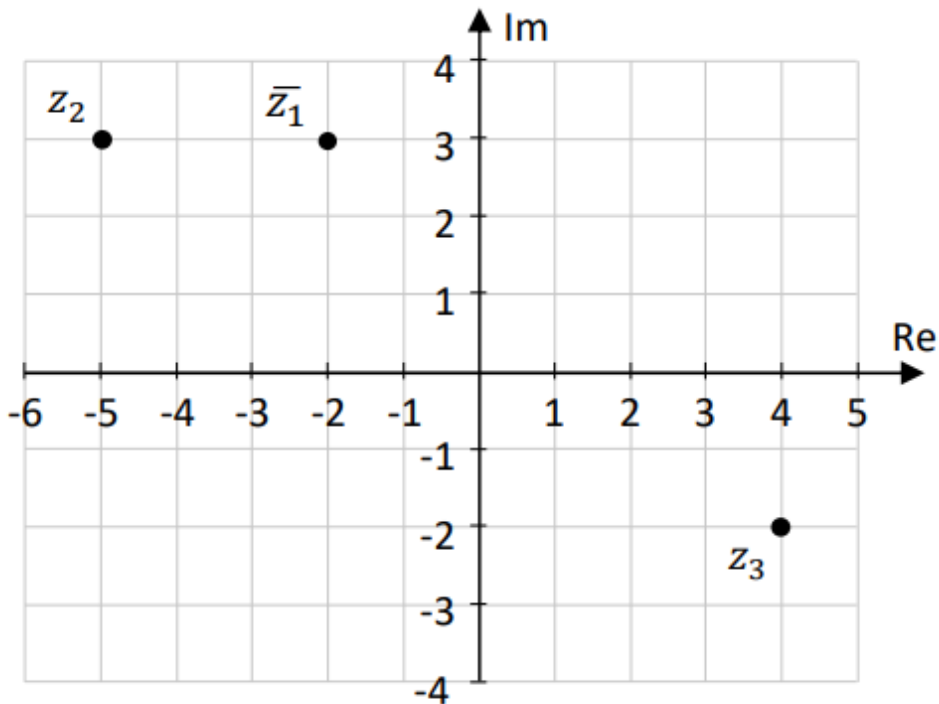


(a) (i) $z_1 = \boxed{-2 - 3i}$ $\bar{z}_1 = \boxed{-2 + 3i}$

(ii)

(b)



(c) $z_2 - z_3$

$$-5 + 3i - (4 - 2i)$$

$$-9 + i$$

$$|z_2 - z_3| = |-9 + i| \quad (-9)^2 + (5)^2 = r^2 \quad (\text{Pythagoras theorem})$$

$$\sqrt{(-9)^2 + (5)^2} = \sqrt{106}$$

(d) $(4 - 2i)^2 + 2i(4 - 2i) - 7i = 0$ (sub root into equation)

$$16 - 16i + 4(-1) + 8i - 4(-1) - 7i = 0$$

$$16 - 16i - 4 + 8i + 4 - 7i = 0$$

$$16 - 4 + 4 - 16i + 8i - 7i = 0$$

$$16 - 15i \neq 0$$

Therefore z_3 is not a root

(a) $6x - 10 + 8 = 4x - 5$

$$2x = -5 + 2$$

$$2x = -3$$

$$x = -\frac{3}{2}$$

(b) $\frac{3^{4 \times 5}}{3^6} \rightarrow \frac{3^{20}}{3^6} \rightarrow 3^{20-6} = 3^{14}$

(c) $3x + 2y = 1$ multiply by (-5)

$$7x + 5y = -2 \quad \text{multiply by } (2)$$

$$-15x - 10y = -5$$

$$\underline{14x + 10y = -4}$$

$$-x = -9$$

$$x = 9$$

$$3(9) + 2y = 1$$

$$27 + 2y = 1$$

$$2y = -26$$

$$y = -13$$

$$(9, -13)$$

(a) $27,500 \times 0.2 = 5,500$

Tax: $5,500 - 3,300 = 2,200$ (tax credit of 3,300)

$27,500 - 2,200 = \text{€}25,300$

(b) Tax for first 35,300: $35,300 \times 0.2 = 7,060$

Remainder: $(43,450 - 35,300) \times 0.4 = 3,260$

Tax: $7,060 + 3,260 - 3,300 = 7,020$

$43,450 - 7,020 = \text{€}36,430$

(c) Net annual income increase by: $80 \times 12 = 960$

^this is post tax so work backwards: $960 = 60\%$

100%: $\frac{960}{60} \times 100 = \text{€}1,600$

(a) (i) $g(5) = (5)^3 - 7(5)^2 + (5) - 12 = -57$

(ii) $g'(x) = 3x^2 - 14x + 1$

(iii) Point: $(5, -57)$

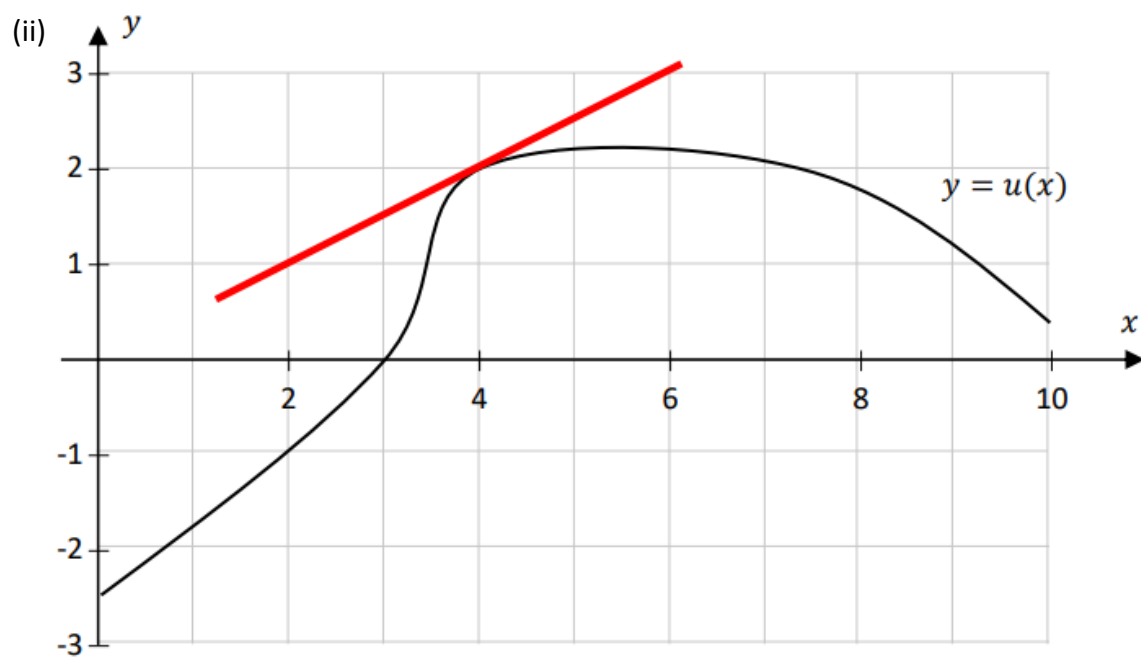
$$y - y_1 = m(x - x_1)$$

$$y - (-57) = 6(x - 5)$$

$$y + 57 = 6x - 30$$

$$6x - y - 87 = 0$$

(b) (i) $x = 8$



(a) (i) 1.2×10^3

(ii) 2.7×10^{-1}

(b) $120 \text{ m/hr} \rightarrow 120 \times 1.6 = 192 \text{ km/hr}$

$19,200 \text{ m/hr}$

$19,200\text{m}/3600\text{s} \quad \frac{3,600}{19,200}$

$1\text{m}/0.01875\text{s}$

$100\text{m}/1.875\text{s}$

1.9 seconds

(c) (i) $x = 1 \text{ or } 4.5$

(ii) $2 < x < 3.5$

$$(a) (i) T_1 = -254 + ((1) - 1)(4) = -254$$

$$(ii) T_2 = -254 + ((2) - 1)(4) = -250$$

$$-250 - (-254) = 4$$

$$(b) -254 + (n - 1)(4) > 0$$

$$-254 + 4n - 4 > 0$$

$$4n > 258$$

$$n > 64.5$$

$$n = 65$$

$$(c) \frac{n}{2} [2(-254) + 4n - 4] = 0$$

$$2(-254) + 4n - 4 = 0 \text{ or } \frac{n}{2} = 0$$

$$-508 + 4n - 4 = 0 \text{ or } \cancel{n = 0}$$

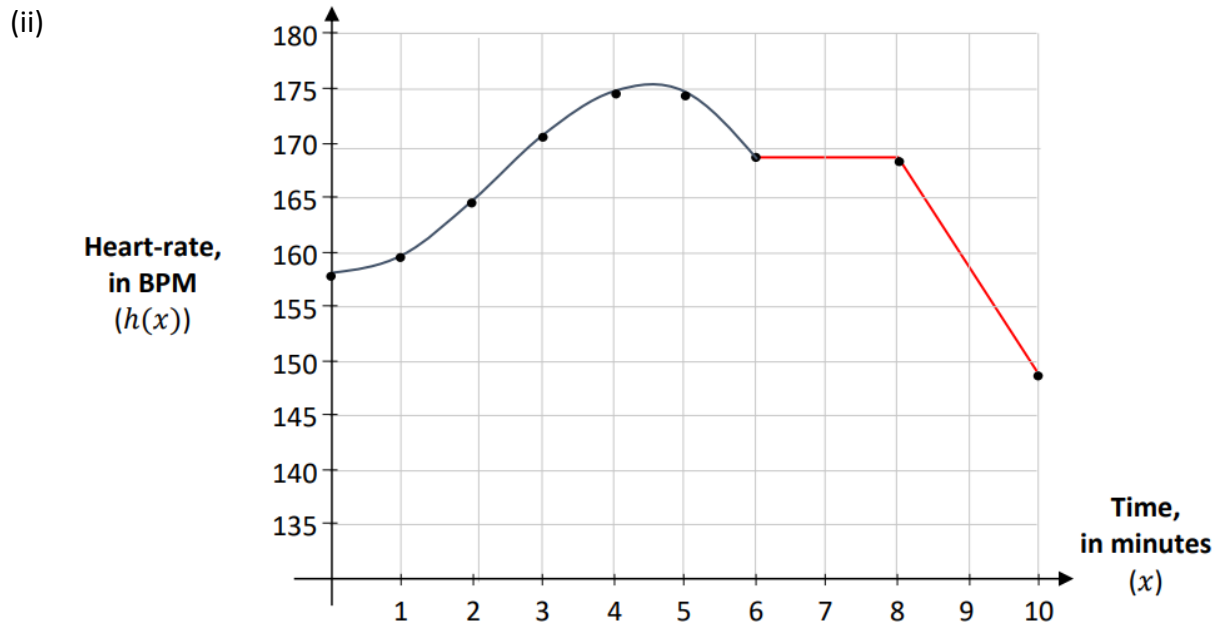
(told in question $n \neq 0$)

$$4n = 512$$

$$n = 128$$

(a) (i)

Time (minutes)	0	1	2	3	4	5	6
Heart-rate (BPM)	158	160	165	171	175	175	169



(b) 6 minutes after the start of the session, Joseph's heart rate is 169 BPM

(c) Graph above ^

(d) $h(6) = -0.38(6)^3 + 2.6(6)^2 - 0.13(6) + 158 = 168.74$

$c(6) = 0.1(168.74) - 7 = 9.9$ calories per minute

(e) 2:55 → 3:23 = 28 mins

15 seconds = $\frac{1}{4}$ of a minute

28 mins, beeps 4 times per minute

$28 \times 4 + 1 = 113$ times (+1 as beeps to start and finish)

$$(f) \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad a = -1.14, \quad b = 5.2, \quad c = -0.13$$

$$\frac{-5.2 \pm \sqrt{(5.2)^2 - 4(-1.14)(-0.13)}}{2(-1.14)} = \frac{-5.2 \pm \sqrt{26.4472}}{-2.28}$$

4.536 *or* 0.025

Look at the graph, and see which of the two points is the maximum for $h(x)$

(a) (i) $12\text{ml} \times 2 = 24\text{ml}$

(ii) Acid in bottle B: $5\text{ml} \times 3 = 15\text{ml}$

$$\frac{24+15}{200+300} = \frac{39}{500} \times 100 = 7.8\%$$

(iii) She can only make solutions with a concentration between 5% and 12%

(iv) $\frac{260-250}{250} \times 100 = 4\%$

(b) (i) $C = 8$, $E = 12$, $F = 6$

$$8 - 12 + 6 = 2$$

(ii) $12 - 30 + F = 2$

$$F = 20$$

$$20 \times 5 = 100 \text{ cm}^2$$

(iii) $6 \left(\frac{6h+5p}{3} - \frac{6h+5p}{2} + h + p \right) = 2(6)$

$$2(6h + 5p) - 3(6h + 5p) + 6h + 6p = 12$$

$$12h + 10p - 18h - 15p + 6h + 6p = 12$$

$$\cancel{12h} - \cancel{18h} + \cancel{6h} + 10p - 15p + 6p = 12$$

$$p = 12$$

(a) (i) $V(0) = €30,000$ $V(1) = €24,000$

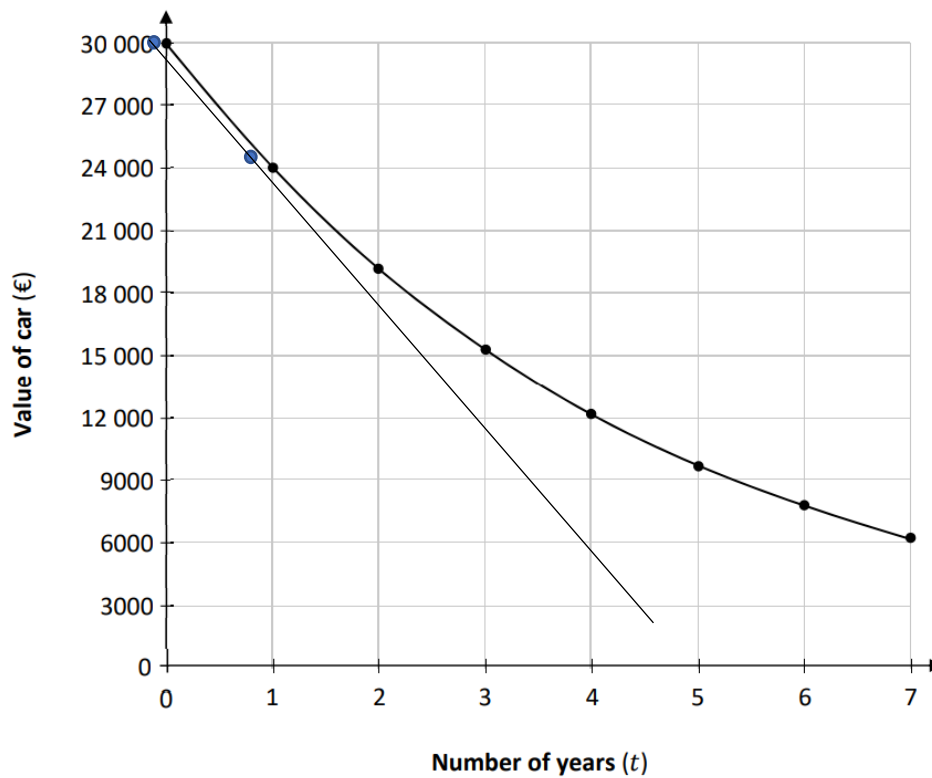
(ii) $\frac{\text{decrease in value}}{\text{original value}} \rightarrow \frac{30,000 - 24,000}{30,000} = \frac{6,000}{30,000} = 0.2 = 20\%$

(b) (i) $T_n = ar^n$ $a = \text{original value}, r = \text{common decrease} = 1 - 0.2 = 0.8$

$T_n = 30,000(0.8^n)$

(ii) $T_4 = 30,000(0.8^{(4)}) = €12,288$

(c) (i)



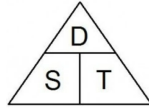
(ii) 5 years

(d) $19,445 \times 0.3 = 5,833.33$

$(3 \times 12) \times 206.97 = 7,450.92$

$5833.5 + 7,450.92 + 7,389 = €20,673.42$

(e) $\frac{\text{Distance}}{\text{Speed}} \rightarrow \frac{12}{60} = 0.2 \text{ hours}$ $\frac{12}{40} = 0.3 \text{ hours}$



$\frac{\text{Change in time}}{\text{Original time}} \rightarrow \frac{0.3-0.2}{0.2} \times 100 = 50\%$

(a) (i) $-2(0)^2 + 5(0) + 1.2 = 1.2\text{m}$

(ii) $-2(2.4)^2 + 5(2.4) + 1.2 = 1.68\text{m}$

(iii) $-2t^2 + 5t + 1.2 = 3.2$

$$2t^2 - 5t + 2 = 0$$

$$(2t - 1)(t - 2) = 0$$

$$2t = 1 \text{ or } t = 2$$

$$t = 0.5 \text{ or } t = 2 \quad (\text{as n-shaped graph and the question said this height is when it is decreasing})$$

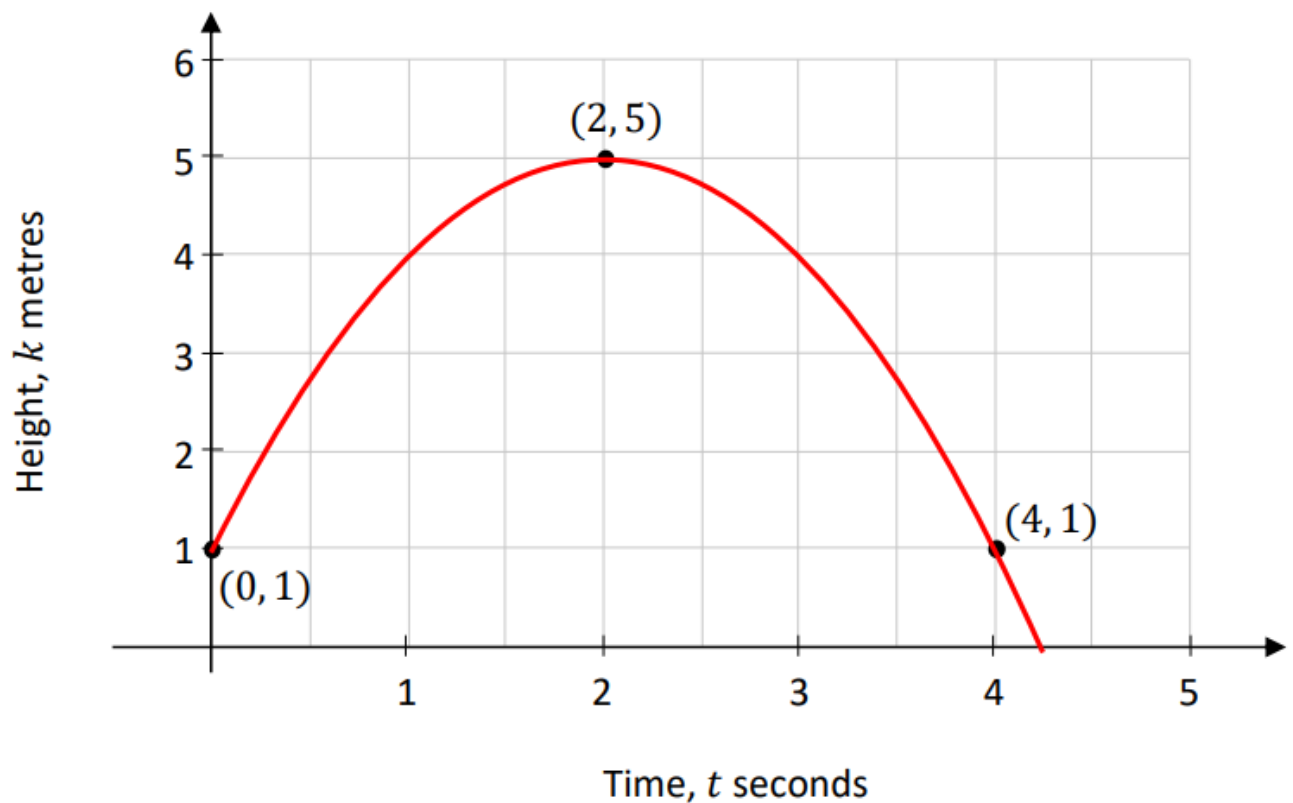
(iv) $\frac{dh}{dt} = -4t + 5$

$$-4t + 5 = 0 \quad (\text{to find maximum})$$

$$4t = 5$$

$$t = 1.25 \text{ seconds}$$

(b) Points: $(0, 1)$, $(2, 5)$, $(4, 1)$



(c) (i) $33(1 - 0.15) = \text{€}28.05$

(ii) $123\% = \text{€}49.50$

$$23\% = \frac{49.50}{123} \times 23 = 9.256$$

$$925.6 \text{ cent} = 926 \text{ cent}$$