# NEWCASTLE GRAMMAR SCHOOL

SPECTEMUR AGENDO

## YEAR 12
## 2005
## MATHEMATICS
## TRIAL EXAMINATION

*Time allowed – Three hours*
*( Plus 5 minutes reading time )*

**DIRECTIONS TO CANDIDATES**

- Attempt ALL questions.
- ALL questions are of equal value.
- All necessary working should be shown in every question. Marks may be deducted for careless or badly arranged work.
- Standard integrals are printed on page 8.
- Board-approved calculators may be used.
- Answer each question in a SEPARATE Writing Booklet.
- You may ask for extra Writing Booklets if you need them.

**QUESTION 1** Use a SEPARATE Writing Booklet. **Marks**

a) Calculate the value of $\sqrt[3]{2^{1.9}+7}$ correct to four significant figures. **2**

b) Factorise completely $6x^3 - 48$ **2**

c) Express $300°$ in radians, in terms of $\pi$ **2**

d) State the domain of the function with the equation $f(x) = \sqrt{3-x}$ **2**

e) Differentiate $\dfrac{4}{x}$ **2**

f) Simplify completely $\log_a a^2 - \log_a \dfrac{1}{a}$ **2**

**QUESTION 2** Use a SEPARATE Writing Booklet.

a) Differentiate:

i) $y = x^5 e^x$ **3**

ii) $y = \sqrt{\sin x}$ **3**

b) The points $A(-2,3)$, $B(3,8)$ and $C(10,9)$ are three of the vertices of parallelogram $ABCD$.

i) Show that the coordinates of $D$ are $(5,4)$. **2**

ii) Find the coordinates of the point $K$ where the diagonals meet. **2**

iii) Prove that this parallelogram is a rhombus. **2**

**QUESTION 3** Use a SEPARATE Writing Booklet. **Marks**

a) The probability that Mary-Anne catches no fish in any one day is 0·6. Find the probability that when Mary-Anne goes fishing for one week that she has at least one day where she does catch fish, answer correct to 2 decimal places. **2**

b) Find:

i) $\int \sqrt{2x+1}\,dx$ **3**

ii) $\int \frac{2x}{4x^2+1}\,dx$ **3**

c) Solve $2\sin^2\theta + \sin\theta = 0$ for $0^\circ \leq \theta \leq 360^\circ$ **4**

**QUESTION 4** Use a SEPARATE Writing Booklet.

a) For the function with the equation $y = 3\sin 2x$:

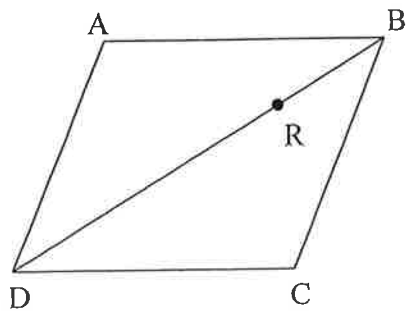
i) state the period of the function **1**

ii) state the amplitude of the function **1**

iii) sketch the graph of the function for $0 \leq x \leq 2\pi$ **2**

b) Find the values of $k$ for which $x^2 - 2kx + 1 = 0$ has real roots **4**

c) ABCD is a rhombus. R is any point on diagonal BD.




i) Prove that triangles ARD and CRD are congruent. **3**

ii) Hence, show that AR=RC. **1**

**QUESTION 5** Use a SEPARATE Writing Booklet. **Marks**

a) For the parabola with the equation $y = x^2 - 4$ find the

i) coordinates of the focus and the equation of the directrix. **4**

ii) exact volume generated when the area in the fourth quadrant, between the curve and the axes, is rotated around the $y$-axis. **3**

b) Show, using calculus, that the graph with the equation $y = x^3(x-4)$ has a horizontal inflection point at $x = 0$. **5**

**QUESTION 6** Use a SEPARATE Writing Booklet.

a) If $\alpha$ and $\beta$ are the roots of the equation $3x^2 - 2x + 1 = 0$ find the value of $\alpha^2\beta + \alpha\beta^2$ **3**

b) The area of an isosceles triangle, in which the two equal sides each have a length of 6 cm, is 10 cm$^2$. Calculate the angle between the two equal sides, correct to the nearest minute. **4**

c) i) Use the trapezoidal rule, with 4 sub-intervals (strips) to estimate the area between the curve $y = e^x$ and the $x$-axis, from $x = -1$ to $x = 1$, correct to 3 decimal places. **3**

ii) Calculate the percentage error in this estimated area. **2**

**QUESTION 7** Use a SEPARATE Writing Booklet. **Marks**

a) A loan of \$50 000 is taken out by a small business. The loan plus interest and charges are to be repaid at the end of each month in equal monthly instalments, \$M, over 8 years. Interest of 12% p.a. on the balance owing at the start of each month is added to the account at the end of each month. Additionally, at the end of each month a management charge of \$15 is added to the account. Let $\$A_n$ be the amount owing after $n$ months.

i) Show that $A_1 = 50000 \times 1 \cdot 01 - (M - 15)$ **2**

ii) Show that $A_2 = 50000 \times 1 \cdot 01^2 - (M - 15)(1 + 1 \cdot 01)$ **2**

iii) Find the amount of each monthly instalment, \$M. **4**

b) A large tank of liquid chemical which contains $L$ litres of chemical is being drained. The amount of chemical in the tank over time, $t$ minutes, is given by:

$$L = 120(40 - t)^2$$

i) At what rate is the water draining out of the tank after 6 minutes ? **2**

ii) How long will it take for the tank to be completely empty ? **2**

**QUESTION 8** Use a SEPARATE Writing Booklet.

a) The number of bees, $B$, in a hive after $t$ days is given by $B = 1200e^{kt}$, where $k$ is a constant.

i) Show that $B = 1200e^{kt}$ satisfies $\frac{dB}{dt} = kB$ **2**

ii) If there are 4 200 bees after 6 days, find the population after a <u>further</u> 10 days. **4**

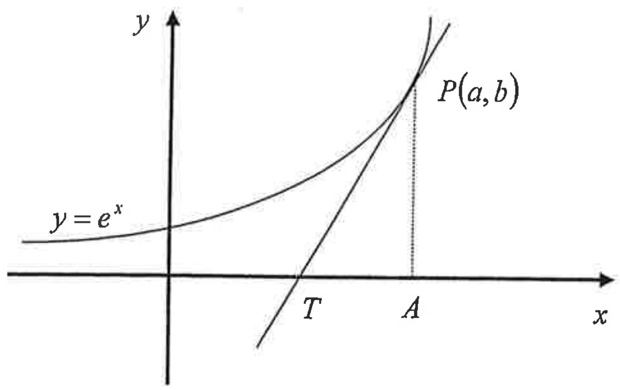
b) i) For $y = \frac{\log_e \sqrt{x}}{x}$ show that $\frac{dy}{dx} = \frac{1}{2}\left(\frac{1 - \log_e x}{x^2}\right)$ **3**

ii) Hence, evaluate $\int_1^e \frac{1 - \log_e x}{x^2}\, dx$, answer in exact form. **3**

**QUESTION 9** Use a SEPARATE Writing Booklet. **Marks**

a) Solve $2\log_e x = \log_e(x+6)$ **3**

b) The point $P(a,b)$ lies on the curve with the equation $y = e^x$.




i) Show that the tangent at $P$ has the equation **3**

$$y - e^a = e^a(x-a)$$

ii) Hence, find the coordinates of $T$, the point where the tangent meets the $x$-axis. Give your answer in terms of $a$. **2**

iii) $A$ is the foot of the perpendicular from $P$ to the $x$-axis. Show that the length of the interval $TA$ is constant, for any point $P$. **2**

c) Find $\int \tan x \, dx$ **2**

**QUESTION 10** Use a SEPARATE Writing Booklet. **Marks**

Two particles A and B move along the $x$-axis, both starting when $t = 0$. The displacement of particle A is given by $x = 4t + 21 - t^2$, where $x$ is measured in metres and $t$ is in seconds. The displacement of particle B is given by $x = 2t(t-7)$.

i) Find when and where particle A is stationary. **2**

ii) On the same diagram, sketch each particle's displacement graph, showing only the $t$-intercepts. **3**

iii) Show that the particles meet only after 7 seconds. **1**

iv) Show that the distance, $D$, between the two particles at any time, $t$, is given by $D = 18t + 21 - 3t^2$ **1**

v) During the first 7 seconds, when are the particles furthest apart ? **3**

vi) Find the time when both particles have the same velocity. **2**

1) a) $\sqrt[3]{2^{1.9}+7}$ : on calculator :-

$\sqrt[3]{}(2 \wedge 1.9 + 7) =$

$= \underbrace{2.205}_{4 \text{ sig. fig.}}77\ldots$

$= 2.206$

b) $6x^3 - 48 = 6(x^3 - 8)$

$= 6((x)^3 - (2)^3)$

using: $a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

$\therefore = 6(x-2)(x^2 + 2x + 4)$

c) $\frac{\cancel{300}^{5}{}^\circ}{1} \times \frac{\pi}{\cancel{180}_{3}} = \frac{5\pi}{3}$ rad

d) For domain : we need :-

$3 - x \geq 0$

ie $3 \geq x$ or $x \leq 3$

e) $\frac{d}{dx}\left(\frac{4}{x}\right) = 4 \times \frac{d}{dx}\left(\frac{1}{x}\right)$

$= 4 \times \log_e x$

$= 4 \log_e x$ (or $4 \ln x$)

f) $\log_a a^2 - \log_a \frac{1}{a} = \log_a\left(\frac{a^2}{1/a}\right)$

$= \log_a(a^2 \div a^{-1})$

$= \log_a(a^3)$

$=$

2) a) $y = x^5 e^x$ $\quad u = x^5 \quad V = e^x$

$\therefore u' = 5x^4 \quad \therefore V' = e^x$

$y' = Vu' + uV'$

$= e^x \times 5x^4 + x^5 \times e^x$ 3

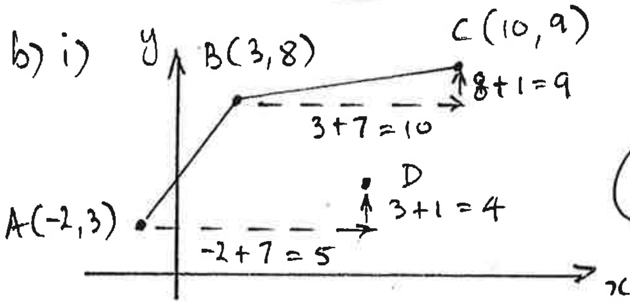
$= x^4 e^x(5 + x)$

b) $y = \sqrt{\sin x}$

$= (\sin x)^{\frac{1}{2}}$ 3

$\therefore \frac{dy}{dx} = \frac{1}{2}(\sin x)^{-\frac{1}{2}} \times \cos x$

$= \frac{\cos x}{2\sqrt{\sin x}}$

b) i) 


2

$\therefore D(5, 4)$ (QED)

ii) Diagonals of parallelogram BISECT

$\therefore$ find midpoint of AC (or BD)

$\therefore K = \left(\frac{-2+10}{2}, \frac{3+9}{2}\right)$ 2

$= (4, 6)$

iii) Parallelogram = rhombus if adjacent pair of sides equal

$\therefore$ show $AB = BC$ 2

$AB = \sqrt{(3+2)^2 + (8-3)^2} = \sqrt{50}$ units

$BC = \sqrt{(10-3)^2 + (9-8)^2} = \sqrt{50}$ units

ie. $AB = BC$ $\therefore$ rhombus (QED)

3 a) $P(\text{at least 1 day catch fish})$

$= 1 - P(\text{no fish})$

$= 1 - (0.6)^7$ ← for 7 days

$= 0.972\ldots$

$= 0.97$

b) i) $\int \sqrt{2x+1}\, dx$

$= \int (2x+1)^{\frac{1}{2}}\, dx$

$= \dfrac{(2x+1)^{\frac{3}{2}}}{\cancel{3/2} \times \cancel{2}} + C$

using: $\int (ax+b)^n\, dx = \dfrac{(ax+b)^{n+1}}{a(n+1)} + C$

$= \dfrac{(2x+1)^{3/2}}{3} + C$

or $\frac{1}{3}\sqrt{(2x+1)^3} + C$

ii) $\int \dfrac{2x}{4x^2+1}\, dx$

$= \frac{1}{4}\int \dfrac{8x}{4x^2+1}\, dx$

$= \frac{1}{4}\log_e(4x^2+1) + C$

$\left\{ \text{using: } \int \dfrac{f'(x)}{f(x)}\, dx = \log_e(f(x)) + C \right\}$

c) $2\sin^2\theta + \sin\theta = 0$

$\therefore \sin\theta\,(2\sin\theta + 1) = 0$

$\therefore \sin\theta = 0$ or $2\sin\theta + 1 = 0$

boundary angle or use sine graph $x$-intercepts

$\therefore \theta = 0°, 180°$ or $360°$

$\therefore \sin\theta = -\frac{1}{2}$

Gap $\angle = 30°$

$\sin\theta < 0 \therefore$ 3rd/4th quadrants

$\therefore \theta = 180 + 30°,\ 360 - 30°$

$\therefore \theta = 210°, 330°$

$\therefore \theta = 0°, 180°, 210°, 330°, 360°$

4 a) $y = 3\sin 2x$

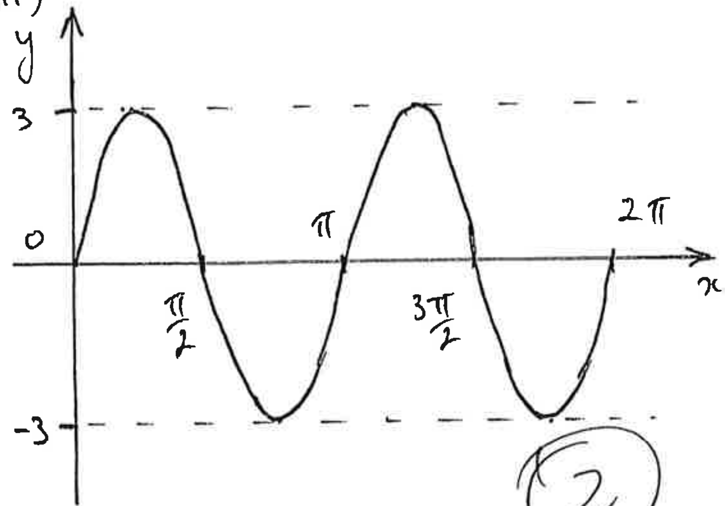
i) period: $P = 2\pi/n$

$= 2\pi/2$

$\therefore P = \pi$ 1

ii) amplitude $= 3$ 1

iii)




2

4 b) For real roots we need:

$$\Delta \geq 0$$

ie $b^2 - 4ac \geq 0$

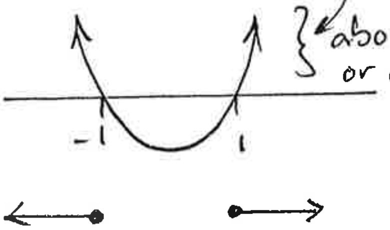
$\therefore (-2k)^2 - 4 \times 1 \times 1 \geq 0$

$\therefore 4k^2 - 4 \geq 0 \quad (\div 4)$

4

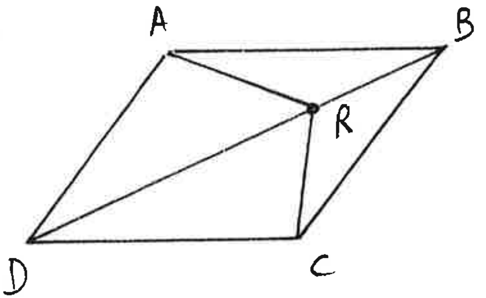
$k^2 - 1 \geq 0$ quadratic inequality

above or on




$\therefore \boxed{k \leq -1 \text{ or } k \geq 1}$

c)




i) $AD = CD$ (sides of rhombus) S

$\angle ADR = \angle CDR$ ($\angle$'s bisected by diagonal) A

3

$DR = DR$ (common) S

$\therefore \Delta ARD \equiv \Delta CRD$ (SAS)

ii) $AR = RC$

1

corresponding sides in cong. $\Delta$'s

5 a) $y = x^2 - 4$ } down 4 ⊛

i) $\therefore x^2 = y + 4$

or: $(x-0)^2 = 1(y+4)$

ie $(x-0)^2 = 4 \times \frac{1}{4}(y-(-4))$

FORMULA: $(x-h)^2 = 4a(y-k)$

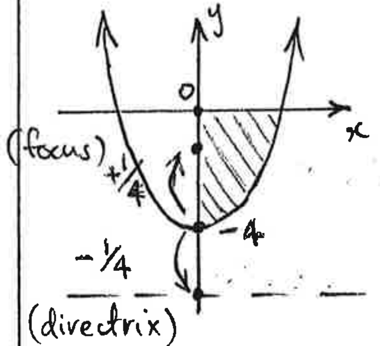
Vertex $= (h, k)$

Focal length $= a$

$\therefore$ Vertex at $(0, -4)$ (⊛ as above)

Focal length $= \frac{1}{4}$

$\therefore$ Sketch:




$\therefore$ Focus is: $\boxed{(0, -3\tfrac{3}{4})}$

Directrix is:- $\boxed{y = -4\tfrac{1}{4}}$

ii) $V = \pi \int_a^b x^2 \, dy$ revolving around y-axis of shaded area in diagram above

$\therefore V = \pi \int_{-4}^{0} y + 4 \, dy$

$= \pi \left[ \frac{y^2}{2} + 4y \right]_{-4}^{0}$

$= \pi \left[ \left( \frac{0^2}{2} + 4 \times 0 \right) - \left( \frac{(-4)^2}{2} + 4 \times -4 \right) \right]$

$= \pi [(0) - 8 + 16]$

$= \boxed{8\pi \text{ units}^3}$

5 b) Horizontal $\Rightarrow \frac{dy}{dx} = 0$ ...(1)

Inflexion $\Rightarrow \frac{d^2y}{dx^2} = 0$ AND sign changes $\Big\}$ ...(2)

(1) $y = x^3(x-4)$
$= x^4 - 4x^3$

$\therefore \frac{dy}{dx} = 4x^3 - 12x^2$
$= x^2(4x-12)$

Letting: $x^2(4x-12) = 0$

$x^2 = 0$ — not required

$\therefore x = 0$

$\therefore$ St. pt. at $x=0$
(ie. horizontal)

(2) $\frac{d^2y}{dx^2} = 12x^2 - 24x$
$= 12x(x-2)$

Letting: $12x(x-2) = 0$

$12x = 0$

$\therefore x = 0$

$\therefore$ POSSIBLE inf. pt. at $x=0$.

AND

| $x$ | $-1$ | $0$ | $1$ |
|---|---|---|---|
| $\frac{d^2y}{dx^2}$ | + | 0 | − |

at $x=-1$ : $\frac{d^2y}{dx^2} = 12(-1)^2 - 24(-1) = +36$

$x = 1$ : $\frac{d^2y}{dx^2} = 12(1)^2 - 24(1) = -12$

ie. sign change : (Has inf. at $x=0$

6 a) $3x^2 - 2x + 1 = 0$

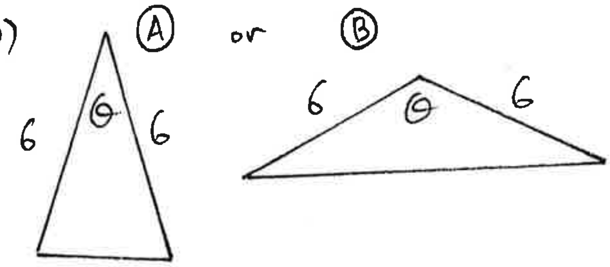
$\therefore \alpha + \beta = -b/a$
$= \frac{-(-2)}{3}$
$= 2/3$

$\alpha\beta = c/a$
$= \frac{1}{3}$

3

and $\alpha^2\beta + \alpha\beta^2 = \alpha\beta(\alpha+\beta)$
$= \frac{1}{3} \times \frac{2}{3}$
$= 2/9$

b)




Area $= \frac{1}{2}ab\sin C$

$\therefore \frac{1}{2} \times 6 \times 6 \times \sin\theta = 10$

$18 \times \sin\theta = 10$

$\sin\theta = 10/18$

$\therefore \theta = \sin^{-1}(5/9)$

$= 33°\,44'\,56.36''...$

$\therefore \theta = 33°45'$ (for A)

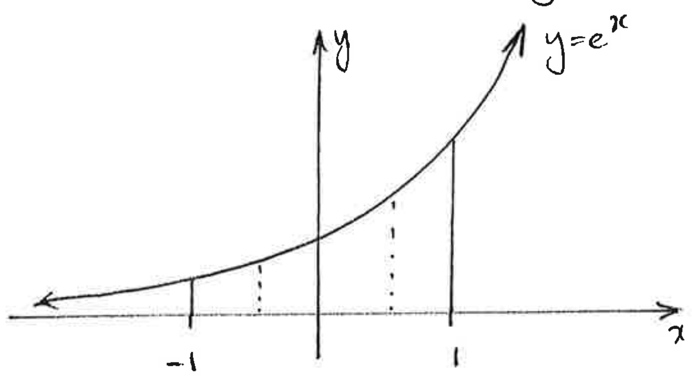
OR $\theta = 180° - 33°45'$

ie $\theta = 146°\,15'$ (for B)

4

(ie. Two possible answers, for $\theta$ acute or obtuse)

c) i) Sketch (not necessary)




Area:

| $x$ | $y$ | $\times$ | $=$ |
|---|---|---|---|
| $-1$ | $0.3679$ | $1$ | $0.3679$ |
| $-0.5$ | $0.6065$ | $2$ | $1.2131$ |
| $0$ | $1$ | $2$ | $2$ |
| $0.5$ | $1.6487$ | $2$ | $3.2974$ |
| $1$ | $2.7183$ | $1$ | $2.7183$ |

3

TOTAL $= 9.5967$

$\therefore$ Area $\doteqdot \frac{h}{2} \times$ TOTAL

$= \frac{0.5}{2} \times 9.5967$

$= 2.3991\ldots$

$\therefore \boxed{\text{Area} = 2.399 \text{ units}^2}$ (3dp)

ii) Exact Area $= \int_{-1}^{1} e^x \, dx$

$= \left[e^x\right]_{-1}^{1}$

$= e^1 - e^{-1}$

$= 2.350 \text{ units}^2$ (3dp)

$\therefore$ Percentage error $= \frac{2.399 - 2.350}{2.350} \times \frac{100}{1}$

$= \frac{0.049}{2.35} \times 100$

2

$= 2.08\ldots$

$\therefore \boxed{\% \text{ error} = 2.1\%}$ (1dp)

7 a) i) $A_1 = \$50000 + 1\%$ per month interest $+ \$15 - M$

$= 50000 \times 1.01 - M + 15$

$= 50\,000 \times 1.01 - (M - 15)$ (QED)

ii) $\therefore A_2 = A_1 \times 1.01 - (M - 15)$

$= \{50\,000 \times 1.01 - (M-15)\} \times 1.01 - (M-15)$

$= 50\,000 \times 1.01^2 - 1.01(M-15) - (M-15)$

$= 50\,000 \times 1.01^2 - (M-15)(1+1.01)$ (QED)

iii) From ii) we "generalise":

$\therefore A_{96} = 50\,000 \times 1.01^{96} - (M-15)(\underbrace{1 + 1.01 + \cdots + 1.01^{95}}_{})$

G.P. $a = 1$, $r = 1.01$
$n = 96$

$\therefore S_n = \frac{a(r^n - 1)}{r - 1}$

$= \frac{1(1.01^{96} - 1)}{1.01 - 1}$

AND $A_{96} = 0$ for loan fully repaid

$\therefore 0 = 50\,000 \times 1.01^{96} - (M-15) \frac{(1.01^{96} - 1)}{0.01}$

$\therefore M = \left\{50\,000 \times 1.01^{96} \frac{\times 0.01}{1.01^{96} - 1}\right\} + 15$

$= 827.642\ldots$

$\therefore \boxed{M = \$827.64}$

7 b) $L = 120(40-t)^2$

i) $\therefore$ Rate $= \frac{dL}{dt} = 120 \times 2(40-t) \times -1$

$= -240(40-t)$

$\therefore$ at $t=6$:

$\frac{dL}{dt} = -240(40-6)$

$= -8160$ l/min

ii) For empty tank: $L = 0$

i.e. $120(40-t)^2 = 0$

$\therefore (40-t)^2 = 0$

$\therefore 40 - t = 0$

$\therefore t = 40$ minutes

8 a) i) $B = 1200e^{kt}$

$\therefore \frac{dB}{dt} = 1200 \times ke^{kt}$

2

$= k(1200e^{kt})$ } from above

i.e. $\frac{dB}{dt} = kB$

(QED)

ii) $4200 = 1200e^{6k}$ $\div 1200$

$e^{6k} = 7/2$

4

$\log_e(e^{6k}) = \log_e(7/2)$

$\therefore 6k = \log_e(7/2)$

$k = \log_e(7/2) \div 6$

$= 0.2088$ (4dp)

$\therefore$ at $t = 16$ days

$B = 1200e^{0.2088 \times 16}$

$= 33\,890$ (nearest whole)

b) i) $y = \frac{\log_e(x^{\frac{1}{2}})}{x}$

$= \frac{\frac{1}{2}(\log_e x)}{x}$

3

$= \frac{1}{2}\left(\frac{\log_e x}{x}\right)$  $u = \log_e x,\ v = x$ ; $u' = \frac{1}{x},\ v' = 1$

$\therefore \frac{dy}{dx} = \frac{1}{2}\left(\frac{vu' - uv'}{v^2}\right)$

$= \frac{1}{2}\left(\frac{x \times \frac{1}{x} - \log_e x \times 1}{x^2}\right)$

$= \frac{1}{2}\left(\frac{1-\log_e x}{x^2}\right)$ (QED)

ii) $\therefore \int_1^e \frac{1-\log_e x}{x^2}\,dx$

$= 2\int_1^e \frac{1}{2}\left(\frac{1-\log_e x}{x^2}\right)dx$

$= 2\left[\frac{\log_e \sqrt{x}}{x}\right]_1^e$

3

$= 2\left\{\left(\frac{\log_e e^{\frac{1}{2}}}{e}\right) - \left(\frac{\log_e \sqrt{1}}{1}\right)\right\}$

$= 2\left\{\frac{\frac{1}{2}}{e} - \frac{0}{1}\right\}$

$= 2 \times \frac{1/2}{e}$

$= \frac{1}{e}$

9 a) $2\log_e x = \log_e(x+6)$

$\therefore \cancel{\log_e}(x^2) = \cancel{\log_e}(x+6)$

$\therefore x^2 = x+6$

$x^2 - x - 6 = 0$

$(x-3)(x+2) = 0$

$\therefore x = -2$ or $3$

BUT by substitution:

at $x=-2$: $2\log_e(-2) = \log_e(-2+6)$

ie. $2\log_e(-2) = \log_e(4)$

$\log_e x$ undefined for negative $x$

$\therefore$ ONLY solution is: $x = 3$

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

at $x_1 = a$, $y_1 = e^a$

and $\frac{dy}{dx} = e^x$ $\therefore m = e^a$

$\therefore y - e^a = e^a(x-a)$ (QED)

ii) For T: let $y=0$:-

ie. $0 - e^a = e^a(x-a)$ $(\div e^a)$

$-1 = x - a$

$\therefore x = a-1$

iii) At T: $x = a-1$

At A: $x = a$

$\therefore TA = a - (a-1)$

$= \cancel{a} - \cancel{a} + 1$

$\therefore TA = 1$ unit (QED)

ie constant for all P

(as independent of "a")

c) $\int \tan x \, dx$

$= \int \frac{\sin x}{\cos x} dx$

$= -\int \frac{-\sin x}{\cos x} dx$

$= -[\log_e(\cos x)] + C$

or $= -\log_e(\cos x) + C$

10 i) A: $x = 4t + 21 - t^2$

$\therefore \frac{dx}{dt} = v_A = 4 - 2t$

$\therefore$ stationary when $v_A = 0$

ie. $4 - 2t = 0$

$2t = 4$

$t = 2$ seconds

and at $t=2$: $x = 4\times 2 + 21 - 2^2$

$x = 25$ m

2

10 ii) A $x = 4t + 21 - t^2$ } concave down

$= -(t^2 - 4t - 21)$

$= -(t-7)(t+3)$

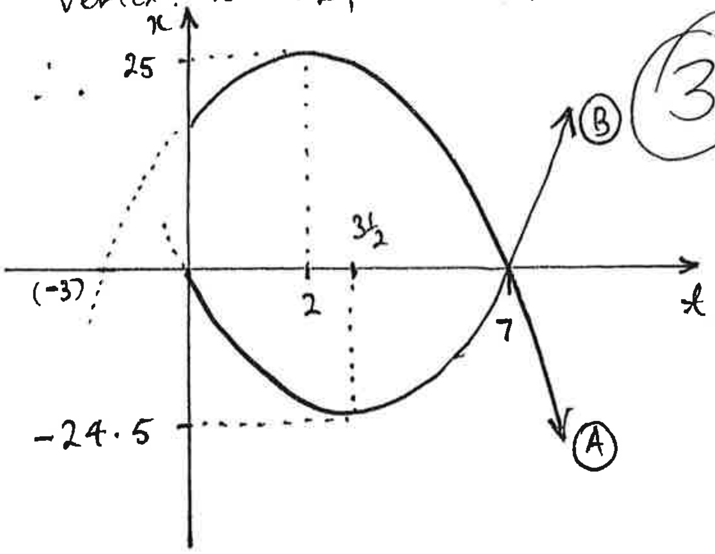
$\therefore$ $t$-int's : $t = -3$ or $7$

Vertex : $t = 2$, $x = 25$ (from i))

B $x = 2t(t-7)$

$\therefore$ $t$-int's: $t = 0$, $t = 7$

Vertex : $t = 3\frac{1}{2}$, $x = -24.5$




3

iii) From graph :

Particles meet when $x$-values equal

ie. graphs intersect

1

We see graphs intersect only once at $t = 7$ (QED)

OR Algebra : $4t + 21 - t^2 = 2t(t-7)$

$= 2t^2 - 14t$

$\therefore$ $3t^2 - 18t - 21 = 0$ $(\div 3)$

$t^2 - 6t - 7 = 0$

$(t-7)(t+1) = 0$

$\therefore$ $t = -1$ (not possible)

$t = 7$ (QED)

iv) Distance between particles : D

$D = A - B$ } for $t=0$ to $t=7$

$= 4t + 21 - t^2 - (2t^2 - 14t)$

$= 4t + 21 - t^2 - 2t^2 + 14t$

$\therefore D = 18t + 21 - 3t^2$ (QED) 1

v) $D_{max}$ at $\frac{dD}{dt} = 0$

ie $18 - 6t = 0$

$\therefore$ $6t = 18$

$\therefore$ $t = 3$ seconds)

NOTE $\frac{d^2D}{dt^2} = -6 < 0$ at $t = 3$

$\therefore$ $\boxed{t = 3 \text{ seconds is a maximum}}$

vi) Same velocity at $v_A = v_B$

and $x_B = 2t^2 - 14t$

$\therefore$ $v_B = 4t - 14$

$\therefore$ need : $4 - 2t = 4t - 14$

$18 = 6t$

$\boxed{\therefore t = 3 \text{ seconds}}$

for same velocities