Student Number | | | | | | | | | |

BAULKHAM HILLS HIGH SCHOOL

HIGHER SCHOOL CERTIFICATE

TRIAL EXAMINATION

2008

MATHEMATICS
EXTENSION 1

Time allowed: Two Hours
(Plus 5 mins reading time)

GENERAL INSTRUCTIONS

- Attempt all questions
- There are seven questions - start each question on a new page
- All necessary working should be shown
- Write, using black or blue pen
- Write your student number at the top of each page of the answer sheets
- At the end of the exam, staple your answers in order, behind the cover sheet.

Marks

Question 1

a) A and C have co-ordinates $(-1,2)$ and $(6,10)$ respectively. Find the point B which divides AC internally in the ratio $2:3$. **2**

b) Find $\int \frac{4x}{2x+1}\,dx$ using the substitution $u = 2x+1$. **3**

c) State the domain of the function $y = \log_e\left(\frac{3x-1}{x+2}\right)$. **3**

d) i) Show that the curves $y = e^{x-1}$ and $y = e^{-x}$ intersect at $x = \frac{1}{2}$. **1**

ii) Find the acute angle between the curves at this point. **3**

Question 2 (start a new page)

a) Find the constant term in the expansion $\left(3x^2 + \frac{5}{x^3}\right)^{10}$. **3**

b) Solve $\sin 4x = \cos 2x$ for $0° \le x \le 360°$ **3**

c) Evaluate $\int_0^{\frac{3}{4}} \frac{dx}{\sqrt{9-4x^2}}$. **3**

d) Taking $x = 2$ as the first approximation for the root of $\sin x - \frac{x}{3} = 0$ find a closer approximation of the root using one application of Newton's method. **3**

Question 3 (start a new page)

a) Find the volume when the area between $y = 2\sin x$, the x ~~and y axes~~ and $x = \frac{\pi}{4}$ is rotated about the x axis. **4**

b) i) State the domain and range of $y = 2\cos^{-1}(x-1)$ **2**

ii) Hence sketch the curve **2**

c) If α, β and γ are the roots of the cubic $2x^3 - 5x^2 - 3x + 1 = 0$, find

i) $\alpha + \beta + \gamma$ **1**

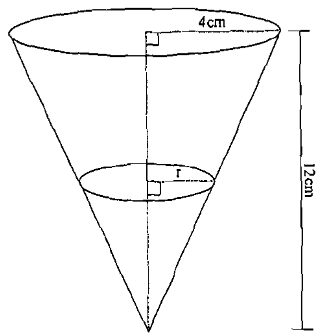
ii) $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$ **1**

iii) $\alpha^2 + \beta^2 + \gamma^2$ **2**

Marks

Question 4 (start a new page)

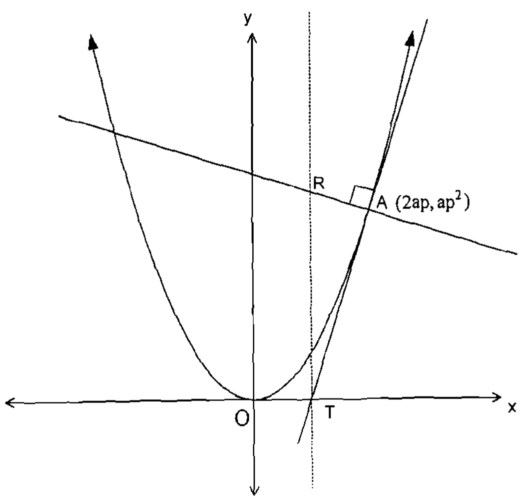
a) The diagram shows a conical drinking cup of height 12cm and radius 4cm. The cup is filled with water at a rate of 3cm^3 per second. The height of water at time t seconds is h cm and the radius of the water's surface is r cm.



i) Show that $r = \frac{1}{3}h$. **1**

ii) Find the rate at which the height is increasing when the height of the water is 9cm. ($V = \frac{1}{3}\pi r^2 h$ is the volume of a cone.) **3**

b) $x = 2at$ and $y = at^2$ are parametric equations for the parabola below.



Marks

Question 4 (cont.)

i) By finding the Cartesian equation of the parabola, find the equation of the tangent at the point A. **2**

ii) The tangent cuts the x axis at T. Find the coordinates of T. **1**

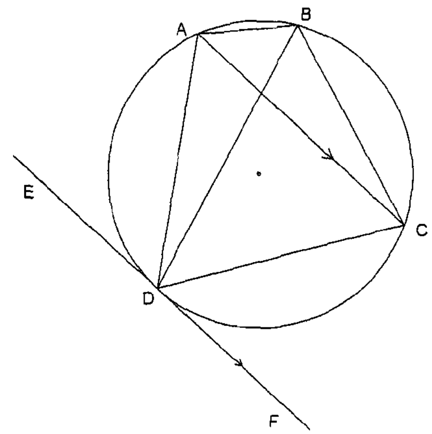
iii) Find the equation of the normal at A. **1**

iv) A line through T parallel to the axis of the parabola cuts the normal at R. Show that the coordinates of R are $(ap, ap^2 + a)$. **1**

(v) Show that the locus of R is a parabola and state the equation of it's directrix. **3**

Question 5 (start a new page)

a) ABCD is a cyclic quadrilateral. EF is a tangent to the circle and AC || EF. **3**



Prove BD bisects $\angle ABC$.

b) The velocity of a particle as it moves along the X axis is given by

$v^2 = -9x^2 + 18x + 27$

i) Show that the particle undergoes Simple Harmonic Motion. **2**

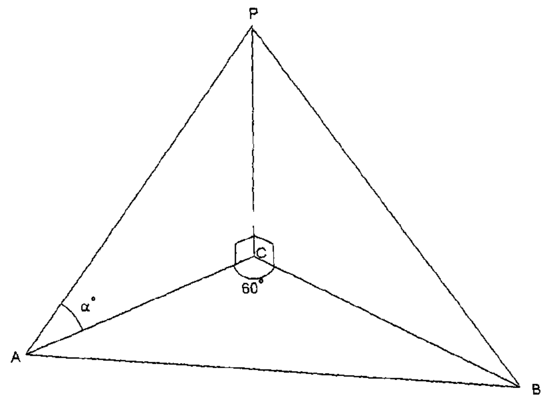
ii) What is the period of the motion? **1**

iii) What is the amplitude of the motion? **2**

Question 5 (cont.)

Marks

c) The position of two yachts, A and B out at sea subtend an angle of $60°$ at the base C of a cliff. The distance AC is 3 times the height of the cliff and the distance BC is 4 times the height of the cliff.



i) Show that the angle of elevation $\alpha°$ of the cliff from Point A is $18°26'$ — 1

ii) The distance AB is 300 metres greater than the height of the cliff. Find the height of the cliff. — 3

Question 6 (start a new page)

a) Solve $|x^2 - 9| < 8$ — 3

b) By integrating both sides of the expansion

$(1 + x)^n = {}^nC_0 + {}^nC_1x + \dots\dots\dots + {}^nC_nx^n$ prove — 3

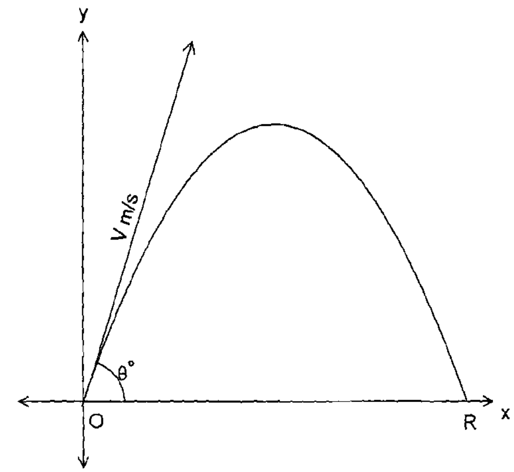
$$1 - \frac{1}{2}{}^nC_1 + \frac{1}{3}{}^nC_2 + \dots\dots + \frac{(-1)^n}{n+1}{}^nC_n = \frac{1}{n+1}$$

Question 6 (cont.)

Marks

c) A projectile is fired with velocity V *m/s* from a point 0 at an angle θ with the horizontal and hits the ground at a horizontal distance R from 0.
Taking g = 10m/s^2 you may assume the equations of motion for the projectile.

i.e.
$$\ddot{x} = 0 \qquad \ddot{y} = -10$$
$$\dot{x} = V\cos\theta \qquad \dot{y} = -10t + V\sin\theta$$
$$x = Vt\cos\theta \qquad y = -5t^2 + Vt\sin\theta$$



i) Show that the range $R = \frac{V^2 \sin 2\theta}{10}$ and that the maximum range is given by $\frac{V^2}{10}$. — 3

ii) The maximum range of a certain rifle is 2000 metres. How much is the range increased when the rifle is mounted on a car travelling at 30 m/s towards the target, the angle of elevation being unaltered. — 3

Question 7 (start a new page) Marks

a) i) Show that $\frac{d}{dx}\left(\tan^3 x\right) = 3\tan^2 x + 3\tan^4 x$ **2**

ii) Hence find $\int \tan^4 x \; dx$ **3**

b) Prove by Mathematical Induction that

$3 \times 2^2 + 3^2 \times 2^3 + \ldots\ldots\ldots\ldots + 3^n \times 2^{n+1} = \frac{12}{5}\left(6^n - 1\right)$ for all positive integers n. **4**

c) If the 3rd and 4th terms of the binomial $(1 + ax)^n$ are $264x^2$ and $1760x^3$ and $n > a$, find the values of a and n. **3**

End of Exam

STANDARD INTEGRALS

$\int x^n dx = \frac{1}{n+1}x^{n+1}, \; n \neq -1; \; x \neq 0, \; if \; n < 0$

$\int \frac{1}{x} dx = \ln x, \quad x > 0$

$\int e^{ax} dx = \frac{1}{a}e^{ax}, \; a \neq 0$

$\int \cos ax dx = \frac{1}{a}\sin ax, \; a \neq 0$

$\int \sin ax dx = -\frac{1}{a}\cos ax, \; a \neq 0$

$\int \sec^2 ax dx = \frac{1}{a}\tan ax, \; a \neq 0$

$\int \sec ax \tan ax dx = \frac{1}{a}\sec ax, \; a \neq 0$

$\int \frac{1}{a^2 + x^2} dx = \frac{1}{a}\tan^{-1}\frac{x}{a}, \; a \neq 0$

$\int \frac{1}{\sqrt{a^2 - x^2}} dx = \sin^{-1}\frac{x}{a}, \; a > 0, \; -a < x < a$

$\int \frac{1}{\sqrt{x^2 - a^2}} dx = \ln\left(x + \sqrt{x^2 - a^2}\right), \; x > a > 0$

$\int \frac{1}{\sqrt{x^2 + a^2}} dx = \ln\left(x + \sqrt{x^2 + a^2}\right)$

NOTE: $\ln x = \log_e x, \; x > 0$

2008 EXT 1 Trial Solutions

1 a) $(-1,2)\quad(6,10)$

$2:3$

$\left(\frac{2(6)+3(-1)}{2+3},\ \frac{2(10)+3(2)}{2+3}\right)$ (1) (1)

$=\left(\frac{9}{5},\frac{26}{5}\right)$

b) $\int \frac{4x}{2x+1}\,dx$ using $u=2x+1$

$\frac{du}{dx}=2 \qquad x=\frac{u-1}{2}$

$dx=\frac{du}{2}$ (1)

$\int \frac{4\left(\frac{u-1}{2}\right)\cdot\frac{du}{2}}{u}$

$=\int \frac{u-1}{u}\,du$ (1)

$=\int 1-\frac{1}{u}$

$=u-\ln u+c$ (1)

$=(2x+1)-\ln(2x+1)+c$

(ignore c)

c) $\frac{3x-1}{x+2}>0$ (1) $\therefore (3x-1)(x+2)>0$ (1)

$-2 \qquad \frac{1}{3}$

$x<-2,\ x>\frac{1}{3}$ (1)

d) (i) $y=e^{-x} \quad y=e^{x-1}$

$\therefore e^{-x}=e^{x-1}$

$\therefore -x=x-1$

$2x=1$

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

(ii) $y=e^{-x} \qquad y=e^{x-1}$

$y'=-e^{-x} \qquad y'=e^{x-1}$

at $x=\frac{1}{2}$ $y'=-e^{-\frac{1}{2}}$ at $x=\frac{1}{2}$

$y'=-\frac{1}{\sqrt{e}} \qquad y'=\frac{1}{\sqrt{e}}$ (1)

$\tan\theta=\dfrac{\frac{1}{\sqrt{e}}+\frac{1}{\sqrt{e}}}{1+\frac{1}{\sqrt{e}}\cdot\frac{-1}{\sqrt{e}}}$ (1)

$=\dfrac{\frac{2}{\sqrt{e}}}{1-\frac{1}{e}}$

$\theta=62°29'$ (1)

Question 2.

a) $\left(3x^2+\frac{5}{x^3}\right)^{10}$

$T_{k+1}={}^{10}C_k\,(3x^2)^{10-k}(5x^{-3})^k$ (1)

$={}^{10}C_k\,3^{10-k}x^{20-2k}5^k x^{-3k}$

$={}^{10}C_k\,3^{10-k}5^k\cdot x^{20-5k}$

Constant term $20-5k=0$, $k=4$ (1)

Constant term is

$\therefore T_5={}^{10}C_4\,3^6 5^4$ (1)

b) $\sin 4x=\cos 2x \quad 0\le x\le 36$

$2\sin 2x\cos 2x=\cos 2x$

$2\sin 2x\cos 2x-\cos 2x=0$

$\cos 2x(2\sin 2x-1)=0$ (1)

$\cos 2x=0 \qquad \sin 2x=\frac{1}{2}$

$2x=90°, 270°, 450°, 630°, \quad 30°, 150°, 390°, \ldots$

$x=\underbrace{45, 135, 225°, 315°}_{(1)}, \underbrace{15°, 75°, 195°, \ldots}_{(1)}$

c) $\int_0^{\frac{3}{4}}\frac{dx}{\sqrt{9-4x^2}}$

$\int_0^{\frac{3}{4}}\frac{dx}{\sqrt{4\left(\frac{9}{4}-x^2\right)}}$

$=\frac{1}{2}\int_0^{\frac{3}{4}}\frac{dx}{\sqrt{\left(\frac{3}{2}\right)^2-x^2}}$ (1)

$=\frac{1}{2}\left[\sin^{-1}\left(\frac{2x}{3}\right)\right]_0^{\frac{3}{4}}$ (1)

$=\frac{1}{2}\left[\sin^{-1}\left(\frac{2}{3}\cdot\frac{3}{4}\right)-\sin^{-1}(0)\right]$

$=\frac{1}{2}\left[\frac{\pi}{6}-0\right]$

$=\frac{\pi}{12}$ (1)

d) $a_1=2-\frac{f(2)}{f'(2)}$

$f(x)=\sin x-\frac{x}{3} \quad f(2)=0.24$ (1)

$f'(x)=\cos x-\frac{1}{3} \quad f'(2)=-0.75$ (1)

$\therefore a_1=2-\frac{0.24}{-0.75}$

$a_1=2.3$ (1)

Question 3.

a) $V=\pi\int_0^{\frac{\pi}{4}}4\sin^2 x\,dx$ (1)

$=\pi\int_0^{\frac{\pi}{4}}4\left(\frac{1}{2}-\frac{\cos 2x}{2}\right)dx$ (1)

$=2\pi\int_0^{\frac{\pi}{4}}(1-\cos 2x)\,dx$

$=2\pi\left[x-\frac{\sin 2x}{2}\right]_0^{\frac{\pi}{4}}$ (1)

$=2\pi\left[\frac{\pi}{4}-\frac{\sin\frac{\pi}{2}}{2}\right]-[0-0]$

$=2\pi\left[\frac{\pi}{4}-\frac{1}{2}\right]$

$=\frac{\pi^2}{2}-\pi$ (1)

b) (i) $y=2\cos^{-1}(x-1)$

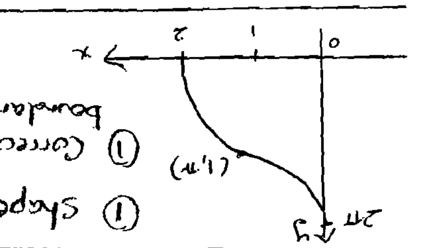
$\frac{y}{2}=\cos^{-1}(x-1)$

Domain $-1\le x-1\le 1$

$0\le x\le 2$ (1)

Range $0\le\frac{y}{2}\le\pi$

$0\le y\le 2\pi$ (1)



(1) shape

(1) Correct boundaries.

c) $2x^3-5x^2-3x+1=0$

(i) $\alpha+\beta+\gamma=\frac{-b}{a}=\frac{5}{2}$ (1)

(ii) $\frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}=\frac{\beta\gamma+\alpha\gamma+\alpha\beta}{\alpha\beta\gamma}$

$=\dfrac{-\frac{3}{2}}{-\frac{1}{2}}$

$=+3$ (1)

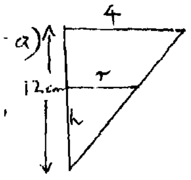
(iii) $\alpha^2+\beta^2+\gamma^2$

$(\alpha+\beta+\gamma)^2=\alpha^2+\beta^2+\gamma^2+2(\alpha\beta+\alpha\gamma+\beta\gamma)$ (1)

$\therefore \alpha^2+\beta^2+\gamma^2=(\alpha+\beta+\gamma)^2-2(\alpha\beta+\alpha\gamma+\beta\gamma)$

$=\left(\frac{5}{2}\right)^2-2\left(-\frac{3}{2}\right)$

$=\frac{37}{4}$ (1)

a) 

$\frac{h}{12} = \frac{r}{4}$

$r = \frac{4}{12}h$

$r = \frac{1}{3}h$ ①

i) Find $\frac{dh}{dt}$ when $h = 9$.

$V = \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi \cdot \left(\frac{h}{3}\right)^2 \cdot h$

$= \frac{\pi h^3}{27}$ ①

given $\frac{dV}{dt} = 3$

$\frac{dV}{dh} = \frac{3\pi h^2}{27}$

$= \frac{\pi h^2}{9}$

$\frac{dV}{dt} = \frac{dV}{dh} \cdot \frac{dh}{dt}$

$3 = \frac{\pi \cdot 9^2}{9} \cdot \frac{dh}{dt}$ ①

$\frac{dh}{dt} = \frac{3}{9\pi}$

$= \frac{1}{3\pi}$ cm/s. ①

b) $x^2 = 4ay$

(i) $y = \frac{x^2}{4a}$

$y' = \frac{2x}{4a}$ — must show working ①

at $x = 2ap$ $y' = p$ (ie $m = p$)

Tangent $y - ap^2 = p(x - 2ap)$

$y = px - ap^2$ ①

(ii) at T $y = 0$ $\therefore 0 = px - ap^2$

$x = ap$

$T(ap, 0)$ ①

(iii) Eq'n of normal

$y - ap^2 = -\frac{1}{p}(x - 2ap)$

$y = -\frac{x}{p} + ap^2 + 2a$ ①

(iv) at R

$x = ap$ $\therefore y = -\frac{ap}{p} + ap^2 + 2a$

$= ap^2 + a$ ①

$R(ap, ap^2 + a)$

(v) $x = ap \Rightarrow p = \frac{x}{a}$

$y = ap^2 + a$

$= a\left(\frac{x}{a}\right)^2 + a$ ①

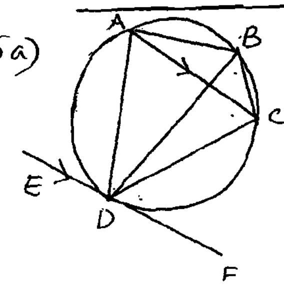
$y = \frac{x^2}{a} + a$ — not essential to state its in the form $y = ax^2 + bx + c$

$x^2 = ay - a^2$

$x^2 = a(y - a)$ ①

Vertex $(0, a)$ focal length $\frac{a}{4}$

$\therefore$ directrix $y = \frac{3a}{4}$ ①

5a) 

let $\angle CDF = x^\circ$ ①

$\therefore \angle DBC = x^\circ$ (Angle between tangent + chord is equal to the angle in the alternate segment)

$\angle ACD = x^\circ$ (Alternate $\angle$'s on $\parallel$ lines.) ①

$\angle ABD = x^\circ$ (Angles at circumference on the same arc are equal) ①

$\therefore \angle ABD = \angle DBC$ $\therefore$ BD bisects $\angle ABC$.

5b) $v^2 = -9x^2 + 18x + 27$

(i) $\frac{1}{2}v^2 = \frac{-9x^2}{2} + 9x + \frac{27}{2}$

$\frac{d}{dx}\left(\frac{1}{2}v^2\right) = -9x + 9$ ①

ie $\ddot{x} = -9(x - 1)$

which is in the form $\ddot{x} = -n^2(x - b)$ in SHM ①

(ii) $T = \frac{2\pi}{n} = \frac{2\pi}{3}$ ①

(iii) At endpoints $v = 0$

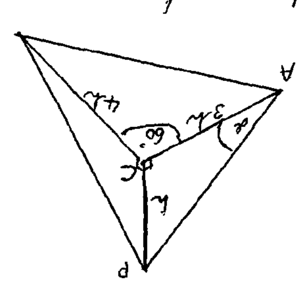
$\therefore -9x^2 + 18x + 27 = 0$

$x^2 - 2x - 3 = 0$

$(x - 3)(x + 1) = 0$ ①

$x = -1, 3$

$\therefore$ Amplitude is $\frac{1}{2} \times 4 = 2$ ①



(i) $\tan\alpha = \frac{h}{3h}$

$\tan\alpha = \frac{1}{3}$ $\therefore \alpha = 18°26'$ ①

(ii) $(h + 300)^2 = (3h)^2 + 4h^2 - 2.3h.4h.\cos 60°$

$(h + 300)^2 = 9h^2 + 16h^2 - 24h^2 \cdot \frac{1}{2}$ ①

$h^2 + 600h + 90000 = 13h^2$

$0 = 12h^2 - 600h - 90000$

$= h^2 - 50h - 7500$ ①

$h = \frac{50 \pm \sqrt{(-50)^2 - 4 \times 1 \times -7500}}{2 \times 1}$

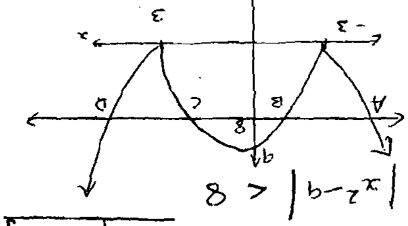
$= \frac{50 \pm \sqrt{32500}}{2}$ $h > 0$

$\therefore h = \frac{50 + \sqrt{32500}}{2}$

$= 115 \cdot 1$ m. ①

Question 6

a) $|x^2 - 9| < 8$ — Graphically



To find A + D. solve

$x^2 - 9 = 8$

$x = \pm\sqrt{17}$ ①

To find BC $9 - x^2 = 8$

$x^2 = 1$

$x = \pm 1$ ①

$\therefore |x^2 - 9| < 8$ when

$-\sqrt{17} < x < -1$, $1 < x < \sqrt{17}$ ①

Algebraically.

$|x^2 - 9| < 8$

$x^2 - 9 < 8$

$x^2 < 17$

$-\sqrt{17} < x < \sqrt{17}$ ①

$-(x^2 - 9) < 8$

$-x^2 + 9 < 8$

$-x^2 < -1$

$x^2 > 1$ ①

ie $x < -1$, $x > 1$

require intersection.

$-\sqrt{17} < x < -1$ $1 < x < \sqrt{17}$. ①

6b) ii)

$(1+x)^n = {}^nC_0 + {}^nC_1 x + {}^nC_2 x^2 + \dots + {}^nC_n x^n$

Integrating

$\frac{(1+x)^{n+1}}{n+1} + c_1 = {}^nC_0 x + \frac{1}{2}{}^nC_1 x^2 + \dots + \frac{1}{n+1}{}^nC_n x^{n+1} + c_2$ (1)

let $x=0$

$\therefore \frac{1}{n+1} + c_1 - c_2 = 0$

$\therefore c_1 - c_2 = -\frac{1}{n+1}$ (1)

$\therefore \frac{(1+x)^{n+1}}{n+1} - \frac{1}{n+1} = {}^nC_0 x + \dots + \frac{1}{n+1}{}^nC_n x^{n+1}$

let $x=-1$

$\therefore 0 - \frac{1}{n+1} = -{}^nC_0 + \frac{1}{2}{}^nC_1 - \frac{1}{3}{}^nC_2 + \dots$

$\frac{1}{n+1} = {}^nC_0 - \frac{1}{2}{}^nC_1 + \frac{1}{3}{}^nC_2 + \dots \frac{(-1)^n}{n+1}{}^nC_n$ (1)

c) Range occurs when $y=0$

$0 = -5t^2 + Vt\sin\theta$

$0 = t(-5t + V\sin\theta)$

$t = 0, \quad \frac{V\sin\theta}{5}$ (1)

$x = Vt\cos\theta$

$= \frac{V \cdot V\sin\theta\cos\theta}{5}$

$= \frac{V^2 \cdot 2\sin\theta\cos\theta}{10}$ (1)

$= \frac{V^2\sin 2\theta}{10}$

Max range when $\theta = 45^\circ$

$\therefore R = \frac{V^2\sin 90}{10} = \frac{V^2}{10}$ (1)

Vertical velocity unchanged

time of flight when $y=0$

$-5t^2 + Vt\sin\theta = 0$

$t(-5t + V\sin\theta) = 0$

$t=0 \quad t = \frac{V\sin\theta}{5}$

but $V = 100\sqrt{2}$ $\theta = 45^\circ$

$t = \frac{100\sqrt{2}\cdot\frac{1}{\sqrt{2}}}{5}$

$= 20$

$\therefore$ extra range

$= 20 \times 30$

$= 600\,m$

Question 7.

a) (i) $\frac{d}{dx}(\tan x)^3 =$

$3(\tan x)^2 \cdot \sec^2 x$ (1)

$= 3\tan^2 x\,(1+\tan^2 x)$

$= 3\tan^2 x + 3\tan^4 x$ (1)

(ii) $\frac{d}{dx}(\tan^3 x) = 3\tan^2 x + 3\tan^4 x$

$\therefore \tan^4 x = \frac{1}{3}\left[\frac{d}{dx}(\tan^3 x) - 3\tan^2 x\right]$ (1)

$\therefore \int \tan^4 x = \frac{1}{3}\int \frac{d}{dx}(\tan^3 x) - 3\tan^2 x$ (1)

$= \frac{1}{3}\int \frac{d}{dx}(\tan^3 x) - 3(\sec^2 x - 1)$

$= \frac{1}{3}\left[\tan^3 x - 3\tan x + 3x\right] + c$

$= \frac{\tan^3 x}{3} - \tan x + x + c$ (1)

$12 = 12$

$\therefore$ True for $n=1$

Assume true for $n=k$

ie

$2^2 + \dots + 3^k \times 2^{k+1} = \frac{12}{5}(6^k - 1)$ (1)

Prove true for $n=k+1$

ie

$2^2 + \dots + 3^k \times 2^{k+1} + 3^{k+1} \times 2^{k+2} = \frac{12}{5}(6^{k+1}-1)$ (1)

ie $\frac{12}{5}(6^k - 1) + 3^{k+1} \times 2^{k+2} = \frac{12}{5}(6^{k+1}-1)$

LHS =

$\frac{12}{5}(6^k) - \frac{12}{5} + 3\cdot 3^k \times 2^k \cdot 2^2$ (1)

$\frac{12}{5}(6^k) - \frac{12}{5} + 12\cdot 6^k$

$\frac{12}{5}\cdot 6^{k+1} - \frac{12}{5}$

$= \frac{12}{5}(6^{k+1} - 1)$ (1)

$= RHS$.

Proved true for $n=1$ & assumed true for $n=k$. Proven true for $n=k+1$ $\therefore$ true for $n=1$, $n=2$ ... & for all n by M.I.

7c) ${}^nC_2\, a^2 = 264$

$\frac{n(n-1)a^2}{2} = 264$ ... (A)

${}^nC_3\, a^3 = 1760$

$\therefore \frac{n(n-1)(n-2)}{1\times2\times3}a^3 = 1760$ ... (B) (1)

$\therefore a = 1, 2, 4, 5, 10, 20$

& $n = 22, 12, 7, 6, 4, 1$.

but $n > a$ $\therefore$

trial $a = 1, 2, 4, 5$.

sub $a=1$ $n=22$ into (A)

$\frac{22(21)}{2}\cdot 1 \neq 264$

$a=2 \quad n=12$

$\frac{12(11)}{2}\cdot 2^2 = 264$ ✓

$\therefore a = 2 \quad n = 12$ (1)

There are other methods of doing this...

$\ln(3x-1) - \ln(x+2)$

$3x-1>0 \qquad x+2>0$ (1)

$x>\frac{1}{3} \qquad x>-2$

intersection $x>\frac{1}{3}$. (1)

also $\ln\left(\frac{3x-1}{x+2}\right)$ could be $\ln\left(\frac{-(3x-1)}{-(x+2)}\right)$

$\therefore -(3x-1)>0 \qquad -(x+2)>0$

$x<\frac{1}{3} \qquad x<-2$

intersection $x<-2$

$\therefore$ final answer

$x<-2 \quad , \quad x>\frac{1}{3}$ (1)

if $x\neq-2$, $x\neq\frac{1}{3}$

$x<-2,\ x>\frac{1}{3}$) give 2.

$(1+ax)^n = \dots \qquad T_3 = 264x^2 \qquad T_4 = 1760x^3$

${}^nC_2\, a^2 = 264 \quad -(1) \qquad {}^nC_3\, a^3 = 1760 \quad (2)$

$(2)\div(1) \Rightarrow \frac{{}^nC_3}{{}^nC_2}\, a = \frac{1760}{264} = \frac{20}{3}$

$\therefore \frac{\cancel{n(n-1)}(n-2)}{6} \cdot \frac{2\, a}{\cancel{n(n-1)}} = \frac{20}{3}$

$\therefore (n-2)a = 20$ (3)

$(1)^3 \div (2)^2 \Rightarrow \frac{({}^nC_3)^2}{({}^nC_2)^3} = \frac{(1760)^2}{(264)^3}$

$\frac{\cancel{n^2}\cancel{(n-1)^2}(n-2)^2}{\cancel{n^3}\cancel{(n-1)^3}\cancel{8}} \cdot \frac{2^3}{6^2} = \left(\frac{20}{3}\right)^2 \cdot \frac{1}{264}$

$n \quad n-1$

$\frac{(n-2)^2}{n(n-1)} \frac{\cancel{8}\,2}{\cancel{36}\,9} = \frac{\cancel{400}\,25}{\cancel{9}\,1} \cdot \frac{1}{\cancel{264}\,33}$

$\frac{(n-2)^2}{n(n-1)} = \frac{25}{33}$

$\therefore 33(n-2)^2 = 25n(n-1)$

let $y = n-2$

$\therefore 33y^2 = 25(y+2)(y+1)$

$33y^2 = 25y^2 + 75y + 50$

$\therefore 8y^2 - 75y - 50 = 0$

$(8y+5)(y-10) = 0$

as n is int so is y $\therefore$ $y=10 \Rightarrow n=12 \quad a=2$