

Student Name: \_\_\_\_\_

# **HUNTERS HILL HIGH SCHOOL**

## **EXTENSION 1**

### **MATHEMATICS**

### **HSC TRIAL 2017**



**Hunters Hill**  
High School

#### **General Instructions**

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Board-approved calculators may be used
- A Reference Sheet is provided
- In Questions 11–14, show relevant mathematical reasoning and/or calculations

**Total marks - 70**

#### **Section I**

10 marks

- Attempt Questions 1-10
- Allow about 15 minutes for this section

#### **Section II**

60 marks

- Attempt Questions 11-14
- Allow about 1 hour 45 minutes for this section

## Section I

10 marks

Attempt Questions 1-10

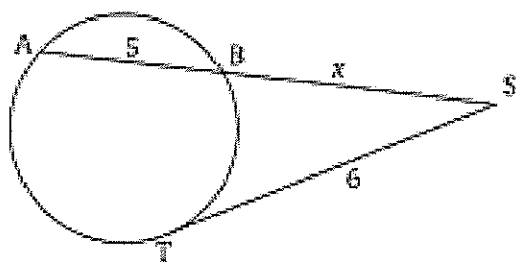
Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1-10.

---

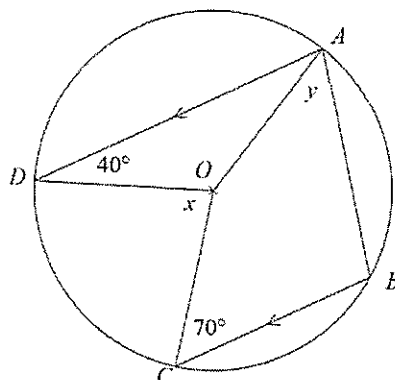
- 1 Which of the following is the domain of  $y = \cos^{-1}\left(\frac{x}{2}\right)$ ?
- (A)  $-2 \leq x \leq 2$
- (B)  $0 < x < 2\pi$
- (C)  $-\frac{1}{2} \leq x \leq \frac{1}{2}$
- (D)  $0 \leq x \leq \frac{\pi}{2}$
- 2 The point dividing the interval from  $A(-3,1)$  to  $B(1,-1)$  externally in the ratio 3:1 is:
- (A)  $\left(0, -\frac{1}{2}\right)$
- (B)  $\left(-1, \frac{1}{2}\right)$
- (C)  $(-5, 2)$
- (D)  $(3, -2)$
- 3 Find the remainder when  $P(x) = 2x^3 + x^2 - 13x + 6$  is divided by  $(x - 1)$ .
- (A) 18    (B) 6    (C) 4    (D) -4

- 4 The line DT is a tangent to the circle at T and AS is a secant meeting the circle at A and B. Given that  $ST = 6$ ,  $AB = 5$  and  $SB = x$ , which of the following is the value of  $x$ ?



- (A)  $x=4$  (B)  $x=5$  (C)  $x=6$  (D)  $x=9$
- 5 Using the auxillary angle method, or otherwise, which expression is equal to  $\cos x - \sin x$ ?
- (A)  $\sqrt{2} \cos(x + 45^\circ)$  (B)  $\sqrt{2} \cos(x - 45^\circ)$
- (C)  $2 \cos(x + 45^\circ)$  (D)  $2 \cos(x - 45^\circ)$
- 6 The equation of the chord of contact of the parabola  $y = x^2$  from the point  $(1, -1)$  is
- (A)  $x + 8y + 8 = 0$  (B)  $x - 8y + 8 = 0$
- (C)  $2x + y + 1 = 0$  (D)  $2x - y + 1 = 0$
- 7 A particle is moving along the  $x$ -axis. Its velocity  $v$  at position  $x$  is given by  $v = \sqrt{8x - x^2}$ . What is the acceleration when  $x = 3$ ?
- (A) 1 (B) 2 (C) 3 (D) 4

- 8 A, B, C and D are points on a circle with centre O.  $\angle ADO = 40^\circ$  and  $\angle BCO = 70^\circ$ .



What are the values of  $x$  and  $y$ ?

- (A)  $x = 80^\circ$  and  $y = 15^\circ$
- (B)  $x = 80^\circ$  and  $y = 30^\circ$
- (C)  $x = 110^\circ$  and  $y = 15^\circ$
- (D)  $x = 110^\circ$  and  $y = 35^\circ$
- 9 Let  $x = 1$  be a first approximation to the root of the equation  $\cos x = \log_e x$ . What is a better approximation to the root using Newton's method?
- (A) 1.28
- (B) 1.29
- (C) 1.30
- (D) 1.31
- 10 How many solutions does the equation  $\sin 2x = 4\cos x$  have for  $0 \leq x \leq 2\pi$ .
- (A) 1      (B) 2      (C) 3      (D) 4

## Section II

60 marks

Attempt Questions 11-14

Allow about 1 hours and 45 minutes for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

In Questions 11-14, your responses should include relevant mathematical reasoning and/or calculations.

---

**Question 11** (15 marks) Use a SEPARATE writing booklet.

- (a) Differentiate  $y = \tan^{-1}\left(\frac{x}{3}\right)$  1
- (b) Given  $f(x) = \sin^{-1} 3x$
- (i) Determine the domain and range. 2
- (ii) Find  $f'(x)$  1
- (iii) Sketch  $y = f(x)$  . 2
- (c) Evaluate  $\int_1^4 x\sqrt{x-1} \, dx$  using the substitution  $u = x-1$ . 3
- (d) Evaluate the following definite integrals:
- (i)  $\int_0^{\frac{\pi}{2}} \cos^2\left(\frac{x}{2}\right) \, dx$  3
- (ii)  $\int_1^2 x(x^2-1)^2 \, dx$ , let  $u = x^2-1$  3

**Question 12** (15 marks) Use a SEPARATE writing booklet.

- (a) If  $f(x) = e^{x+1}$  find the inverse function  $f^{-1}(x)$  and hence show

$$f[f^{-1}(x)] = f^{-1}[f(x)] = x \quad 2$$

- (b) If  $\alpha, \beta$  and  $\gamma$  are the roots of the equation  $x^3 + 2x^2 + 3x + 5 = 0$ , find the value of :

(i)  $\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}$  2

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

- (c) When a polynomial  $P(x)$  is divided by  $x - 2$  the remainder is 4 and when it is divided by  $x - 3$  the remainder is 7. Find the remainder when  $P(x)$  is divided by  $(x - 2)(x - 3)$  3

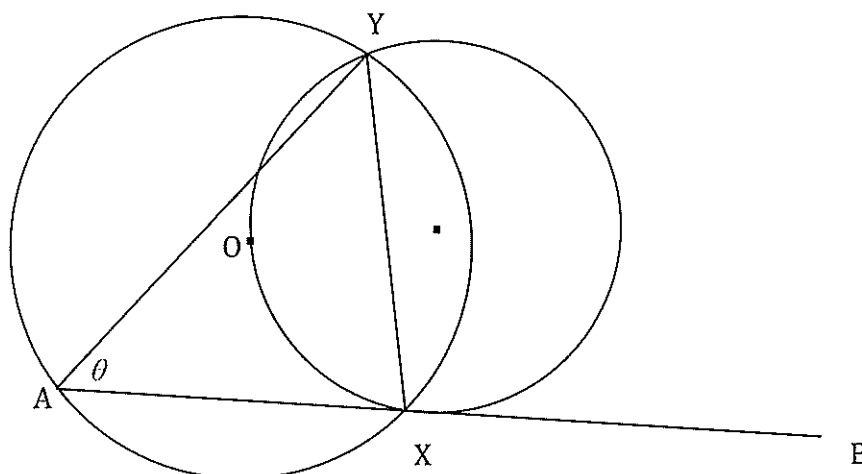
- (d) Solve  $\frac{2x}{x+1} \leq x$  3

- (e) Use mathematical induction to prove that for all positive integers,  $n$

$$\sum_{r=1}^n r^3 = \frac{n^2}{4}(n+1)^2 \quad 3$$

**Question 13** (15 marks) Use a SEPARATE writing booklet.

- (a) Find the coefficient of  $x^6$  in the expansion  $(x^2 + 4)^{12}$  2
- (b) A particle is moving along the  $x$ -axis so that its acceleration after  $t$  seconds is by  $\ddot{x} = 4x(x^2 - 2)$ . The particle starts at the origin with an initial velocity of  $\sqrt{6}$  cm/s.
- (i) If  $v$  is the velocity of the particle, find  $v^2$  as a function of  $x$ . 2
- (ii) Explain why the motion is confined to  $-1 \leq x \leq 1$ . 2
- (c) O is the centre of the larger circle. The two circles intersect at the points X and Y. AXB is a tangent to the smaller circle at point X. O is on the circumference of the smaller circle.



Copy or trace the diagram onto your answer paper.

- (i) Find  $\angle XOY$  in terms of  $\theta$ .  
Give a reason for your answer. 1
- (ii) Explain why  $\angle BXY = 2\theta$  1
- (iii) Prove  $AX = YX$ . 2

**Question 13 continued on next page.**

**Question 13 (continued)**

- (d) (i) By considering the terms in  $x^r$  on both sides of the identity

**2**

$$(1+x)^{m+n} = (1+x)^m (1+x)^n, \text{ show that } {}^{m+n}C_r = \sum_{k=0}^r {}^mC_k {}^nC_{r-k}$$

for  $0 \leq r \leq m$  and  $0 \leq r \leq n$ .

- (ii) Hence show that

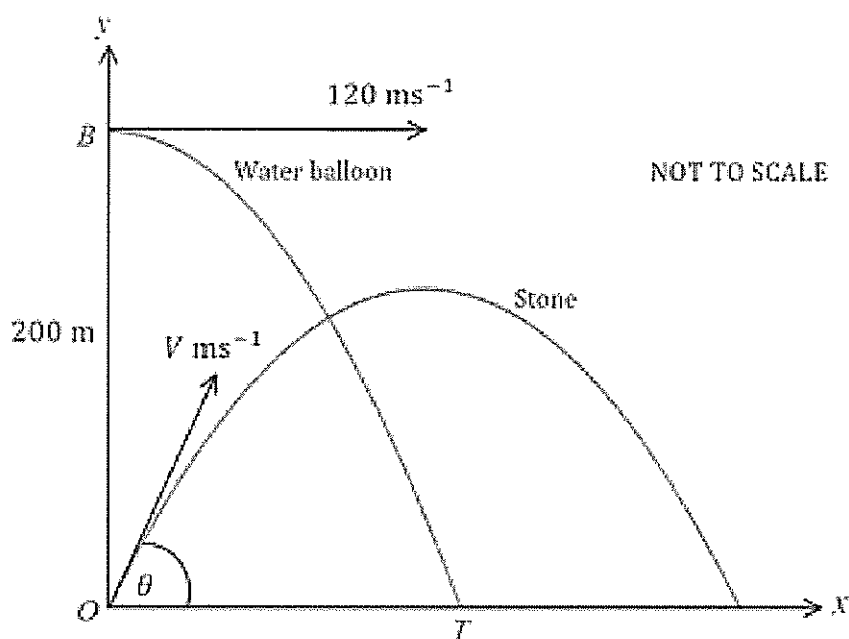
**3**

$${}^{m+1}C_0 {}^nC_2 + {}^{m+1}C_1 {}^nC_1 + {}^{m+1}C_2 {}^nC_0 = {}^mC_0 {}^{n+1}C_2 + {}^mC_1 {}^{n+1}C_1 + {}^mC_2 {}^{n+1}C_0$$

**Question 14** (15 marks) Use a SEPARATE writing booklet.

- (a) Find the exact value of  $\sin \left[ \cos^{-1} \left( \frac{4}{5} \right) - \tan^{-1} \left( \frac{5}{12} \right) \right]$ .  
Show all working. 3
- (b) At time  $t$  years the number  $N$  of individuals in a population is given by  

$$N = 5000 - 4250e^{-kt} \text{ for some } k > 0.$$
- (i) Find the initial population. 1
- (ii) Sketch the graph of  $N$  as a function of  $t$  showing clearly the initial and limiting populations. 2
- (iii) Find the value of  $k$  if  $\frac{dN}{dt} = 250$  when  $N$  is three times the initial population. 2
- (c) A water balloon is fired horizontally by a cannon from the point B with a velocity of  $120 \text{ ms}^{-1}$  to reach a target at T.  
 At the same time, a stone is launched from the point O with a velocity of  $V \text{ ms}^{-1}$  and an angle of projection of  $\theta$  in order to burst the water balloon in the air.  
 The point O is 200 metres directly below the point B and  $\theta = \tan^{-1} \left( \frac{3}{4} \right)$ .  
 Take the acceleration due to gravity as  $10 \text{ ms}^{-2}$ .



- (i) For the water balloon, show that the equations of motion of the water balloon are given by  $x = 120t$  and  $y = -5t^2 + 200$ . 2

**Question 14 continued on next page.**

**Question 14** (continued)

**2**

- (ii) For the stone, assume that the equations of motion are given by  $x = Vt \cos \theta$  and  $y = -5t^2 + Vt \sin \theta$ . (Do NOT prove this.) **3**

Show that in order for the stone to successfully burst the water balloon in the air, it must be launched at a velocity of  $150 \text{ ms}^{-1}$ .

- (iii) How high above the ground does the collision occur? Give your answer correct to the nearest metre.

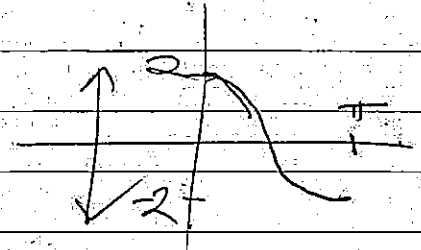
**END OF EXAMINATION**

# MAX TRIAL SOLUTIONS - 2017

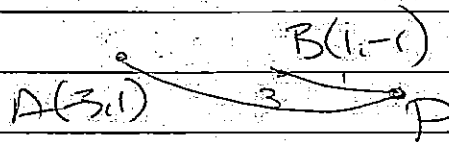
## SECTION I

Q1. A

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



Q2. D



Q3. D

$$P(1) = 2 + 1 - 13 + 6$$
$$= -4$$

Q4. A

$$SI^2 = SB \cdot SA$$
$$6^2 = x(x+5)$$

$$x^2 + 5x - 36 = 0$$

$$(x+9)(x-4) = 0$$

$$x = 4$$

Q5. A

Q6. D

$$x x_0 = 2a(y y_0) \quad (1, -1)$$
$$\cancel{1 \cdot (-1)}$$

$$x^2 = 4ay$$

$$4a = 1$$

$$a = \frac{1}{4}$$

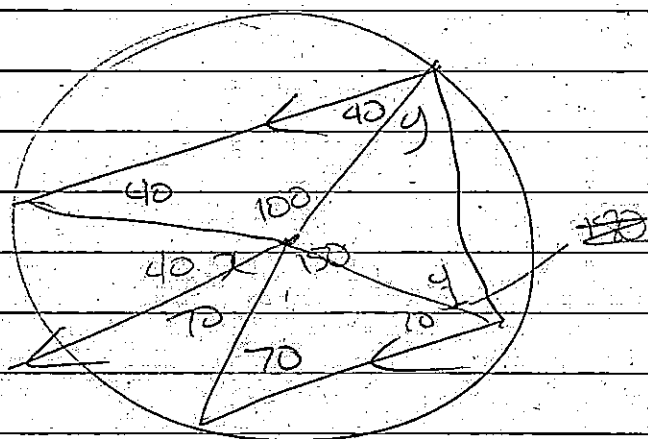
$$x(1) = 2\left(\frac{1}{4}\right)(y-1)$$

$$2x = y - 1$$

Q7. 

$$\frac{1}{2} \sqrt{8x - x^2}$$

$$\frac{d}{dx} a = \frac{1}{2} (8 - 2x)$$
$$= 4 - x.$$



$$76 = 110$$

$$2y + 140 + 150 = 300$$

$$\text{let } f(x) = \cos x - \ln x \geq 0$$
$$f'(x) = -\sin x - \frac{1}{x}$$

$$x = \frac{1 - \cos \theta - \ln |1 - \sin \theta|}{2}$$

B

## SECTION II

### Question 11.

a)  $y = \tan^{-1}\left(\frac{x}{3}\right)$

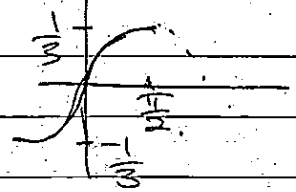
$$y' = \frac{3}{9+x^2}$$

b)  $f(x) = \sin^{-1} 3x$

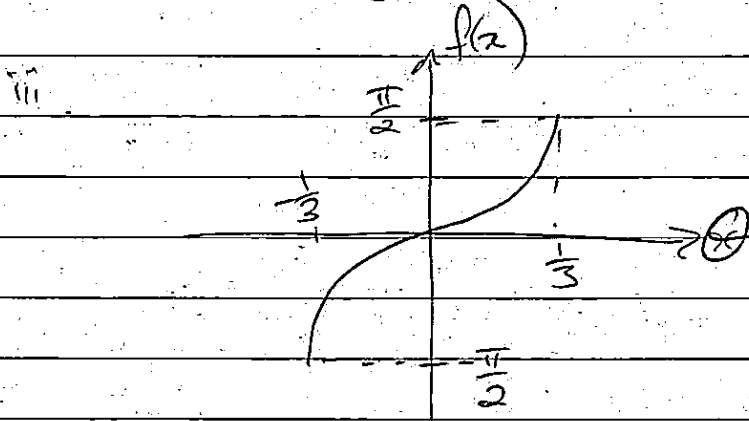
$$\theta = \frac{1}{3} \sin f(x)$$

i domain:  $\{x: -\frac{1}{3} \leq x \leq \frac{1}{3}\}$

range:  $\{y: -\frac{\pi}{2} \leq y \leq \frac{\pi}{2}\}$



ii  $f'(x) = \frac{1}{\sqrt{1-(3x)^2}} \cdot 3$   
 $= \frac{3}{\sqrt{1-9x^2}}$



$$c) \quad I = \int_1^4 x(x-1) dx$$

$$\text{let } u = x-1 \\ du = dx$$

$$\text{for } x=1, u = 1-1 \\ = 0$$

$$x=4 \quad u = 4-1 \\ = 3$$

$$I = \int_0^3 (u+1)u du$$

$$= \int_0^3 \left( u^{\frac{3}{2}} + u^{\frac{1}{2}} \right) du$$

$$= \left[ \frac{2u^{\frac{3}{2}}}{\frac{3}{2}} + \frac{2u^{\frac{1}{2}}}{\frac{1}{2}} \right]_0^3$$

$$= \frac{2}{5} \cdot 3^{\frac{3}{2}} + \frac{2}{3} \cdot 3^{\frac{3}{2}} - \left( \frac{2}{5} (0)^{\frac{3}{2}} + \frac{2}{3} (0)^{\frac{3}{2}} \right)$$

$$= \frac{2}{5} \cdot 9\sqrt{3} + \frac{2}{3} \cdot 3\sqrt{3}$$

$$= \frac{2\sqrt{3}}{5} (9 + 5)$$

$$= \frac{28\sqrt{3}}{5}$$

$$= \frac{13.16358614}{9.699484522}$$

$$\begin{aligned}
 d). i) \int_0^{\frac{\pi}{2}} \cos^2\left(\frac{x}{2}\right) dx & \quad \cos 2\theta = 2\cos^2\theta - 1 \\
 &= \frac{1}{2} \int_0^{\frac{\pi}{2}} (1 + \cos x) dx \\
 &= \frac{1}{2} \left[ x + \sin x \right]_0^{\frac{\pi}{2}} \\
 &= \frac{1}{2} \left( \frac{\pi}{2} + \sin \frac{\pi}{2} - 0 - \sin 0 \right) \\
 &= \frac{1}{4} (\pi + 2)
 \end{aligned}$$

$$ii) I = \int_1^2 x(x^2-1)^3 dx$$

$$\begin{aligned}
 \text{let } u &= x^2 - 1 \\
 du &= 2x dx
 \end{aligned}$$

$$\begin{aligned}
 x=1 &\Rightarrow u=0 \\
 x=2 &\Rightarrow u=3
 \end{aligned}$$

$$\begin{aligned}
 I &= \frac{1}{2} \int_0^3 u^3 du \\
 &= \frac{1}{2} \left[ \frac{u^4}{4} \right]_0^3 \\
 &= \frac{1}{2} \left( \frac{3^4}{4} - \frac{0^4}{4} \right) \\
 &= \frac{9}{2}
 \end{aligned}$$

## Question 2

a)  $f(x) = e^{x+1}$

$f^{-1}: x = e^{f^{-1}(x)+1}$

$$\ln x = f^{-1}(x) + 1$$

$$f^{-1}(x) = \ln x - 1$$

$$\begin{aligned} f[f^{-1}(x)] &= e^{(\ln x - 1) + 1} \\ &= e^{\ln x} \\ &= x \end{aligned}$$

$$\begin{aligned} f^{-1}[f(x)] &= \ln(e^{x+1}) - 1 \\ &= x + 1 - 1 \\ &= x \end{aligned}$$

$$\therefore f[f^{-1}(x)] = f^{-1}[f(x)] = x$$

b)  $x^3 + 2x^2 + 3x + 5 = 0$

$$\begin{aligned} \text{i) } \frac{1}{x} + \frac{1}{y} + \frac{1}{z} &= \frac{xy + yz + zx}{xyz} \\ &= \frac{3}{-5} \\ &= -\frac{3}{5} \end{aligned}$$

$$\begin{aligned} \text{ii) } x^2 + y^2 + z^2 &= (x + y + z)^2 - 2(xy + yz + zx) \\ &= (-2)^2 - 2(3) \\ &= -2 \end{aligned}$$

c)

$$P(2)=4, P(3)=7$$

$$P(x) = (x-2) \cdot Q(x) + 4$$

when  $x=3$

$$P(3) = (3-2)Q(3) + 4$$

$$7 = Q(3) + 4$$

$$Q(3) = 3$$

$$\therefore Q(x) = (x-3)M(x) + 3$$

$$\text{So, } P(x) = (x-2)((x-3)M(x) + 3) + 4$$

$$= (x-2)(x-3)M(x) + 3(x-2) + 4$$

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

$\therefore$  remainder is  $3x-2$ .

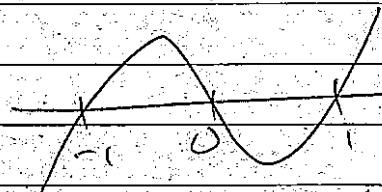
d)

$$\frac{2x}{x+1} \leq x, x \neq -1$$

$$2x(x+1) \leq x(x+1)^2$$

$$x(x+1)[x+1-2] \geq 0$$

$$x(x-1)(x+1) \geq 0$$



$\therefore -1 < x \leq 0, x \geq 1$  is the solution

$$c) \sum_{r=1}^n r^3 = \frac{n^2 (n+1)^2}{4}, \quad n \geq 1$$

Prove true for  $n=1$

$$\text{LHS} = \sum_{r=1}^1 r^3 \quad \text{RHS} = \frac{1^2 (1+1)^2}{4}$$

$$= 1^3$$

$$= 1$$

$$= \frac{4}{4}$$

$$= 1 = \text{LHS}$$

- true for  $n=1$ .

~~Assume~~

~~Prove~~ true for  $n=k$ .

$$1^3 + 2^3 + 3^3 + \dots + k^3 = \frac{k^2 (k+1)^2}{4}$$

Prove true for  $n=k+1$

$$\text{i.e. } 1^3 + 2^3 + 3^3 + \dots + k^3 + (k+1)^3 = \frac{(k+1)^2 ((k+1)+1)^2}{4} \\ = \frac{(k+1)^2 (k+2)^2}{4}$$

$$\text{LHS} = \frac{k^2 (k+1)^2}{4} + (k+1)^3$$

$$= \frac{(k+1)^2}{4} [k^2 + 4(k+1)]$$

$$= \frac{(k+1)^2}{4} (k^2 + 4k + 4)$$

$$= \frac{(k+1)^2 (k+2)^2}{4}$$

$$= \text{RHS}$$

$\therefore$  by induction, statement is true for all  $n \geq 1$

### Question 13

a)

$$(x^2 - 4)^{12}$$

general term.  ${}^{12}C_k (x^2)^{12-k} 4^k$

for  $x^6$ ,  $(x^2)^{12-k} = x^6$

$$24 - 2k = 6$$

$$2k = 18$$

$$k = 9$$

coefficient.

$$= {}^{12}C_9 4^9$$

$$= 57\,671\,680$$

b)

$$\ddot{x} = 4x(x^2 - 2)$$

at  $t=0$ ,  $x=0$ ,  $\dot{x}=\sqrt{6}$

i)  $\frac{d}{dx} \left( \frac{1}{2} \dot{x}^2 \right) = 4x(x^2 - 2)$

$$\frac{1}{2} \dot{x}^2 = \int 4x(x^2 - 2) dx$$

$$\dot{x}^2 = 8 \int x(x^2 - 2) dx$$

let  $u = x^2 - 2$

$$du = 2x dx$$

$$\dot{x}^2 = 4 \int u du$$

$$= 4 \frac{u^2}{2} + C$$

$$= 2u^2 + C$$

$$= 2(x^2 - 2)^2 + C$$

at  $x=0$ ,  $\dot{x}=\sqrt{6}$

$$(\sqrt{6})^2 = 2(0^2 - 2)^2 + c$$

$$6 = 8 + c$$

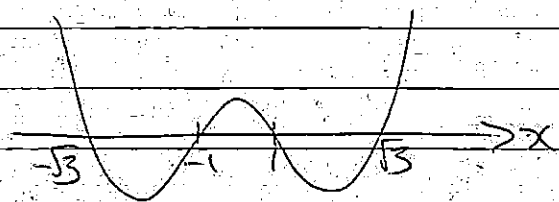
$$c = -2$$

$$\begin{aligned} \therefore \dot{x}^2 &= 2(x^2 - 2)^2 - 2 \\ &= 2(x^2 - 3)(x^2 - 1) \end{aligned}$$

ii) as initial velocity is positive  
 $\dot{x}^2 > 0$

$$\text{so, } (x^2 - 3)(x^2 - 1) > 0$$

$$(x - \sqrt{3})(x + \sqrt{3})(x - 1)(x + 1) > 0$$



hence,  $-1 < x < 1$

c) i)  $\angle XOY = 2\theta$  (angle at centre twice angle at circumference)

ii) angle in alternate segment equal to angle between tangent and chord

iii)  $\angle YAX + \angle AYX = \angle BYX$  (exterior angle of triangle)

$$\theta + \angle AYX = 2\theta$$

$$\angle AYX = \theta$$

$$= \angle YAX$$

$\therefore \triangle XYA$  is isosceles (two equal angles)

hence,  $AX = YX$  (equal sides of isosceles triangle)

d) i)  $(1+x)^{m+n} = (1+x)^m (1+x)^n$

coefficient of  $x^r$  in  $(1+x)^{m+n}$  is  $\binom{m+n}{r}$

$x^r$  terms from  $(1+x)^m (1+x)^n$

coefficient

$$x^r \cdot 1 + x^{r-1} \cdot x + x^{r-2} \cdot x^2 + \dots + x^2 \cdot x^{r-2} + x^{r-1} \cdot x + 1 \cdot x^r$$

$$= \sum_{k=0}^r \binom{m}{k} \binom{n}{r-k}$$

Hence  $(1+x)^{m+n} = \sum_{k=0}^r \binom{m}{k} \binom{n}{r-k}$

ii) from (i), if  $m \geq 2, n \geq 2$  ( $r=2$ )

$$\binom{m+n}{2} = \binom{m}{0} \binom{n}{2} + \binom{m}{1} \binom{n}{1} + \binom{m}{2} \binom{n}{0}$$

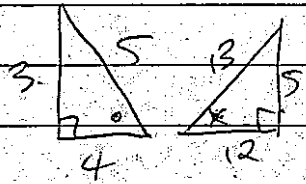
also  $\binom{m+n}{2} = \binom{m}{0} \binom{n+1}{2} + \binom{m}{1} \binom{n+1}{1} + \binom{m}{2} \binom{n+1}{0}$

hence  $\binom{m}{0} \binom{n}{2} + \binom{m}{1} \binom{n}{1} + \binom{m}{2} \binom{n}{0} = \binom{m}{0} \binom{n+1}{2} + \binom{m}{1} \binom{n+1}{1} + \binom{m}{2} \binom{n+1}{0}$

### Question 4.

$$a) \sin \left[ \cos^{-1} \left( \frac{4}{5} \right) - \tan^{-1} \left( \frac{5}{12} \right) \right]$$

$$= \sin \left( \cos^{-1} \left( \frac{4}{5} \right) \right) \cos \left( \tan^{-1} \left( \frac{5}{12} \right) \right) - \sin \left( \tan^{-1} \left( \frac{5}{12} \right) \right) \cos \left( \cos^{-1} \left( \frac{4}{5} \right) \right)$$



$$= \frac{3}{5} \cdot \frac{12}{13} - \frac{5}{13} \cdot \frac{4}{5}$$

$$= \frac{36 - 20}{65}$$

$$= \frac{16}{65}$$

$$b. \quad N = 5000 - 4250e^{-kt}$$

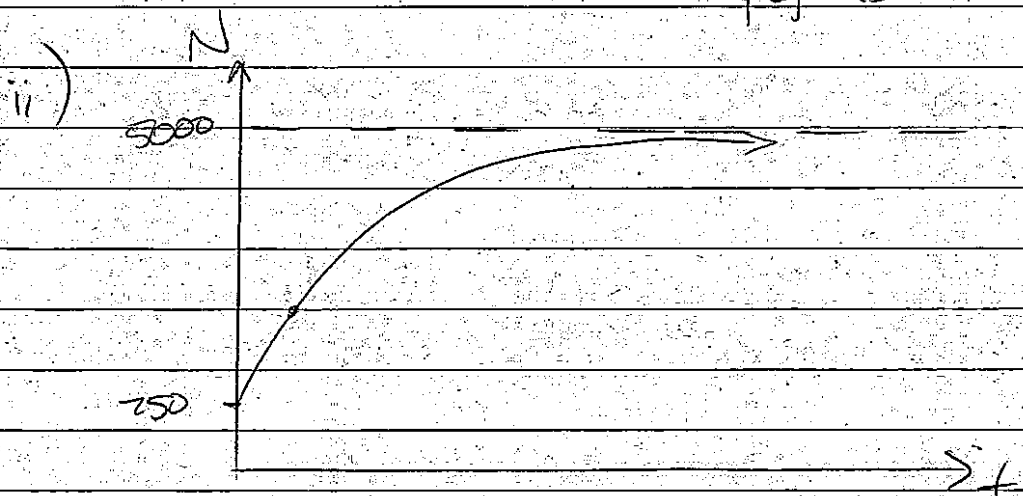
i) at  $t=0$

$$N = 5000 - 4250e^{-kt}$$

$$= 5000 - 4250$$

$$= 750$$

initial pop is 750



$$\begin{aligned}
 \text{ii)} \quad \frac{dN}{dt} &= 4250 k e^{-kt} \\
 &= k(5000 - N) \\
 250 &= k(5000 - 3 \times 750) \\
 k &= \frac{1}{11}
 \end{aligned}$$

$$\begin{aligned}
 \text{c)} \quad \ddot{x} &= 0 & - \text{horizontally} \\
 \ddot{y} &= -10
 \end{aligned}$$

$$\begin{aligned}
 x &= \int 120 dt \\
 &= 120t + c
 \end{aligned}$$

$$\text{at } t=0, x=0$$

$$\text{so } c=0$$

$$\therefore x = 120t$$

$$\begin{aligned}
 \ddot{y} &= -10 & - \text{vertically} \\
 \dot{y} &= \int -10 dt
 \end{aligned}$$

$$= -10t + c$$

$$\text{at } t=0, \dot{y}=0$$

$$\text{so } c=0$$

$$\dot{y} = -10t$$

$$\begin{aligned}
 y &= \int -10t dt \\
 &= -5t^2 + c
 \end{aligned}$$

$$\text{at } t=0, y=200$$

$$\text{so, } c=200$$

$$\text{and } y = -5t^2 + 200$$

ii)

$$x = Vt \cos \theta$$

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

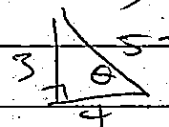
$$\theta = \tan^{-1}\left(\frac{3}{4}\right)$$

for  $V = 150$

$$x = 150 + \cos \theta$$

$$= 150 + \left(\frac{4}{5}\right)$$

$$= 120t$$



time of balloon  
Range of balloon,  $y=0 \Rightarrow -5t^2 + 200 = 0$

$$t^2 = 40$$

$$t = 2\sqrt{10}$$

time of flight of stone,  $y=0 \Rightarrow -5t^2 + 150 + \left(\frac{3}{5}\right) = 0$

$$5t(-t + 18) = 0$$

$$t = 0, 18$$

as balloon and stone have same horizontal motion equate, and stone travels for longer, stone will intersect under balloon

iii)

collision at  
equate vertical

$$-5t^2 + 200 = -5t^2 + 90t$$

$$t = \frac{20}{9}$$

$$y = -5\left(\frac{20}{9}\right)^2 + 200$$

$$= \frac{14200}{81} \approx 175$$

m above ground  
(0 dp)