SECTION I Questions 1 – 10 (10 marks -1 mark each)

Choose the best alternative and mark it on the answer sheet provided.

1. A straight line has a gradient of $-\frac{1}{k}$ $(k > 0)$. The y intercept of the line is $y = k$.

   The x intercept of the line is $x =$

A. $-\frac{1}{k^2}$ B. $\frac{1}{k}$ C. k D. k^2

2. w rabbits can dig a rabbit hole in w weeks. The number of weeks it would take $w+3$ rabbits to dig an identical rabbit hole if they all dug at the same rate is

A. $\frac{w^2}{w+3}$ B. w+3 C. $\frac{w}{w+3}$ D. $\frac{w-3}{2w}$

3. Triangle ABC is such that its three angles $\angle A$, $\angle B$, $\angle C$ are in the ratio 3:4:5.
   The ratio of the lengths of the sides BC:CA is

A. $\sqrt{3}:2$ B. $3:4$ C. $\sqrt{2}:\sqrt{3}$ D. $\left(1+\sqrt{2}\right):\left(1+\sqrt{3}\right)$

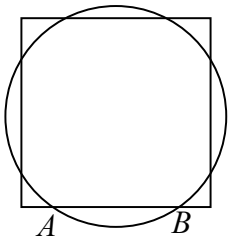
4. The value of $\left[(-3)^{-2}\right]^{-1}$ is

A. 9 B. -9 C. $\frac{1}{9}$ D. $-\frac{1}{9}$

5. An ordinary 6 sided die, with faces numbered 1 to 6, is rolled.
   The number on the uppermost side is most likely to be:

A. Odd B. A factor of 18 C. Prime D. A factor of 12

6. The circle and square shown below have the same centre and same area.
   The circle has a radius of 1 unit.



Not to scale

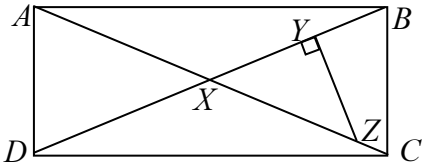
The length of AB is

A. $\sqrt{4-\pi}$ units B. $2\sqrt{1-\pi}$ units C. $4-2\sqrt{\pi}$ units D. $4-\pi$ units

Section I continued over page

Section I continued.

7. *ABCD* is a rectangle. The diagonals *AC* and *BD* intersect at *X*. *Z* lies on *CX* and *Y* is the foot of the perpendicular from *Z* to *BX*.



Not to scale

Given that $XY = 3$ cm, $YZ = 4$ cm and $ZX = 5$ cm, then $AB : BC =$

A. 3:4 B. $4:\sqrt{5}$ C. 4:3 D. 2:1

8. Which of the following is the fastest speed?

A. 1 cm/s B. 1 m/min C. 100 m/hr D. 1 km/day

9. The polynomial $P(x) = 7x^3 - x^5 + 9x - 5$

A. Is monic.
B. Is of degree 5 .
C. Has a leading coefficient of 7 .
D. Has a zero at $x = 0$.

10. A Year 10 student collects the following sets of data.
Which situation is a set of bivariate data?

A. The time Jim spends watching television each night.
B. The height of each boy in Year 10 and the number of children in his family.
C. The best scores recorded by all Year 10 students on a particular video game.
D. The favourite TV show of each Year 10 student.

SECTION II Questions 11 - 15

Question 11 (20 Marks) **Marks**

(a) Solve for *x*: $2^x - 2^{x-2} = 192$ **3**

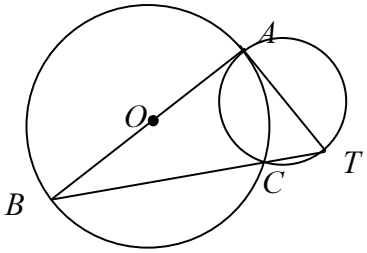
(b) The ratio of the roots of the equation $x^2 + 4x + a = 0$ is $-3:1$ Find the value of *a*. **4**

(c) Find integers *x* and *y* so that $x + y - \sqrt{x - 2y} = 8 - 2\sqrt{5}$. **3**

(d) Solve for *x*: $\dfrac{2}{x^2 - 4} = \dfrac{x - 4}{x^3 + 8}$ **4**

Question 11 continued over page

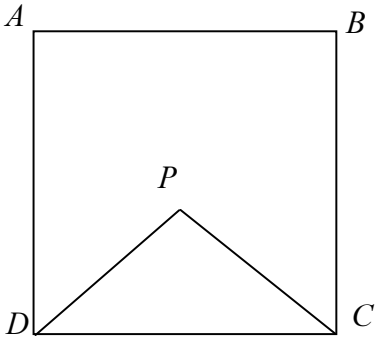
(e) AT is a tangent to the circle with centre O and AB is a diameter. BT intersects this circle at C as shown in the diagram below.



Not to scale

Copy the diagram and prove that BA is a tangent to the circle which passes through the points A, C and T. **4**

(f) A point P is chosen at random in a square $ABCD$. **2**



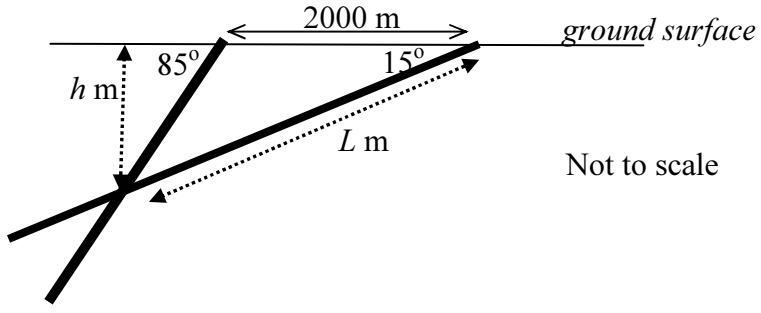
Not to scale

What is the probability that $\angle DPC$ is **NOT** acute. Explain your result.

Question 12 (20 Marks) START A NEW PAGE

(a) Find all solutions for x: $2(\cos x + \sec x) + 5 = 0$ for $0° \le x \le 360°$ **4**

(b) Two mine shafts meet the level ground surface at points 2000m apart.
The angles made by the shafts with the horizontal are 15^o and 85^o respectively as shown in the diagram below.



Not to scale

Draw a well labelled diagram and calculate:

(i) The length of the longer mine shaft (L m) from their common point to the surface. **2**
(ii) The vertical depth (h m) of the point where the mine shafts meet? **2**
Give your answer to the nearest metre.

Question 12 continued over page

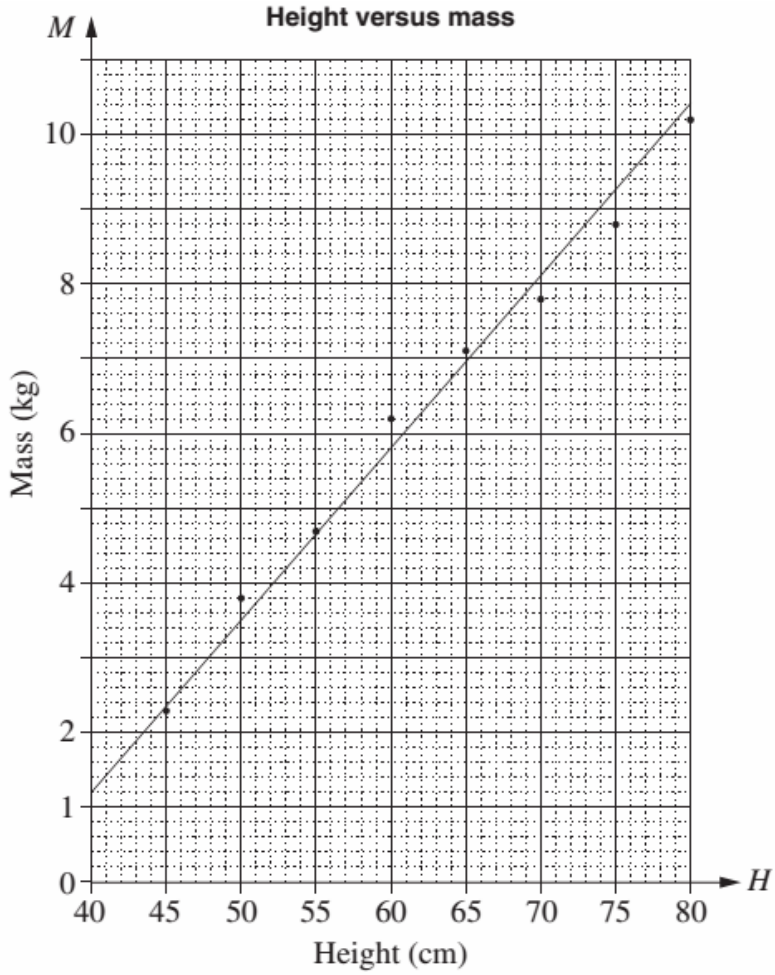
(c) A man recorded the number of minutes his train was late each day for 12 days.
His results are shown below.

5 8 10 15 2 1 -3 0 -2 0 5 7

(i) Calculate the mean time of arrival for his train, if it is timetabled to arrive at 7:58 am. **1**

(ii) What percentage of these late times are within 1 standard deviation of the mean? **2**

(d) The height and mass of a girl are measured and recorded over her first two years.
The information is displayed in a scatter graph shown below.
A line of best fit has been drawn on the graph.



(i) Find the equation of this line of best fit. **3**

(ii) Use the equation of the line of best fit to estimate the height of the girl when she has a mass of 11 kg. **1**

Question 12 continued over page

(e) Three people Annie, Bobbie and Charlie play 3 games of cards. The probability that Annie, Bobbie or Charlie will win any particular game is $\frac{1}{2}, \frac{1}{3}, \frac{1}{6}$ respectively.

Calculate the probability that:

(i) Annie wins at least one game. **2**

(ii) Charlie wins the most games. **3**

Question 13 (20 Marks) START A NEW PAGE

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(a) Show that the roots of the equation $x^2 - (m+1)x + (m-2) = 0$ are real and different for all real values of *m.* **3**

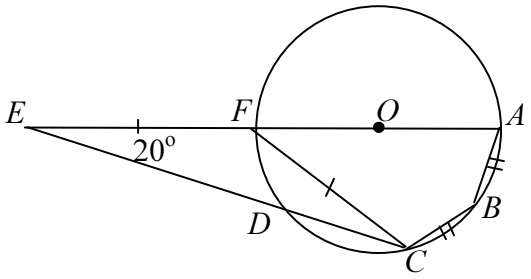
(b) Sketch the graph of $y = 1 - 2\sin(3x)$ for $0° \le x \le 90°$. Show all intercepts with the axes. **5**

(c) The equation of a circle is $x^2 + y^2 - 4x + 6y - 7 = 0$.

(i) Find the coordinates of the centre and the length of the radius of the circle. **3**

(ii) Find the equation of one tangent to the circle which is parallel to $2x + y - 3 = 0$. **3**

(d) The centre of the circle is *O* and $EF = FC$ as shown in the diagram below.
B is the midpoint of the minor arc *AC* and $\angle CEF = 20°$



Not to scale

(i) Copy the diagram and calculate the size of $\angle EFC$, giving reasons. **2**

(ii) Prove that ΔEFC and ΔABC are similar. **4**

Question 14 (20 Marks) START A NEW PAGE

(a) Point *P* divides the interval joining $A(1, 4)$ and $B(7, 2)$ internally in the ratio *m*:*n*.

(i) Write down the coordinates of *P* in terms of *m* and *n*. **2**

(ii) Hence or otherwise find the ratio which the line $x - 2y + 3 = 0$ divides the interval *AB*. **2**

Question 14 continued over page

(b) Sketch the graph of $y = \dfrac{x^2 - 3x}{x - 1}$. Clearly label all asymptotes and intercepts. **4**

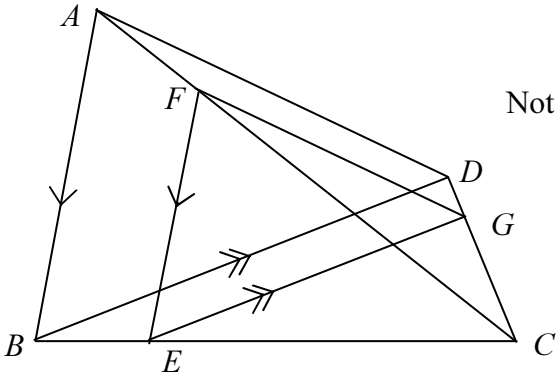
(c) Consider the function $f(x) = 3x(x-2)$.

(i) What is the largest domain containing the origin for which $f(x)$ has an inverse function $f^{-1}(x)$? **1**

(ii) Sketch the graph of $y = f^{-1}(x)$. **4**

(d) Neatly sketch the graph of $2y = (x-1)^3(3-x)(x+2)^2$, clearly showing all intercepts. **3**

(e) ΔABC and ΔDBC have a common base BC. Point E is on BC. EF is drawn parallel to BA meeting AC at F and EG is parallel to BD meeting DC at G.



Not to scale

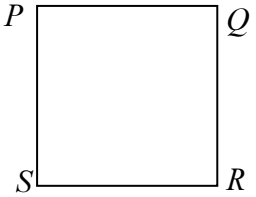
Copy the diagram and prove that FG is parallel to AD. **4**

Question 15 (20 Marks) START A NEW PAGE

(a) The roots of the equation $2x^3 - 3x + 1 = 0$ are α, β and γ.

Calculate the value of $\dfrac{1}{\alpha} + \dfrac{1}{\beta} + \dfrac{1}{\gamma}$. **3**

(b) Four towns are joined by straight roads which form a square P, Q, R, S of side length 12 km.



Not to scale

At 9 am a hiker leaves P in the direction of Q at 3 km/hr and at the same time another hiker leaves Q in the direction of R at 4 km/hr. Both hikers maintain their speeds until they stop walking at 1 pm.

(i) Show that the distance d km between them after t hours is given by **3**

$d = \sqrt{25t^2 - 72t + 144} \qquad (0 \le t \le 4)$

(ii) They are able to make radio contact with each other when the distance between then is 10 km or less. Between what times will the hikers be able to contact each other by radio. **4**

Question 15 continued over page

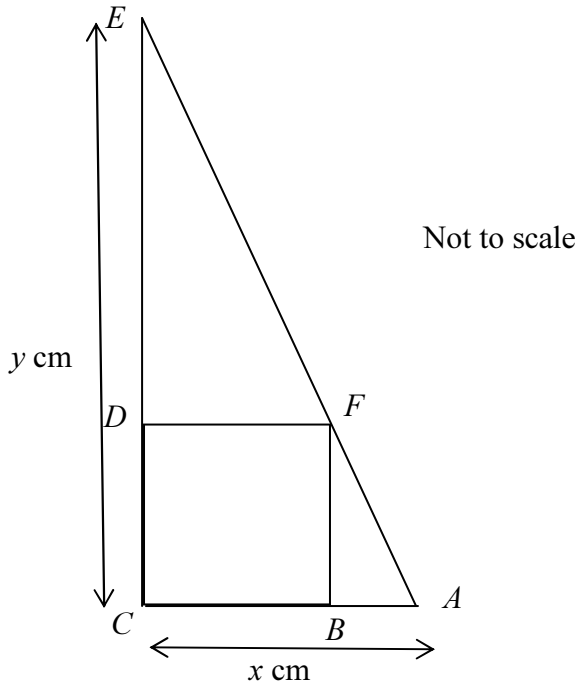
(c) The horizontal range (R m) of a rocket varies directly with the square of the velocity of projection (v m/s) and the sine of twice the angle of elevation (A^o) for $0 \le A \le 90$.
That is: $R \propto v^2 \sin(2A)$

When a rocket is projected with an angle of elevation of 15^o and a velocity of 10 m/s it reaches a range of 5 m.

(i) Write a formula for the range of the rocket in terms of R, v and A. **2**

(ii) Calculate the angle of elevation, to the nearest degree, required for a rocket projected at 12 m/s to reach a range of 10 m. **4**

(d) ΔACE is a right-angle triangle. A square $BCDF$ is drawn inside the ΔACE such that F lies on AE. AE is 20 cm long and DC is 6 cm long.



Copy the diagram and calculate the exact perimeter of ΔACE, giving reasons. **4**

You may assume that ΔACE, ΔABF and ΔFDE are similar in shape. (Do not prove this.)
Let $AC = x$ cm and $EC = y$ cm.

End of Examination

Multiple Choice Section I

1. $y = \frac{-1}{k}x + k$

$y = 0$

$x = \frac{-k}{-1/k} = k^2$

1D

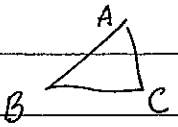
2. $T = \frac{K}{R}$ $\quad K = T \cdot R$ $\quad R = W \cdot W$

$T = \frac{W \cdot W}{W+3} = \frac{W^2}{W+3}$

2A

3. $\angle A : \angle B : \angle C = 3:4:5$

$\therefore \angle A = \frac{3}{12} \times 180 = 45 \quad \angle B = \frac{4}{12} \times 180 \; 60$



3C

$\frac{\sin 60}{CA} = \frac{\sin 45}{BC} \quad \therefore \frac{BC}{CA} = \frac{\sin 45}{\sin 60}$

$= \frac{1}{\sqrt{2}} / \frac{\sqrt{3}}{2} \cdot \frac{\sqrt{2}}{\sqrt{3}}$

4. $\left((-3)^{-2}\right)^{-1} = \frac{1}{\left(\frac{1}{-3}\right)^2} = 9$

4A

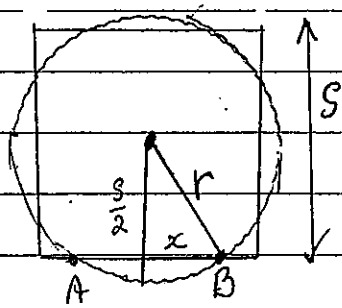
5. 1 2 3 4 5 6

odd $= 3/6$ $\quad$ factor of $18 = 4/6$

prime $= 3/6$ $\quad$ factor of $12 = 5/6$

5D

6.



$S^2 = \pi$ (same area)

$r^2 = x^2 + \left(\frac{S}{2}\right)^2 \quad r = 1$

$x^2 = 1 - \frac{S^2}{4}$

$2x = \sqrt{4 - \pi}$

6.A

7. $\sin \angle BXC = 4/5 \quad \therefore \angle BXC \approx 53.13010235$

$\tan\left(\frac{1}{2}\angle BXC\right) = 0.5 \quad \therefore AB : BC = 2:1$

7D

8. A. $= 1$ cm/s B 1.6 cm/s C. 2.7 cm/s D 1.16 cm/s

8C

9. Degree 5

9B

10. 2 variables

10B

Question 11. Section II

a) Solve. $2^x - 2^{x-2} = 192$.

$2^x\left[1 - 2^{-2}\right] = 192$

$2^x\left[1 - \frac{1}{4}\right] = 192$

$2^x\left[\frac{3}{4}\right] = 192$

$2^x = 256$

$2^x = 2^8$

$x = 8$

① separating $2^{x-2} = 2^x \times 2^{-2}$ etc or similar

① simplified index equation (or similar)

① correct answer.

b) $x^2 + 4x + a = 0$.

has roots α, β : $\frac{\alpha}{\beta} = \frac{-3}{1}$ $\therefore \alpha = -3\beta$

① relating roots.

$\alpha + \beta = -4$

$-3\beta + \beta = -4$

$-2\beta = -4$

$\beta = -2$. $\therefore \alpha = 6$.

① sum of roots.

① one root $= -2$

$\alpha\beta = a$.

$-2 \times 6 = a$

$-12 = a$.

① a value.

c) $x + y - \sqrt{x - 2y} = 8 - 2\sqrt{5}$

$x + y = 8$ (i)

① Equation (i)

$x - 2y = 20$ (ii)

① Equation (ii)

$3y = -12$

$y = -4$

$x = 12$.

① both correct values of x and y.

d) $\frac{2}{x^2 - 4} = \frac{x - 4}{x^3 + 8}$.

① Factorise denominator

$\frac{2}{(x-2)(x+2)} = \frac{x-4}{(x+2)(x^2 - 2x + 4)}$ $x \neq \pm 2$.

① cross multiply & simplify (or similar)

$2(x^2 - 2x + 4) = (x - 4)(x - 2)$.

$2x^2 - 4x + 8 = x^2 - 6x + 8$

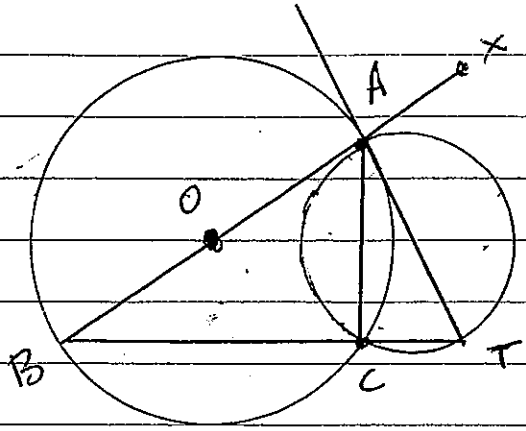
$x^2 + 2x = 0$. $\therefore x = 0$ only as $x + 2 \neq 0$

$x(x + 2) = 0$

① reject $x = -2$

① $x = 0$ only answer.

c)



Construct AC.

$\angle ACB = 90^\circ$ (angle in semi circle is 90°) ①

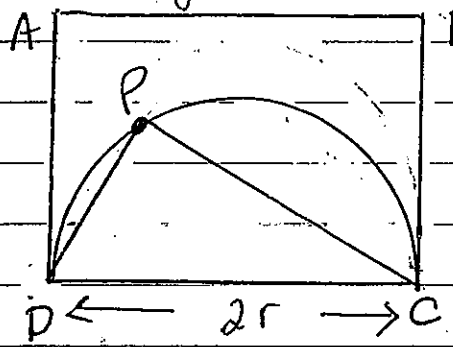
$\therefore \angle ACT = 90^\circ$ (BT is perpendicular to AC) } ① (or similar)

$\therefore$ AT is diameter of small circle } ①
(angle in semi circle is 90°)

$\therefore \angle BAT = 90^\circ$ (angle between tangent and radius of circle O) } ①
(Accept Similarly)

$\therefore$ BA is tangent to 2nd circle
(angle between tangent and radius)

f)



FOR $\therefore$ $\angle DPC$ not acute } ① reason.

$\therefore$ P must be inside the semi circle

$P(\angle DPC \text{ not acute}) = \dfrac{\text{Area Semicircle}}{\text{Area Square}}$

$= \dfrac{\frac{1}{2}\pi r^2}{4r^2}$

$= \dfrac{\pi}{8}$ ① Answer.

— angle in a semi circle is 90°.

Question 12. (4)

(a) $2(\cos x + \sec x) + 5 = 0$

$2\cos x + \frac{2}{\cos x} + 5 = 0$ ① $\sec x = \frac{1}{\cos x}$

$2\cos^2 x + 5\cos x + 2 = 0$

$(2\cos x + 1)(\cos x + 2) = 0$

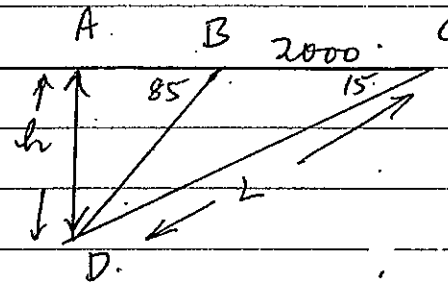
$\cos x = -\frac{1}{2}$ or $\cos x = -2$ ① must reject $\cos x = -2$. (solutions & no solution)

2nd Q $x = 180° - 60°$

3rd Q $x = 180° + 60°$

$x = 120°$ or $240°$. ① + ① each answer.

(b)



(i) $85° + \angle DBC = 180°$ (angle sum of straight angle)

$\angle DBC = 95°$

$\angle BDC + 15° = 85°$ (exterior angle of $\triangle DBC$ equals sum of 2 opposite interior angles)

$\angle BDC = 70°$

$\frac{2000}{\sin 70°} = \frac{L}{\sin 95°}$ } ① angles (reasons not required)

$DB = \frac{2000 \times \sin 95}{\sin 70°}$

$L = 2120.2565$ ① answer.

(ii)

$\sin 15° = \frac{h}{L}$ (same answer if 2120 used)

$h = \sin 15 \times 2120.2565$ ① answer corrected to.

$= 548.76$

depth is 549 (1 dp) ① 1 dp

(c) (i) $\bar{x} = 4$ ∴ time is 8:02. ① answer.

(ii) $\sigma_n = 5.1185$ ① SD.

∴ no. of scores between -1.1185 and 9.1185 is $\frac{8}{12} = 66\frac{2}{3}\%$ of ~~scores~~ times ① Answer.

d) Question 12 continued.

(i) gradient $= \frac{10.4 - 1.2}{40} = \frac{9.2}{40} = 0.23$

$y - 1.2 = 0.23(x - 40)$

$y - 1.2 = 0.23x - 9.2$

$y = 0.23x - 8$

Equation is $M = 0.23H - 8$

① gradient.
① line (any form).
① (must ... have M and H) in equation

(ii) When $M = 11$

$11 = 0.23(H) - 8$

$H = 82.6$.

Height is 82.6 kg.

① Answer. (must use formula).

e) (i) P (Annie wins at least one game)

$= 1 - P(\text{Annie wins no game})$

$= 1 - \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$

$= \frac{7}{8}$.

① method. (others possible)
① answer

(ii) Charlie wins 2 or 3 games.

$P(3 \text{ games}) = \frac{1}{6} \times \frac{1}{6} \times \frac{1}{6} = \frac{1}{216}$

① Prob(3 games).

$P(2 \text{ games}) = P(WWL) + P(WLW) + P(LWW)$

$= 3 \times \frac{1}{6} \times \frac{1}{6} \times \frac{5}{6} = \frac{15}{216}$

① Prob(WWL) $= \frac{5}{216}$

Total Prob(most games) $= \frac{16}{216} = \frac{2}{27}$

① Answer.

Question 13.

a) $x^2 - (m+1)x + (m-2) = 0$

real & different roots $\Delta > 0$

$\Delta = (m+1)^2 - 4(m-2)$

$= m^2 + 2m + 1 - 4m + 8$

$= m^2 - 2m + 9.$

$= m^2 - 2m + 1 + 8$

$= (m-1)^2 + 8$

> 0 as $(m-1)^2 \geq 0.$

$\therefore \Delta > 0.$

① Δ expression

① Expansion + simplifying Δ.

① Reason why $\Delta > 0$.

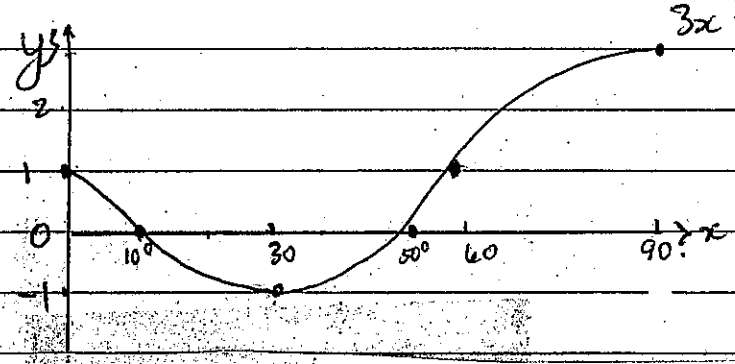
b) $y = 1 - 2\sin 3x.$

y intercept $x = 0$ $y = 1$

x intercept $y = 0$ $\therefore \sin 3x = \frac{1}{2}.$

$3x = 30^\circ$ $\therefore x = 10^\circ$

$3x = 150^\circ$ $x = 50^\circ$



② x intercepts

① Amplitude

① Max./min pts

① y intercept

c) (i) $x^2 + y^2 - 4x + 6y - 7 = 0$

$x^2 - 4x + y^2 + 6y = 7$

$x^2 - 4x + 4 + y^2 + 6y + 9 = 7 + 4 + 9$

$(x-2)^2 + (y+3)^2 = 20$

centre $(2, -3)$

radius $\sqrt{20} = 2\sqrt{5}$ units

① complete squares

① centre

① radius

Q13.

(ii) Perpendicular distance from tangent to centre is equal to radius

centre $(2,-3)$ radius is $2\sqrt{5}$

tangent parallel to $2x+y-3=0$

is $2x+y+k=0$.

① Method/idea

$$\therefore 2\sqrt{5} = \frac{|2(2)+1(-3)+k|}{\sqrt{2^2+1^2}}$$

① sub correct values into formula

$$2\sqrt{5} = \frac{|4-3+k|}{\sqrt{5}}$$

$$10 = |1+k|$$

$$k = 9 \text{ or } -11$$

correct answers

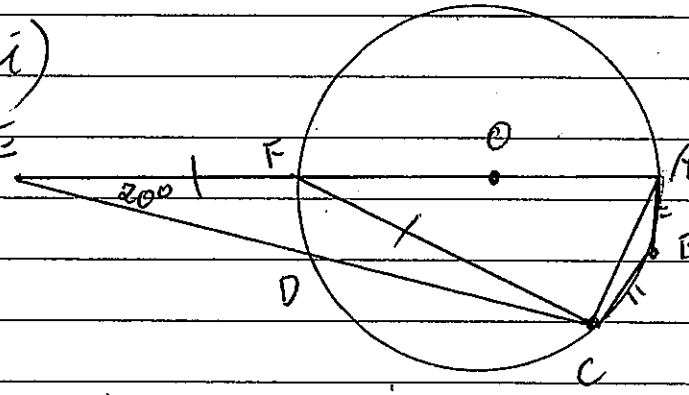
$\therefore$ tangent is $2x+y+9=0$

OR $2x+y-11=0$.

① Accept either

Many other methods possible.

d) i)



① equal angles $\angle FEC = 20°$

①

$EF = FC$ Given

$\therefore \angle FCE = \angle FEC = 20°$ (equal angles opposite equal side)

$\angle EFC + 20° + 20° = 180°$ (in $\triangle EFC$).

$= 140°$ (angle sum of $\triangle EFC$ is $180°$)

Q13

d(ii) $\angle ABC = \angle EFC$ (exterior angle of cyclic quadrilateral are equal)
$= 140^\circ$

① $\angle ABC = 140^\circ$ with reason

arc AB = arc BC (B is midpoint of arc AC)

AB = BC (equal arcs subtend equal chords)

① AB = BC with reason

In $\triangle ABC$ and $\triangle EFC$

$\frac{EF}{AB} = \frac{FC}{BC}$.

① correct ratio of sides comparing between triangles

$\angle ABC = \angle EFC = 140^\circ$

$\therefore \triangle ABC \,|||\, \triangle EFC$. (sides about equal angles are in the same ratio)

① correct reason for similarity

Alternatively (or similar).

$\angle BAC = \angle BCA$ (equal angles opposite equal sides in $\triangle ABC$)

$\angle BAC + \angle BCA + 140^\circ = 180^\circ$

(angle sum of $\triangle ABC$ is 180°)

$\therefore \angle BAC = 20^\circ$

$\therefore \angle BAC = \angle EFC = 20^\circ$

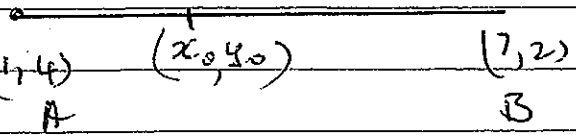
$\angle ABC = \angle EFC = 140^\circ$

① $\angle BAC = \angle EFC = 20^\circ$ with reason

$\therefore \triangle ABC \,|||\, \triangle EFC$ (equiangular).

① correct reason for similarity

Q (c)



$x_0 = \frac{7m+n}{m+n}$ ① x expression

$y_0 = \frac{2m+4n}{m+n}$ ① y expression

(ii) (x_0, y_0) lies on $x - 2y + 3 = 0$.

$\left(\frac{7m+n}{m+n}\right) - 2\left(\frac{2m+4n}{m+n}\right) + 3 = 0$ ① sub expression

$7m + n - 4m - 8n + 3m + 3n = 0$

$6m - 4n = 0$

$6m = 4n$

$m : n = 2 : 3$ ① answer

other methods possible

D $y = \frac{x^2 - 3x}{x-1} = \frac{x(x-3)}{x-1}$ ① both x intercepts

x int $x = 0$, $x = 3$.

y int $y = 0$.

① vert as't

Vert As't $x =$

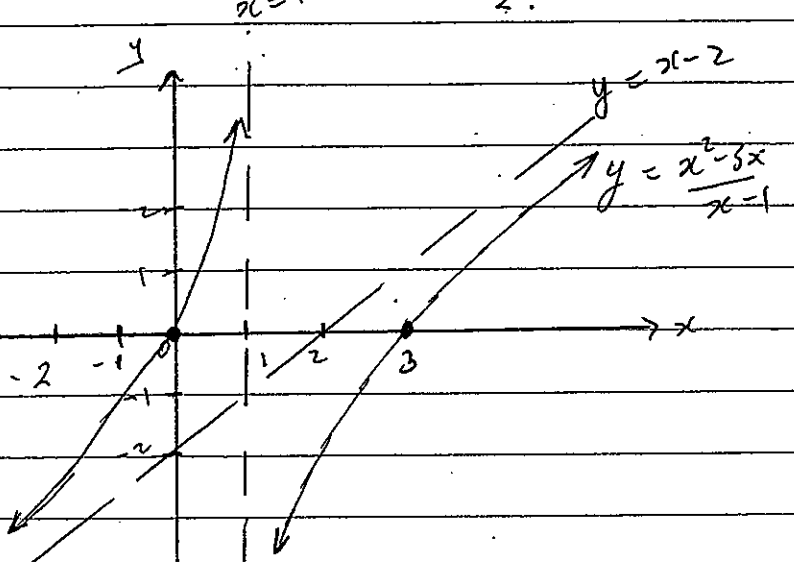
① oblique as't

Oblique as't

$\therefore y = x - 2$

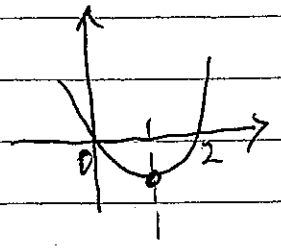
$$x-1 \overline{)\, x^2 - 3x + 0} \quad x - 2$$
$$x^2 - x$$
$$-2x + 0$$
$$-2x + 2$$
$$-2.$$

① shape/axes etc



c) (1,4)

$f(x) = 3x(x-2)$

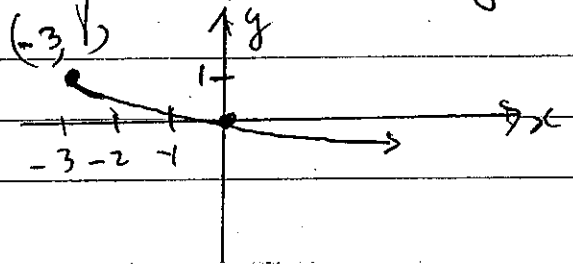


Vertex at $x = 1$

$\therefore$ for inverse to be a function
$x \geq 1$ or $x \leq 1$

$\therefore$ domain containing $x = 0$
$\therefore x \leq 1$

Vertex at $(1, -3)$ of $f(x)$.
Points for $f^{-1}(x)$ $(-3, 1)$, $(0, 0)$
Reflect about $y = x$.

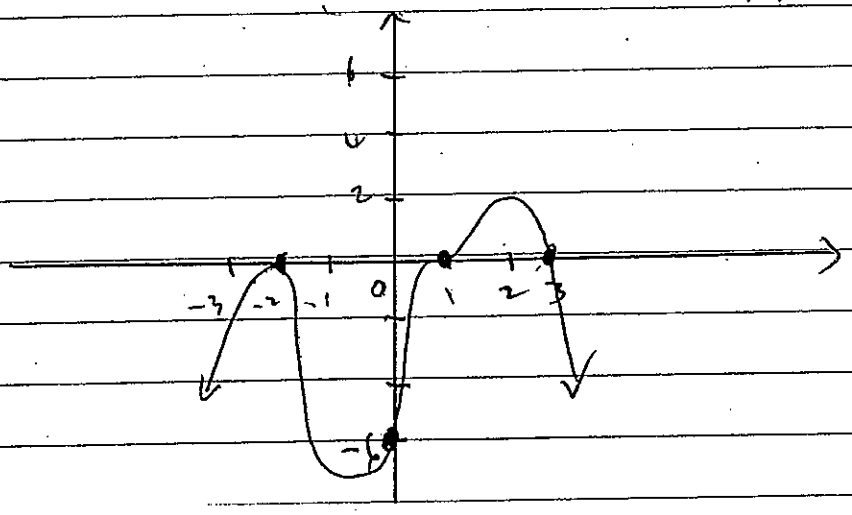


$x = 3y^2 - 6y$
$x = 3(y^2 - 2y)$
$x + 3 = 3(y^2 - 2y + 1)$
$= 3(y-1)^2$
$y - 1 = \sqrt{\frac{x+3}{3}}$
$y = \sqrt{\frac{x+3}{3}} + 1$

① Answer.
① $x = -3$ } ① $y = 1$.
① $(0, 0)$
① shape (axes).

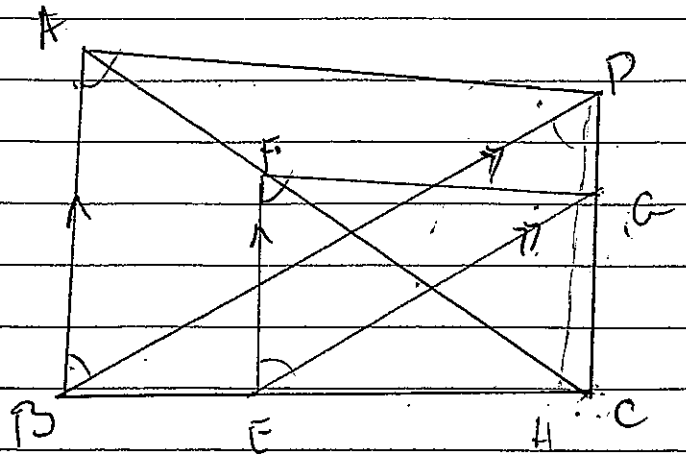
d) $y = (x-1)^3(3-x)(x+2)^2$.

y int $= -6$.
x int $= 1, 3, -2$.



① at $x = -2$
① at $x = 1$
① $x = 3, y = -6$ } and shape

(14) e)



$\frac{CE}{EB} = \frac{CF}{FA}$ an interval parallel to one side of a triangle divides the other two sides in the same ratio ① Ratio + Reason

Similarly $\frac{CE}{EB} = \frac{CG}{GD}$. ① Ratio

$\therefore \frac{CF}{FA} = \frac{CG}{GD}$ ① equal ratio

$\therefore$ FG divides the sides of $\triangle ACD$ in the same ratio

$\therefore$ FG is parallel to AD ① conclusion with reason

as a line which divides the sides of a triangle in the same ratio is parallel to the third side.

Question 15.

$2x^3 - 3x + 1 = 0$ Roots α, β, γ

a) $\alpha + \beta + \gamma = 0$

$\alpha\beta + \beta\gamma + \alpha\gamma = -3/2$ ①

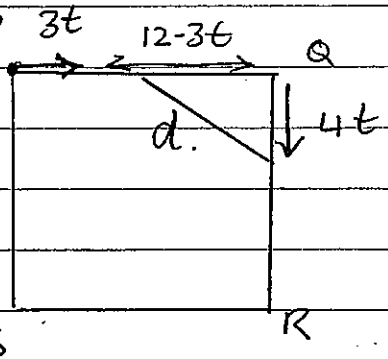
$\alpha\beta\gamma = -1/2$. ①

$$\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} = \frac{\beta\gamma + \alpha\gamma + \alpha\beta}{\alpha\beta\gamma}$$

$$= -3/2 \div -1/2$$

$$= 3$$ ①

b) (i)



① $(12-3t)$

① $4t$

① expansion.

$d^2 = (12-3t)^2 + (4t)^2$

$= 144 - 72t + 9t^2 + 16t^2$

$d = \sqrt{25t^2 - 72t + 144}$ $\quad d > 0$

(ii) let $d = 10$

$100 = 25t^2 - 72t + 144$ ① sub $d=10$ and square

$0 = 25t^2 - 72t + 44$

$t = \frac{72 \pm \sqrt{(72)^2 - 4(25) \times 44}}{50}$ ② quadratic solutions

$= \frac{72 \pm \sqrt{784}}{50}$

$= \frac{72 \pm 28}{50}$

$= 2$ or $\frac{44}{50} = 52$ mins 48 sec ① Answer question in times.

Times between 9:53 am and 11 am.

(no loss for incorrect rounding).

15

c)(i) $R = kv^2 \sin 2A$

$5 = k(10)^2 \sin(2\times 15^\circ)$

$5 = 100k \times \frac{1}{2}$

$5 = 50k$

$k = \frac{1}{10}$ $\therefore R = \frac{1}{10} v^2 \sin 2A$

(ii) $R = \frac{1}{10} v^2 \sin 2A$.

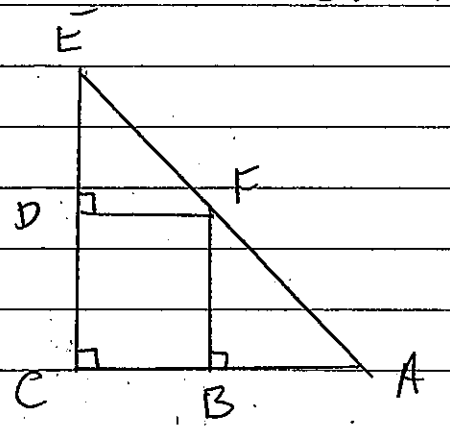
$10 = \frac{1}{10} \times (12)^2 \sin(2A)$

$\frac{100}{144} = \sin 2A$

$2A = 43^\circ.982^\circ$ $\therefore A = 22^\circ$ (nearest degree)

$136^\circ.017^\circ$ OR $A = 68^\circ$ " "

d)



In $\triangle EDF$ and $\triangle ECA$

$\frac{ED}{EC} = \frac{DF}{CA}$ (corresponding sides in similar triangles are in same ratio)

$\frac{y-6}{y} = \frac{6}{x}$

$xy - 6x = 6y$.

$xy = 6(x+y)$.

$x^2 + y^2 = 20^2$ (Pythagoras' theorem)

$(x+y)^2 - 2xy = 400$.

$(x+y)^2 - 12(x+y) = 400 = 0$

$u = x+y$ $\quad u^2 - 12u - 400 = 0$.

$u = \frac{12 \pm \sqrt{144 + 4(400}}{2}$

13

① formula with k

k value & ① formula

① sub values

① 44° (solution)

② correct angles. (no loss for incorrect rounding)

① triangle side ratio in x and y. with reason.

① some form of substitution into $x^2+y^2=400$. no loss for Pythagoras reason omitted.

(15)

(14)

d. $u = \frac{12 \pm \sqrt{1744}}{2}$

$u = \frac{12 \pm 4\sqrt{109}}{2}$

$x+y = 6 \pm 2\sqrt{109}$ $\quad x+y > 0.$

$\therefore$ Perimeter $= 20 + 6 + 2\sqrt{109}$

① recognising quadratic in $(x+y)$

① correct answer.