Name:	School:	Target Grade:

PARADIGM

MOCK EOY PAPER 2025
SECONDARY 3 E MATH

READ THESE INSTRUCTIONS FIRST

INSTRUCTIONS TO CANDIDATES

1. Find a nice comfortable spot without distraction.

2. Be fully focused for the whole duration of the test.

3. Speed is KING. Finish the paper as soon as possible then return-back to Check Your Answers.

4. As you are checking your answers, always find ways to VALIDATE your answer.

5. Avoid looking through line by line as usually you will not be able to see your Blind Spot.

6. If there is no alternative method, cover your answer and REDO the question.

7. Give non-exact answers to 3 significant figures, or 1 decimal place for angles in degree, or 2 decimal place for $$$, unless a different level of accuracy is specified in the question.

Wish you guys all the best in this test.

You can do it.

I believe in you.

Team Paradigm

PARADIGM [Turn Over]

1	**[Algebra]** (a) Simplify $\frac{2y^2-3y-5}{y^2-1}$. (b) $b=\sqrt{\frac{4+5a}{3a-11}}$ Make *a* the subject of the formula. (c) (i) Express $x^2+6x-11$ in the form $(x+b)^2+c$, where *b* and *c* are constants. (ii) **Hence**, solve the equation $x^2+6x-11=0$.	[3] [3] [2] [2]
2	**[Quadratic Equation]** A road up a mountain is 18 km long. Paul followed this road at an average speed of *x* km/h. (i) Write down an expression, in terms of *x*, for the number of hours he took to walk up the mountain. (ii) Paul came down the mountain by a different road. The length of this road was 25 km. His average speed coming down the mountain was 2 km/h greater than his average speed going up the mountain. Write down an expression, in terms of *x*, for the number of hours he took to walk down. (iii) It took Paul 1.5 hours less to come down than to go up. Write down an equation in *x*, and show that it simplifies to $3x^2+20x-72=0$. (iv) Solve the equation $3x^2+20x-72=0$, giving both answers to 2 decimal places. (v) Calculate, correct to the nearest minute, the total time Paul took to go up and come down the mountain.	[1] [1] [3] [3] [2]
3	**[Indices]** (a) Simplify $(5x)^3\times(9y^4)^{-\frac{1}{2}}$, leaving your answer in positive index notation. (b) Solve $\frac{6^{2y}\times 36}{6^{\frac{1}{3}}}=216^y$.	[3] [3]
4	**[Standard Form]** (a) Sound travels at 1234.8 km/h. Express the speed of sound in metres per second, giving your answer in standard form. (b) Mercury is 6.58×10^7 kilometres from the Sun and the Pluto is 5.914 billion kilometres from the Sun. How much further from the Sun is Pluto than Mercury?	[2] [2]

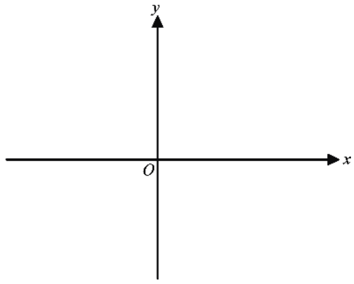
5 **[Finance]**

Peter invested a sum of money in an account paying compound interest at 1.5% per year. After 8 years, the money had earned total interest of $3162.32. Calculate the sum of money Peter invested in the account. [3]

6 **[Quadratic Functions – Sketching]**

(a) Factorise $-x^2 + 5x + 6$. [2]

(b) Sketch the graph of $y = -x^2 + 5x + 6$, indicate clearly the x-intercepts and y-intercept. [2]



(c) Write down the equation of the line of symmetry. [1]

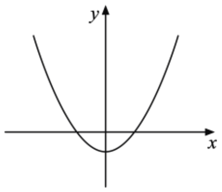
(d) Write down the equation of a horizontal line that intersects the graph of $y = -x^2 + 5x + 6$ at only **one** point. [1]

7 **[Graph Functions]**

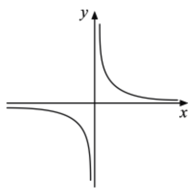
Select a possible equation from the box to represent each of the sketch graphs below.

$xy = 2$	$y = x^3 - 2$	$y = 2 - x^3$
$y = 2 - x^2$	$y = x^2 - 2$	$x^2y = 2$

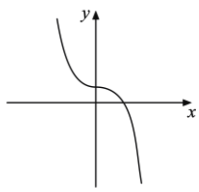
(a) [1]



(b) [1]



(c) [1]



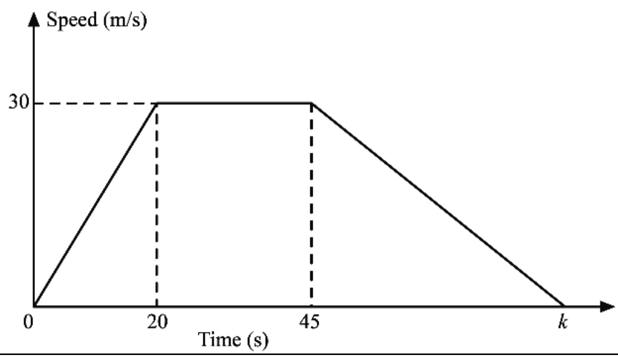
8 **[Speed Time Graph]**

The diagram shows the speed – time graph of a moving object.

(a) Calculate the acceleration of the object at time $t = 22\ s$. [1]

(b) Find the speed when t = 4 s. [2]

(c) Find the value of k if the total distance travelled is 1.35 km. [2]



9 **[Coordinate Geometry]**

A is the point (– 2, 8) and B is the point (x, – 4).

(a) Given that the gradient of line AB is -1.5, find the value of x. [2]

(b) Find the length of AB. [2]

The equation of line CD is $6y + 9x = 5$.

(c) The point $(4b, -b)$ lies on the line CD. Find the value of b. [1]

(d) Explain why line CD does not intersect line AB. [2]

10 **[Coordinate Geometry]** [1]

Complete the table of values for $y = \frac{x^3}{5} - x + 4$ below.

x	-3.5	-3	-2	-1	0	1	2	3
y	-1.1	1.6		4.8	4	3.2	3.6	6.4

(a) Using a scale of 2 cm to represent 1 unit on both axes, plot the points given in the table and join them with a smooth curve for $-3.5 \leq x \leq 3$. [3]

(b) By drawing a tangent, find the gradient of the curve at $x = 2$. [2]

(c) Use your graph to find the solutions of the equation $\frac{x^3}{5} - \frac{1}{2}x = 0$ for $-4 \leq x \leq 3$. [2]

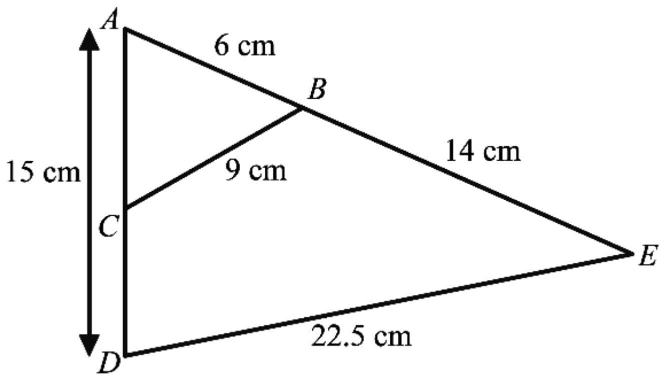
(d) The solutions in part (d) above are also the solutions for the equation $2x^3 + Ax^2 + Bx = 0$. Find the value of A and of B. [2]

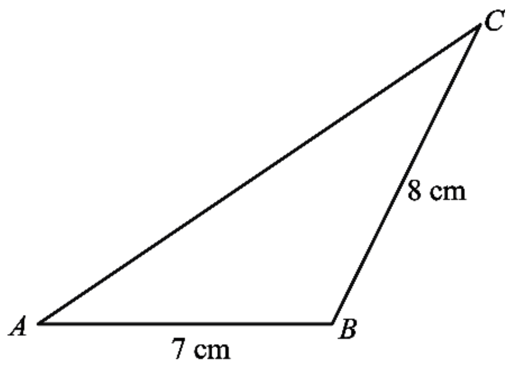
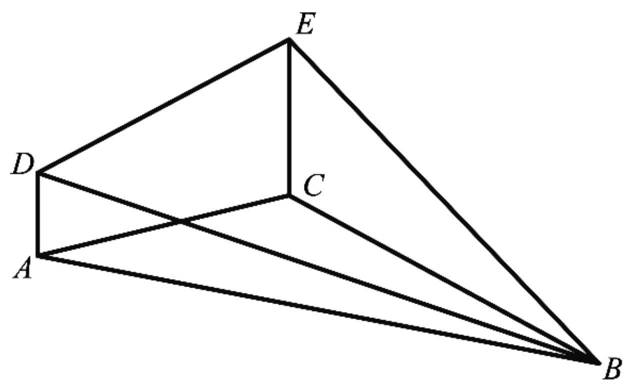
11 **[Congruency and Similarity]**

In the diagram below, B is on AE such that $AB = 6$ cm and $BE = 14$ cm. $AD = 15$ cm and C is on AD such that $BC = 9\ cm$, $DE = 22.5$ cm and $\angle ABC = \angle ADE$.

(a) Prove that ΔACB is similar to ΔAED. [2]

(b) Show that CD = 7 cm. [2]



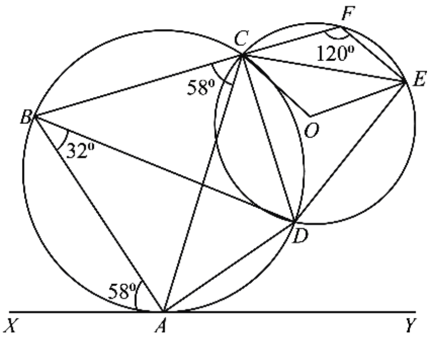
12	**[Congruency and Similarity – Similar Figures]** Two geometrically similar containers have volume 250 ml and 54 ml respectively. Find the ratio of the base area of the bigger container to the base area of the smaller container.	[2]
13	**[Trigonometry – Triangle Formula]** In the diagram, $AB = 7\ cm$ and $BC = 8\ cm$. The area of triangle ABC is $24.249\ cm^2$. Given that $\angle ABC$ is an obtuse angle, find the length of AC. 	[5]
14	**[Trigonometry – Area of Triangle]** The area of triangle ABC is 36.7 cm^2 The length of AB is 14.2 cm and BC is 6.1 cm. Find the possible values of angle ABC.	[2]
15	**[Trigonometry]** In the diagram above, triangle ABC forms a garden on level ground. $BC = 32$ m, angle $ACB = 100°$ and angle $BAC = 53°$. (a) Show that $AC = 18.19$ m, correct to 4 significant figures. (b) Triangle BDE is a roof designed for the garden. Two vertical poles, $AD = 2$ m and $CE = 5$ m, were built to hold up the roof. Find (i) the length of DE, (ii) angle DBE. 	[2] [2] [5]

16 **[Circle]**

In the diagram, XAY is a tangent to the circle $ABCD$ at A.

O is the centre of the circle $CDEF$ and BCF is a straight-line.

It is given that $\angle BCA = \angle XAB = 58°$, $\angle ABD = 32°$ and $\angle CFE = 120°$



(a) Find angle ACD. [1]

Give a reason for each step of your working.

(b) Explain why BD is a diameter of circle $ABCD$. [1]

(c) Find angle DAY. [1]

Give a reason for each step of your working.

(d) Given that $FC = FE$, show that triangle CDE is equilateral. [3]

Give a reason for each step of your working.

(e) (i) Prove that triangle OCE is congruent to triangle FCE. [3]

(ii) Hence, what is the special name given to quadrilateral $COEF$? [1]

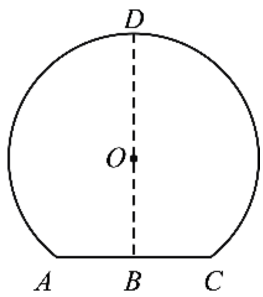
17 **[Arc Sector Segment]**

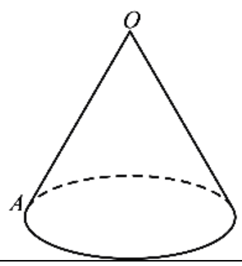
(a) $ABCD$ is a major segment of a circle, centre O. BD is 32 cm, AC is 48 cm and angle DBA is $\frac{\pi}{2}$. [3]

(b) The sector $OADC$ was cut from the above to form a cone where the OA is glued to OC. [4]

(i) Calculate the circumference of the base circle of the cone. [2]

(ii) Hence, calculate the vertical height of the cone. [3]





Answer Key

1	(a) $\frac{2y^2-3y-5}{y^2-1} = \frac{(2y-5)(y+1)}{(y-1)(y+1)} = \frac{(2y-5)}{y-1}$ (b) $b = \sqrt{\frac{4+5a}{3a-11}}$ $b^2 = \frac{4+5a}{3a-11}$ $3ab^2 - 11b^2 = 4 + 5a$ $3ab^2 - 5a = 4 + 11b^2$ $a(3b^2 - 5) = 4 + 11b^2$ $a = \frac{4+11b}{(3b^2-5)}$ (c) (i) $x^2 + 6x - 11 = x^2 + 6x + (3)^2 - 11 = (x+3)^2 - 20 =$ (ii) $(x+3)^2 - 20 = 0$ $(x+3)^2 = 20$ $x + 3 = \pm\sqrt{20}$ $x = 1.47$ or -7.47 Ans: (a) $\frac{(2y-5)}{(y-1)}$ (b) $a = \frac{4+11b^2}{(3b^2-5)}$ (cii) $x = 1.47$ or 7.47	
2	(iii) $\frac{18}{x} - \frac{25}{x+2} = \frac{3}{2}$ $\frac{18(x+2)-25x}{x(x+2)} = \frac{3}{2}$ $2(18x + 36 - 25x) = 3x(x+2)$ $3x^2 + 6x + 14x - 72 = 0$ $3x^2 + 20x - 72 = 0$ (shown) (iv) $x = \frac{20\pm\sqrt{20^2-4(3)(-72)}}{2(3)}$ $= \frac{-20\pm\sqrt{1264}}{6}$ $= 2.5921\ldots.$ or $-9.2587\ldots.$ $= 2.59$ or -9.26 (v) $\frac{18}{x} + \frac{25}{x+2} = \frac{18}{2.5921} + \frac{25}{2.5921+2} = 12.3883h = 12$ h 23 min Ans: (i) $\frac{18}{x}$ (ii) $\frac{25}{x+2}$ (iv) 2.59 or -9.26 (v) 12 h 23 min	

3

(a) $(5x)^3 \times (9y^4)^{-\frac{1}{2}}$

$= 125x^3 \times \frac{1}{(9y^4)^{\frac{1}{2}}}$

$= 125x^3 \times \frac{1}{3y^2}$

$= \frac{125x^3}{3y^2}$

(b) $\frac{6^{2y} \times 36}{6^{\frac{1}{3}}} = 216^y$

$\frac{6^{2y} \times 36}{6^{\frac{1}{3}}} = 6^{3y}$

By comparing powers,

$2y + 2 - \frac{1}{3} = 3y$

$y = 1\frac{2}{3}$

Ans: (a) $\frac{125x^3}{3y^2}$ (b) $y = 1\frac{2}{3}$

4

(a) $\frac{1234.8 \times 1000}{60 \times 60} = 343 = 3.43 \times 10^2 m/s$

(b) $5.914 \times 10^9 - 6.58 \times 10^7 = 5.8482 \times 10^9$ or 5.85×10^9

Ans: (i) 3.43×10^2 *m/s* (b) 5.8482×10^9 or 5.85×10^9

5

$3162.32 = P\left(1 \div \frac{1.5}{100}\right) - P$

$P = \frac{3162.32}{1.015^8 - 1}$

$= \$25\ 000$ or $\$25\ 000.04$

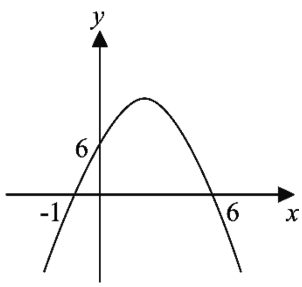
Ans: \$25 000 or \$25 000.04

6

$-x^2 + 5x + 6$

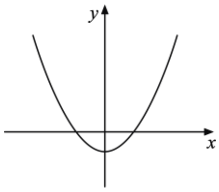
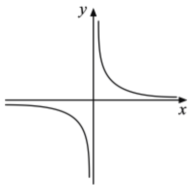
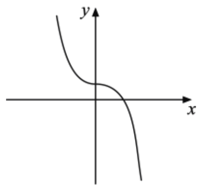
$= -(x^2 - 5x - 6)$ $\quad$ $-x^2 + 5x + 6$

$= -(x + 1)(x - 6)$ $\quad$ or $\quad$ $= (x + 1)(-x + 6)$



Ans: (a) $-(x + 1)(x - 6)$ or $(x + 1)(-x + 6)$ (b)

(c) $x = 2.5$ (d) $y = 12.25$

7	(a)  (b)  (c)  Answer: (a) $y = x^2 - 2$ (b) $xy = 2$ (c) $y = 2 - x^3$	
8	(a) Gradient $= \frac{30}{20}$ $\frac{speed}{4} = \frac{3}{2}$ $speed = \frac{3}{2} \times 4$ $speed = 6m/s$ (b) $1350 = \frac{1}{2}(25 + k)30$ $2700 = (25 + k)30$ $\frac{2700}{30} = 25 + k$ $90 = 25 + k$ $90 - 25 = k$ $k = 65$ $\left(\frac{1}{2} \times 20 \times 70\right) + (25 \times 30) + \left(\frac{1}{2} \times (k - 45) \times 30\right) = 1350$ $300 + 750 + 15(k - 45) = 1350$ $15k = 975$ $k = 65$ Answer: (a) 0 (b) $Speed = 6m/s$ (c) $k = 65$	
9	(a) $\frac{-4-8}{x(-2)} = -1.5$ $-1.5(x + 2) = -12$ $x = 6$ OR Equation of line *AB*: $y = -1.5x + c$ $8 = -1.5(-2) + c \rightarrow c = 5$ Hence, equation of line *AB*: $y = -1.5x + 5$ $-4 = -1.5x + 5$ $x = 6$ (b) Length of *AB* $= \sqrt{(-2-6)^2 + (8-(-4))^2}$ $= \sqrt{208} = 14.4$ units (3sf) (c) $6(-b) + 9(4b) = 5 \rightarrow b = \frac{1}{6}$ (d) Line *CD*: $6y + 9x = 5 \rightarrow y = -1.5x + \frac{5}{6}$ Gradient of line $CD = -1.5$ Since the gradients of line *CD* and line *AB* are equal, line *CD* is parallel to line *AB*. Thus, line *CD* does not intersect line *AB* Answer: (a) $x = 6$ (b) 14.4 $units\ (3sf)$ (c) $b = \frac{1}{6}$ (d) Since the gradients of line CD and line AB are equal, line CD is parallel to line AB. Thus, line CD does not intersect line AB.	

10

x	-3.5	-3	-2	-1	0	1	2	3
y	-1.1	1.6	4.4 (B1)	4.8	4	3.2	3.6	6.4

(c) Gradient $= 1.38 \pm 0.1$

(d) $\frac{x^5}{5} - \frac{1}{2} = 0$

$\frac{x^3}{5} = \frac{1}{2}x$

$\frac{x^3}{5} - x + 4 = \frac{1}{2}x - x + 4$

$y = -\frac{1}{2}x + 4$

$x = -1.45, 0, 1.45$

(e) $\frac{x^3}{5} - x + 4 = -\frac{1}{2}x + 4$

Multiply by 10.

$2x^3 - 10x + 40 = -5x + 40$

$2x^3 - 5x = 0$

$\therefore A = 0,\ B = -5$

Answer: (a) 4.4 (c) Gradient $=1.38 \pm 0.1$ (d) $x = -1.45, 0, 1.45$

(e) $A = 0, B = -5$

11

(a) $\angle ABC = \angle ADE(given)$

$\frac{AB}{AD} = \frac{6}{15} = \frac{2}{5}$

$\frac{BC}{DE} = \frac{9}{22.5} = \frac{2}{5}$

Since two pairs of corresponding sides are in the same ratio and one pair of corresponding included angles is the same, ΔACB and ΔAED are similar.

OR

$\angle ABC = \angle ADE(given)$

$\angle BAC = \angle DAE\ (common\ angle)$

Since two pairs of corresponding angles are the same.

ΔACB and ΔAED are similar.

(b) $\frac{AC}{AE} = \frac{AB}{AD}$

$\frac{AC}{20} = \frac{6}{15}$

$AC = \frac{6}{15} \times 20$

$AC = 8\ cm$

$CD = 15 - 8$

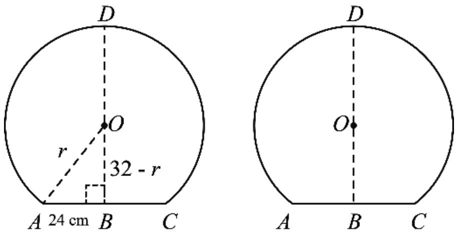
$CD = 7cm$

Answer: (a) Shown (b) Shown

12	$\frac{L_1}{L_2} = \sqrt[3]{\frac{250}{54}}$ $= \frac{5}{3}$ ……………… M1 $\frac{BA_1}{BA_2} = \left(\frac{5}{3}\right)^2$ $= 25:9$ ……………… A1 Answer: $25:9$	
13	$24.249 = \frac{1}{2} \times 7 \times 8 \times \sin \angle ABC$ $\angle ABC = \sin^{-1}\left(\frac{24.249}{\frac{1}{2}\times 7\times 8}\right)$ $\angle ABC = 60.001°$ obtuse $\angle ABC = 180 - 60.001 = 119.999°$ Appling cosine rule. $AC = \sqrt{7^2 + 8^2 - 2(7 \times 8 \times \cos 119.999)}$ $AC = \sqrt{168.998}$ $AC = 12.999$ $AC = 13.0\ (3sf)cm$ Answer: $AC = 13.0(3sf)cm$	
14	$\frac{1}{2}(14.2)(6.1) \sin A\hat{B}C = 36.7$ $\sin A\hat{B}C = 0.847379$ $A\hat{B}C = \sin^{-1} 0.847379$ $= 57.9277°$ or $180° - 57.9277°$ $= 57.9°$ or $122.1°$ Answer: $122.1°$	

15	(a) $\angle ABC = 180° - 100° - 53°$ $= 27°$ (adj. $\angle$s on a str. line) $\frac{AC}{\sin 27°} = \frac{BC}{\sin 53°}$ $AC = \frac{32 \sin 27°}{\sin 53°}$ $= 18.19065$ $= 18.19$ m (b) (i) $DE = \sqrt{18.19^2 + (5-2)^2}$ $= 18.4357$ $= 18.4$ m (ii) angle DBE (ii) $\frac{AB}{\sin 100°} = \frac{BC}{sin\, 53°}$ $AB = \frac{32 \sin 100°}{sin\, 53°}$ $= 39.4596$ m $BD = \sqrt{3^2 + 39.4596^2}$ $= 39.5735$ m $BE = \sqrt{5^2 + 32^2}$ $= 32.3883$ m $DE^2 = BD^2 + BE^2 - 2(BD)(BE)\cos\angle DBE$ $18.4357^2 = 39.57355^2 + 32.3883^2 - 2(39.5735)(32.3883)\cos\angle DBE$ $\cos\angle DBE = 0.887554$ $\angle DBE = \cos^{-1} 0.887554$ $= 27.43257$ $= 27.4°$ Answer: (a)18.19 m (bi)18.4 m (bii)27.4°	
16	(a) $\angle ACD = 32°$ ($\angle$s in same seg.) (b) $\angle BCD = 32° + 58°$ $= 90°$ Since it obeys **right angle in semicircle property**, $\Longrightarrow BD$ is a diameter. (shown) (c) $\angle DAB = 90°$ $\angle DAY = 180° - 90° - 58°$ $= 32°$ (adj $\angle$s on a straight line) (d) $\angle FCE = \angle FEC = \frac{180°-120°}{2}$ (base $\angle$s of isos. Δ) $= 30°$ (A) $\angle ECD = 180° - 90° - 30°$ (adj. $\angle$s on straight line) $= 60°$ $\angle FED = 90°$ ($\angle$s in opp. seg.) $\angle CED = 90° - 30° = 60°$ $\therefore \angle CDE = 60°$ Since all 3 angle are 60° $\Longrightarrow \Delta CDE$ is an equilateral Δ. (shown) (e) (i) $\angle COE = 120°$ (at centre = 2 $\angle$s at circumference) $\Longrightarrow \angle OCE = \angle)EC = 30°$ (base $\angle$s of Isos. Δ) $\angle COE = \angle CFE = 120°$ (A) $\angle OCE = \angle FCE = 30°$ (base $\angle$s of Isos. Δ) CE is common (S) $\therefore \Delta OCE \equiv \Delta FCE$ (AAS) (ii) *COEF* is a rhombus. Answer: (a) $\angle ACD = 32°$ (b) $90°$ (c) $32°$ (d) $\angle CDE = 60°$ (ei) $\Delta OCE = \Delta FCE\ (AAS)$ (eii) $COEF\ is\ a\ rhombus$	

17 (a) (i) Let the radius of the circle be r cm.



$r^2 = \left(\frac{48}{2}\right)^2 + (32 - r)^2$

$r^2 - (32 - r)^2 = 24^2$

$(r - 32 + r)(r + 32 - r) = 576$

$(2r - 32)32 = 576$

$2r - 32 = \frac{576}{32}$

$2r - 32 = 18$

$2r = 50$

$r = 25$

The radius of the circle is 25 cm. (shown)

(ii) $\sin \angle AOB = \frac{24}{25}$

$\angle AOB = 1.2870$

$\angle AOC = 1.2870 \times 2$

$= 2.574$

Area of major segment *AODC*

= Area of major sectorr *AODC* + Area of triangle *OABC*

$= \frac{1}{2} r^2 (\text{reflex } \angle AOC) + \frac{1}{2} r^2 \sin(\text{acute } \angle AOC)$

$= \frac{1}{2} (25)^2 (2\pi - 2.574) + \frac{1}{2} (25)^2 \sin(2.574)$

≈ 1327.12

≈ 1330 cm^2

(b) (i) Circumference of the base of the cone

= arc length of the major sector *OADC*

$= r$ (reflex $\angle AOC$)

$= 25(2\pi - 1.574)$

≈ 92.730

≈ 92.7 cm

(ii) Hence, calculate the vertical

(ii) Radius of base circle

$= \frac{92.730}{2\pi}$

≈ 14.758 cm

Let the vertical height be h cm.

$25^2 = h^2 + (14.758)^2$

$h^2 = 25^2 - (14.758)^2$

$h = \sqrt{25^2 - (14.758)^2}$

$h \approx 20.179$

$h \approx 20.2$

The vertical height is about 20.2 cm

Answer: (a-i)$r = 25$ (a-ii) $1330\ cm^2$ (b-i)$92.7\ cm$ (b-ii) $20.2\ cm$