For Examiner's Use

Answer all the questions

For Examiner's Use

1 Solve $15-\frac{x}{4}=2$.

Answer $x =$ ..... [1]

2 John played four rounds of golf.
His score has a mean of 65, a mode of 68 and a median of 66.

Find the four scores.

Answer ..... , ... , ... , ... [2]

3 (a) Calvin thinks of a two-digit number.
It is a factor of 1320.
It is a prime number.

What is his number?

Answer (a) ..... [1]

(b) Written as a product of its prime factors, $504 = 2^3 \times 3^2 \times 7$. Find the smallest positive integer value of n for which $70n$ is a multiple of 504.

Answer (b) ..... [1]

For Examiner's Use

4 (a) Find the range of values of w such that $(2w-5)°$ is an obtuse angle.

Answer (a) ..... [1]

(b) **Hence** write down the smallest integer that satisfies the range of values of w.

Answer (b) ..... [1]

For Examiner's Use

5 Factorise fully $9by - 6bx - 3ay + 2ax$.

Answer ..... [2]

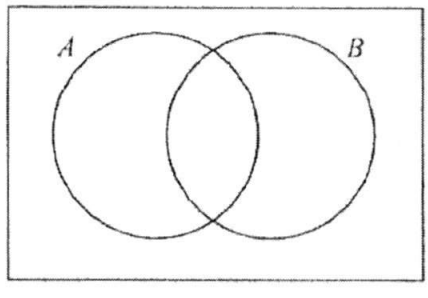
6 ξ = {positive integers x : $x < 10$}
A = {factors of 8}
B = {odd numbers}

(a) List the elements in $A \cap B'$.

Answer (a) ..... [1]

(b) On the Venn diagram, shade the region which represents $A \cap B'$.

Answer (b)



[1]

For Examiner's Use

7 $\mathbf{X} = \begin{pmatrix} 2 & -3 \\ 7 & 1 \end{pmatrix}$ $\mathbf{Y} = \begin{pmatrix} 10 & 3 \\ 14 & -2 \end{pmatrix}$

For Examiner's Use

(a) Find $2\mathbf{X} - \mathbf{Y}$.

Answer (a) ..... [1]

(b) Without evaluating $\frac{1}{3}\mathbf{Y}\begin{pmatrix} \frac{4}{5} & 0.5 & 3.7 \\ 3 & \frac{1}{9} & 4.5 \end{pmatrix}$, state the order of the result of

$\frac{1}{3}\mathbf{Y}\begin{pmatrix} \frac{4}{5} & 0.5 & 3.7 \\ 3 & \frac{1}{9} & 4.5 \end{pmatrix}$

Answer (b) ..... [1]

8 Given that the lines $y = \frac{1}{3}x - 4$ and $(9 - 2p)y = 20 + px$ are parallel, find the value of p.

Answer p = ... [2]

For Examiner's Use

9 (a) Write 0.000 007 82 in standard form.

Answer (a) ..... [1]

(b) The total amount of waste collected is 7.67 million tonnes and 2878.6 thousand tonnes were disposed at the incinerator plants.

Calculate the percentage of waste disposed at the incinerator plants.

Answer (b) ..... % [2]

For Examiner's Use

10 Simon notices that his clock display shows 06 12.

06 : 12

He looks at his clock again between 08 00 and 09 00.
What is the probability that

(a) the clock display shows 10 00?

Answer (a) ..... [1]

(b) the last digit in the clock display shows a 5?

Answer (b) ..... [2]

11 Given that $5^x = 9$, write down the value of

(a) 5^{-x},

Answer (a) ..... [1]

(b) $5^{\frac{x}{2}}$,

Answer (b) ..... [1]

(c) 5^{x+1}.

Answer (c) ..... [1]

For Examiner's Use

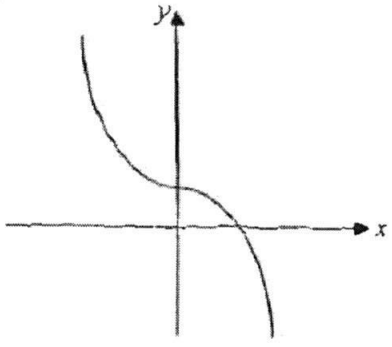
12

$y = 3 - x^2$	$y = x^3 + 5$	$y = -x^3 + 5$
$y = -2^x$	$y = -3 + x^2$	$y = 2^{-x}$

For Examiner's Use

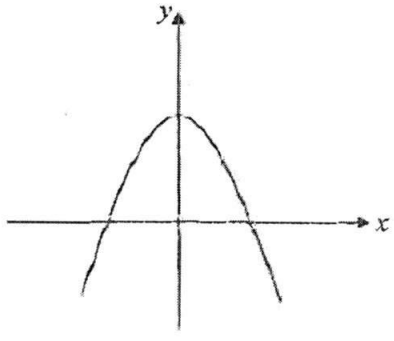
Write down a possible equation for each of the sketch graphs below.
In each case select one of the equations from the box above.

(a)



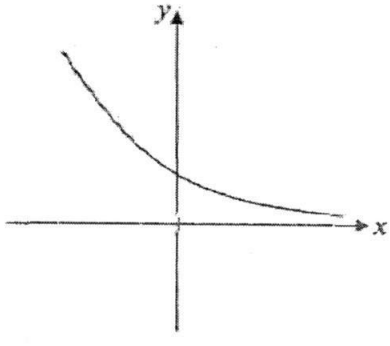
Answer (a) ..... [1]

(b)



Answer (b) ..... [1]

(c)



Answer (c) ..... [1]

For Examiner's Use

13 8 spheres, each of radius 3 cm, have a total volume of $k\pi$ cm^3.

(a) Find the value of k.

Answer (a) $k =$ ..... [1]

(b) The spheres are placed inside an open cylinder, with radius 6 cm. The cylinder stands on a horizontal surface and contains enough water to cover the spheres.

Calculate the change in depth of the water when the spheres are taken out of the cylinder.

Answer (b) ..... cm [2]

For Examiner's Use

14 A straight line passes through the points P (−4, 13) and Q (0, 5).

(a) Calculate the length of the line joining P and Q.

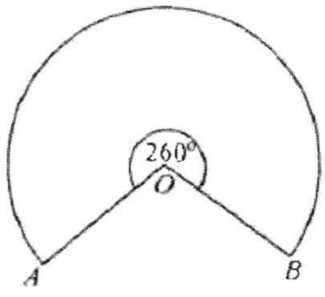
Answer (a) ..... [2]

(b) Find the equation of the line PQ.

Answer (b) ..... [2]

For Examiner's Use

15 The diagram shows the major sector of a circle, centre O and radius 15 cm. The reflex angle AOB is 260°. A cone is formed by joining OA and OB together.



Calculate the

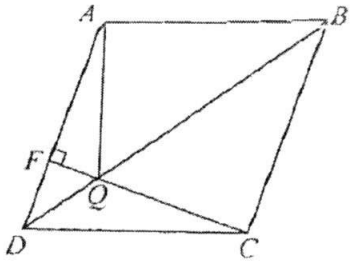
(a) radius of the cone,

Answer (a) ..... cm [2]

(b) height of the cone.

Answer (b) ..... cm [2]

16 $ABCD$ is a rhombus. CF is perpendicular to AD and intersects BD at Q.



(a) Prove that triangle CQB is congruent to triangle AQB.

Answer (a)

.....

.....

.....

..... [3]

(b) Name two other triangles that are congruent.

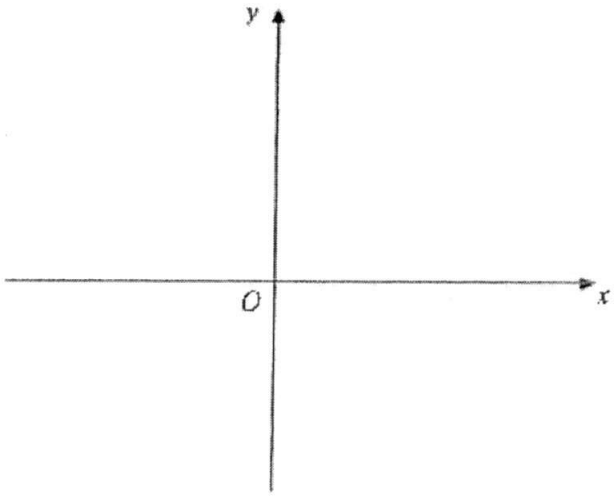
Answer (b) ..... and ..... [1]

For Examiner's Use

17 (a) Sketch the graph of $y = (2 - x)(x + 3)$.

For Examiner's Use

Answer (a)



[2]

(b) State the equation of the line of symmetry of the graph.

Answer (b) ..... [1]

(c) Find the turning point of the graph.

Answer (c) (..... , ...) [1]

For Examiner's Use

18 (a) The first four terms in a sequence are 67, 75, 83 and 91.

(i) Find an expression, in terms of n, for the nth term T_n, of this sequence.

Answer (a)(i)..... [1]

(ii) Evaluate T_{21}.

Answer (a)(ii)..... [1]

(b) The scores of a group of 21 students were recorded.
The results are shown in the stem-and-leaf diagram.

2	5	6	7	7	
3	2	2	4		
4	5	5	5	6	
5	0	0	3	7	7
6	1	8	8	8	9

Key 3 | 2 means 32

(i) State the median score.

Answer (b)(i)..... [1]

(ii) It was discovered that the scores had been recorded incorrectly.
The corrected scores are all 3 marks less than those recorded.

Explain how the mean of the corrected scores has been affected by this error.

Answer (b)(ii)

.....

..... [1]

For Examiner's Use

For Examiner's Use

19 (a) The line PQ is shown below. R is a point above PQ.
Construct the triangle PQR in which $\angle QPR = 40°$ and $PR = 7$ cm.

[2]

(b) The point G is on the same side of PQ as R.
Find and label point G for which it is 5 cm away from point R and equidistant from point P and Q. [3]

For Examiner's Use

For Examiner's Use

For Examiner's Use

20 (a) The scale of a map is 1 cm : 0.25 km.

(i) The distance between the stadium and the airport is 14 km.
Find the distance between the stadium and the airport on the map.

Answer (a)(i) ..... cm [1]

(ii) The area of the stadium on the map is 32 cm^2.
Calculate the actual area of the stadium.

Answer (a)(ii) ..... km^2 [2]

(b) In a football league, each team gains 3 points for a win, 1 point for a draw and 0 point for a loss. The champion of the league plays 38 games and gains a total of 92 points.

Given that the champion does not lose any games, find the number of games that the champion wins.

Answer (b) ..... [3]

For Examiner's Use

21 (a) A restaurant sells wine by the glass. The table lists the prices.

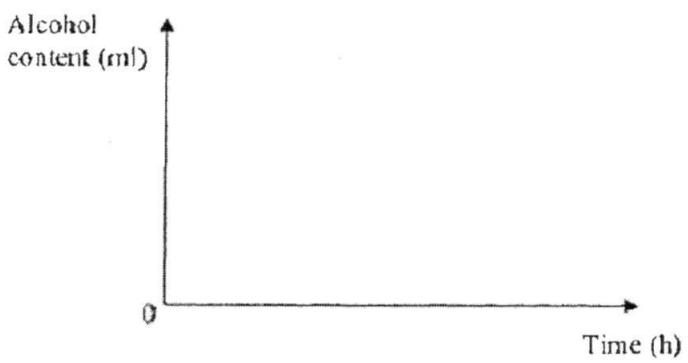
Glass	125 ml	$ 35
Glass	175 ml	$ 50
Glass	250 ml	$ 70

Determine whether the price of a glass of wine is directly proportional to the amount of wine. Justify your answer.

Answer (a) ..... [1]

(b) The alcohol content in a glass of 250 ml is found to be 30 ml. Given the constant rate of decay of alcohol is 13ml/h, sketch a graph to represent the decay of 30 ml of alcohol. Label your intercept(s) clearly, if any.

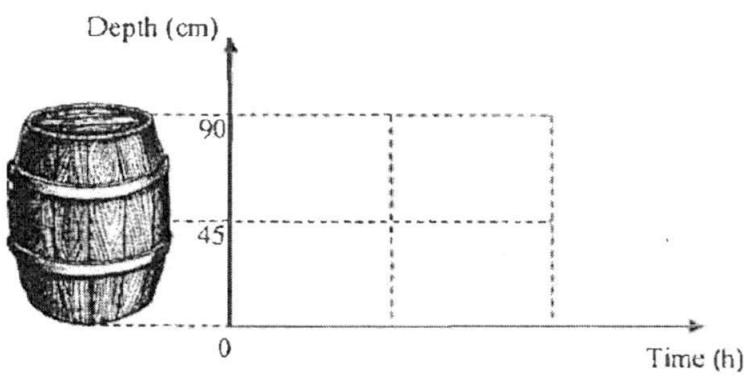
Answer (b)



[2]

(c) The 225-litre wine barrel is symmetrical about its biggest cross-sectional area in the middle. Wine is leaking through a hole at the base of the barrel at a constant rate of 15 ml per minute.

Complete the sketch below and fill in the time taken for the barrel to be completely emptied.



[3]

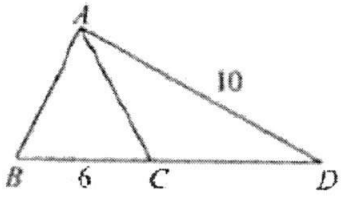
For Examiner's Use

22 (a) One approximate solution of the equation $\sin y° = 0.41$ is $y = 24.2$.
Use this value of y to find the solution of the equation that lies between 90° and 180°.

For Examiner's Use

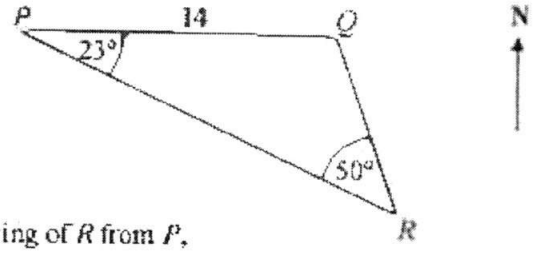
Answer (a) $y =$ ..... [1]

(b) In the diagram, BCD is a straight line.
$BC = 6$ cm and $AD = 10$ cm.
Given that the area of $\Delta ABC = 14$ cm^2, find the exact value of $\sin \angle ADC$.



Answer (b) $\sin \angle ADC =$ ..... [2]

(c) P, Q and R represent three islands that are on level ground such that P is 14 km due west of Q. Angle $QPR = 23°$ and angle $PRQ = 50°$.



Calculate
(i) the bearing of R from P,

Answer (c)(i) ..... [1]

(ii) the distance RP.

Answer (c)(ii) ..... km [2]

For Examiner's Use

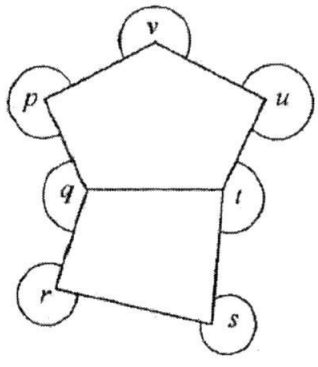
23 (a) One of the angles of an isosceles triangle is 32°.

Write down the possible values for the remaining two angles.

Answer (a) ..... and .....

..... and ..... [2]

(b) Calculate the sum of the angles p, q, r, s, t, u and v shown in the diagram.



Answer (b) ..... [2]

(c) A regular polygon has n sides. Each exterior angle is $\frac{n}{40}$ degrees.

Find the size of each of an interior angle of this polygon.

Answer (c) ..... [3]

For Examiner's Use

End of paper

1 52

2 60, 64, 68, 68

3a 11

3b 36

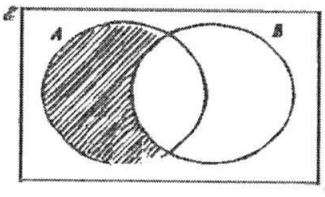
4a $47.5 < w < 92.5$

4b 48

5 $(3b - a)(3y - 2x)$

6a 2, 4, 8 or $A \cap B = \{2, 4, 8\}$

6b



7a $\begin{pmatrix} -6 & -9 \\ 0 & 4 \end{pmatrix}$

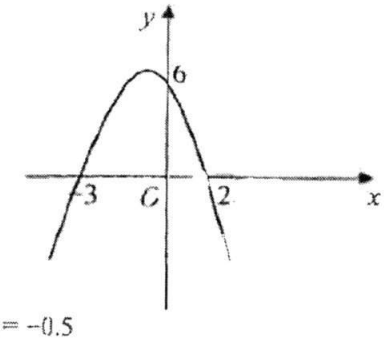
7b 2 x 3

8 1.8

9a 7.82×10^{-6}

16b ΔAQD and ΔCQD
ΔABD and ΔCDB
ΔABC and ΔADC / ΔCDA

17a



17b $x = -0.5$

17c $(-0.5, 6.25)$

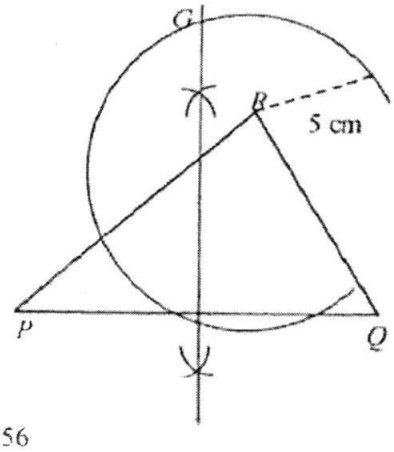
18ai $59 + 8n$

18aii 227

18bi 46

18bii The mean will reduce by 3.

19



20ai 56

20aii 1 cm^2 : 0.0625 km^2

20b 2
$3x + y = 92$
$x + y = 38$

27

21a Not proportion because $\frac{125}{35} \neq \frac{175}{50}$

9b 37.5 %

10a 0

10b $\frac{6}{59}$

11a $\frac{1}{9}$

11b 3

11c 45

12a $y = -x^3 + 5$

12b $y = 3 - x^2$

12c $y = 2^{-x}$

13a 288

13b $\frac{288\pi}{\pi(6)^2}$

$= 8$

14a 8.94

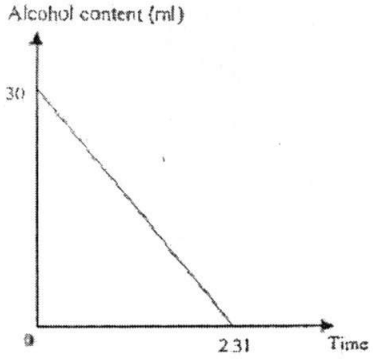
14b $y = 2x + 5$

15a $10\frac{5}{6}$, 10.8, 10.83

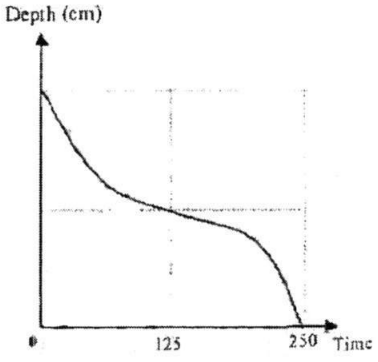
15b $\sqrt{15^2 - (10\frac{5}{6})^2}$

$= 10.4$

21b



21c



22a 155.8

22b $\frac{7}{15}$

22ci 113

22cii $RP = 17.5$

23a 32 and 116
74 and 74

23b 1620

23c 177

16a	QB is common side AB = CB (sides of rhombus) $\angle ABQ = \angle CBQ$ (diagonals of rhombus bisect)		

Mathematical Formulae

Mensuration

Curved surface area of a cone $= \pi r \ell$

Curved surface area of a sphere $= 4\pi r^2$

Volume of a cone $= \frac{1}{3} \pi r^2 h$

Volume of a sphere $= \frac{4}{3} \pi r^3$

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

Arc length $= r\theta$, where θ is in radians

Sector area $= \frac{1}{2} r^2 \theta$, where θ is in radians

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

1 (a) Express $\frac{5x+1}{2x^2-x-6}+\frac{2}{2-x}$ as a single fraction in its simplest form. [3]

(b) Factorise $49m^4-(m^2-m)^2$ completely. [3]

(c) Express x^2-6x-5 in the form $(x-b)^2+c$.

Hence, solve $x^2-6x-5=0$, giving your answers correct to 2 decimal places. [4]

(d) Given that $\sqrt{\frac{k-p}{p}}=\frac{k}{2}$, express p in terms of k. [3]

---

2 (a) Mr Lim spends $x on petrol originally. When the cost of petrol rose by 8%, he decreased his petrol consumption by 8%. He claimed that there was no change in his expenditure on petrol. Explain if he is right or wrong. [2]

(b) A team of 3 players, Adam, Bruce and Calvin won $10 000 in a competition.

(i) The money is to be divided among them in the ratio of 1 : 2 : 5 respectively.

Calculate

(a) the amount Adam will receive, [1]

(b) the percentage of the total sum that Bruce will get, [1]

(c) angle that will represent Calvin's share if the money distribution is to be represented on a pie chart. [2]

(ii) If they donated k% of the total prize money of $10 000, the ratio becomes 1 : 3 : 6 respectively and Calvin now received $4800.

(a) Find the value of k. [3]

(b) Calculate how much more or less will Adam get with this arrangement as compared to the one in part (i). [2]

3 A factory produces sports equipment.

(a) In 6 hours, it produces x floorball sticks.
Write down an expression, in terms of x, for the number of hours it takes to produce one floorball stick. [1]

(b) In 6 hours, it produces 15 less badminton rackets than floorball sticks.
Write down an expression, in terms of x, for the number of hours it takes to produce one badminton racket. [1]

(c) It takes 2 minutes longer to produce one badminton racket than one floorball stick.
Form an equation in x and show that it reduces to $x^2 - 15x - 2700 = 0$. [3]

(d) Solve the equation $x^2 - 15x - 2700 = 0$ [2]

(e) Find the time taken to produce 800 badminton rackets.
Give your answer in hours and minutes. [2]

4 There are three types of tickets available for sale for a concert.

Some of the information regarding the sale of the tickets are summarised in the table below.

	Type 1	Type 2	Type 3
Cost of 1 ticket (Saturday)	\$48	\$68	\$88
Cost of 1 ticket (Sunday)	\$68	\$88	\$108
Number of tickets available for sale per day	100	60	40

(a) Represent the cost of tickets in a 2×3 matrix **P**. [1]

(b) Represent the number of tickets available per day in a 3×1 column matrix **Q**. [1]

(c) Evaluate $\begin{pmatrix} 2 & 2 & 2 \end{pmatrix}\mathbf{Q}$ and state what your answer represent. [2]

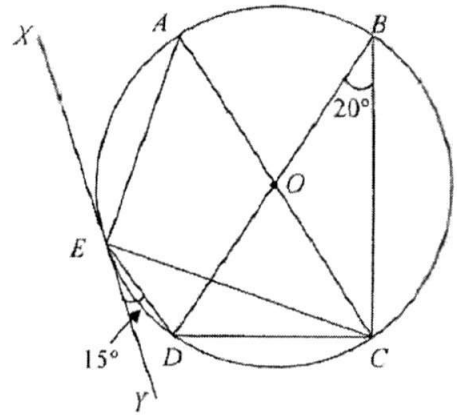
(d) It is given that 20, 9 and 4 tickets for Type 1, Type 2 and Type 3 tickets respectively for both days were unsold.

(i) Find a 3×1 column matrix **R** whose elements represent the number of different types of tickets sold per day. [2]

(ii) Evaluate **PR** and hence find the total revenue for the weekend. [3]

5 In the diagram, A, B, C, D and E are five points on the circle with centre O and diameters AC and BD. XEY is a tangent to the circle at E.

Angle $DBC = 20°$ and angle $DEY = 15°$.



(a) Giving your reasons, find

(i) $\angle DEC$, [1]

(ii) $\angle DOC$, [1]

(iii) $\angle DCE$, [1]

(iv) $\angle AEC$, [1]

(v) $\angle EAC$. [1]

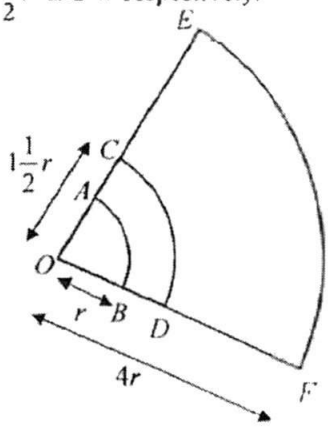
(b) Determine if AC is parallel to XEY. [2]

(c) A student claims that a new circle can be drawn using the points E, O, C and D to form a cyclic quadrilateral. Do you agree?

Justify your answer with clear explanation. [3]

(d) If $AE = 8.5$ cm, find the radius of the circle. [2]

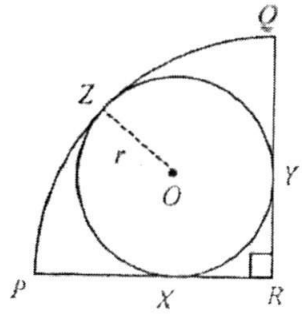
6 (a) The diagram shows the minor arcs AB, CD and EF of three concentric circles, centre O with radii r, $1\frac{1}{2}r$ and $4r$ respectively.



(i) Find the ratio of arc AB to arc EF. [1]

(ii) Find the ratio of the area of sector OCD to the area of sector OEF. [2]

(b) The diagram shows a circle of radius r cm, centre O. PR and QR are two tangents which are perpendicular to each other and they touch the circle at X and Y respectively. PQ is an arc of a circle, centre R, radius 18 cm.



Given that arc PQ meets the circle with centre O at Z,

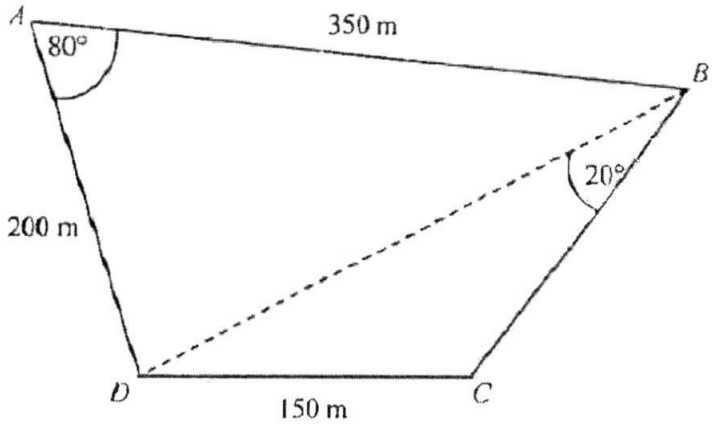
(i) show that $r = 7.456$ cm, [3]

(ii) calculate the area of PQR not covered by the circle. [3]

7 The diagram shows a plot of land $ABCD$ on horizontal ground.

$AB = 350$ m, $AD = 200$ m, angle $DAB = 80°$ and angle $DBC = 20°$.

Angle DCB is obtuse.



(a) Calculate

(i) the distance BD, [3]

(ii) angle BDC. [3]

(b) At noon, the farmer standing at A observes a hot air balloon, H directly above D.

The angle of elevation of the hot air balloon from the farmer at A is 19°.

(i) Calculate the height HD. [2]

(ii) The hot air balloon rises vertically at a constant speed of 1.5 m/s.

Find the new angle of elevation of the hot air balloon from the farmer at A 3 minutes later. [3]

[Turn over

8 **Answer the whole of this question on a piece of graph paper.**

The number of bacteria, N units in a food item in time, t minutes are connected by the equation $N = 35(2^{t-1})$.

t	0	0.5	1	1.5	2	2.4	2.5
N	17.5	24.7	35	49.5	70	a	99.0

(a) Calculate the value of a. [1]

(b) Using the scale of 4 cm to represent 1 unit, draw a horizontal t-axis for $0 \le t \le 2.5$.
Using the scale of 2 cm to represent 10 units, draw a vertical N-axis for $0 \le N \le 100$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

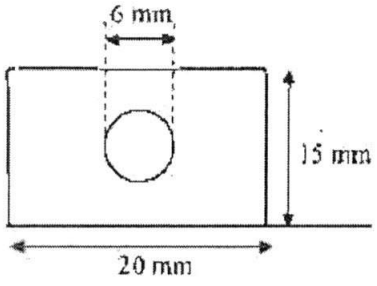
(c) Use your graph to find the range of values of t for $75 < 35(2^{t-1}) \le 80$. [2]

(d) By drawing a tangent, find the gradient of the curve at (1, 35).
State what does this tangent represent. [3]

(e) Use your graph to solve the equation $35(2^{t-1}) + 5t - 80 = 0$. [3]

(f) When $t \ge k$ minutes, the number of bacteria has increased by 200% from its original amount and the food item is not safe to be consumed.
Use your graph to determine this value of k. [2]

9 The diagram shows the cross-section of a pendant, which is in the form of a rectangular prism of sides 20 mm by 15 mm and thickness 5 mm with a circular hole of diameter 6 mm drilled in the centre along the axis of the prism.



(a) Find the cross section area, in mm^2 of the pendant. [2]

(b) Find the volume of the pendant, in mm^3. [2]

(c) The manufacturer claims that the pendant is made of pure silver and has a mass of 0.48 oz. Justify his claim using the additional information given below. [5]

Density of pure silver = 10.5 g/cm^3
1 ounce (oz) = 28.35 g

(d) The manufacturer decides to melt the original pendant to form more than one identical cone.
The radius of the base of the cone is 5 mm and the height of the cone is 10 mm.
How many complete cones can he make? [3]

END OF PAPER

Answers

1(a) $\dfrac{x-5}{(x-2)(2x+3)}$ (b) $m^2(8m-1)(6m+1)$ (c) $(x-3)^2 = 14$
$x = 6.74, -0.74$

(d) $p = \dfrac{8k}{k^3+8}$

2(a) He is wrong.
New exp is 99.36%x (b)(i)(a) \$1250 (b) 25% (c) 225% (ii)(a) 20 (b)\$450 less

3(a) $\dfrac{6}{x}$ (b) $\dfrac{6}{x-15}$ (d) $x = 60$ or $x = -45$
(e) 106 h 40 mins

4(a) $\mathbf{P} = \begin{pmatrix} 48 & 68 & 88 \\ 68 & 88 & 108 \end{pmatrix}$

4(b) $\mathbf{Q} = \begin{pmatrix} 100 \\ 60 \\ 40 \end{pmatrix}$

4(c) (400)
Total number of tickets available for sale for Saturday and Sunday.

4(d)(i) $\mathbf{R} = \begin{pmatrix} 80 \\ 51 \\ 36 \end{pmatrix}$

4(e)(ii) $\begin{pmatrix} 10476 \\ 13816 \end{pmatrix}$
Total revenue for the weekend= \$24292

5(a)(i) 20°
5(a)(ii) 40°
5(a)(iii) 15°
5(a)(iv) 90°
5(a)(v) 35°

5(c) $\angle OEY = 90°$(tangent ⊥ radius)
$\angle OED = 75°$
$\angle OCD = 15 + 55$
$= 70°$
Since $\angle OED + \angle OCD = 145° \neq 180°$
They are not angles in opposite segments.
Do not agree/Points do not form a cyclic quadrilateral.

5(d) 5.188 cm

6(a)(i)	$\frac{1}{4}$ (ii) $\frac{9}{64}$
6(b)(ii)	79.82 cm^2
7(a)(i)	372m
7(a)(ii)	38.0°
7(b)(i)	68.9m
7(b)(ii)	59.5°
8(a)	a=92.4
8(c)	$2.1 < t \leq 2.2$
8(d)	24.53 How fast bacteria increase/change with time/ rate of change of number of bacteria
8(e)	$t = 2$
8(f)	1.6
9(a)	272mm^2
9(b)	1360 mm^3
9(c)	His claim is NOT TRUE.
9(d)	He can make 5 complete cones.