

Answer **all** the questions.

1 (a) Solve the inequality  $1 - \frac{2x-1}{2} \geq \frac{x+1}{3} - x$ . [3]

(b) Given that  $x = \frac{3y-4}{x-4}$ , express  $x$  in terms of  $y$ . [3]

$$x = 3y - 4$$

(c) Solve the equation  $\frac{1}{3x^2 - x - 2} = \frac{4x}{3x+2} + \frac{2}{1-x}$ , giving your answers to 2 decimal places. [5]

- 2** John took up a job offer in Japan. His annual salary package at that time was 5 500 000 Yen for his one-year contract.

The exchange rate between Singapore dollars and Japanese Yen at that time was S\$1 = 82.6 Yen.

- (a)** Calculate his average monthly salary in Singapore dollars.  
Give your answer correct to the nearest dollar.

[2]

Upon completion of his contract, his company decided to extend his contract by another year. His new annual salary package entitled him to a pay rise of 3.5% based on his past annual salary package plus 200 000 Yen as gratuity if he completes his entire contract.

- (b)** Assuming he completes his entire contract, calculate his revised annual salary package in Yen.

[2]

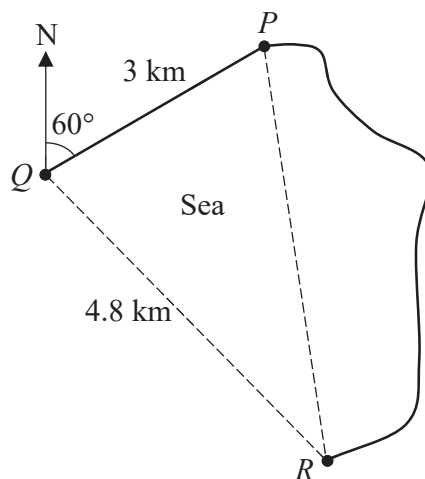
Based on the exchange rate between Singapore dollars and Japanese Yen at that time, John realised that his new average monthly salary in Singapore dollars was S\$5 191.

- (c)** Calculate the exchange rate between Singapore dollars and Japanese Yen at that time.  
Give your answer to one decimal place.

[2]

- (d) Calculate the percentage decrease in the value of Yen against the Singapore dollar. [3]

- 3 The diagram below shows a rescue tower at point  $P$  and a jetty at point  $Q$  along the shore of a bay on a level ground. A lighthouse is on top of a hill at point  $R$ . Rescue tower  $P$  is 3 km along a straight shoreline at a bearing of  $060^\circ$  from jetty  $Q$ . Lighthouse  $R$  is 4.8 km southeast of Jetty  $Q$ .



- (a) Show that the distance between rescue tower  $P$  and lighthouse  $R$  is approximately 4.96 km. [3]

- (b) The angle of depression from the top of the hill at  $R$  to the jetty  $Q$  is  $1.2^\circ$ .  
 The angle of depression from the top of the lighthouse at  $R$  to the jetty  $Q$  is  $2.1^\circ$ .  
 Calculate the height of the lighthouse, in metres, correct to the nearest one decimal place. [3]

- (c) A boat travelling from  $Q$  to  $R$  capsized at point  $X$ , which is nearest to rescue tower  $P$ .  
 A rescue boat was dispatched immediately from  $P$ , travelling at 55 km/h.  
 Calculate the time it will take to reach the capsized boat.  
 Express your answer in terms of minutes and seconds. [3]

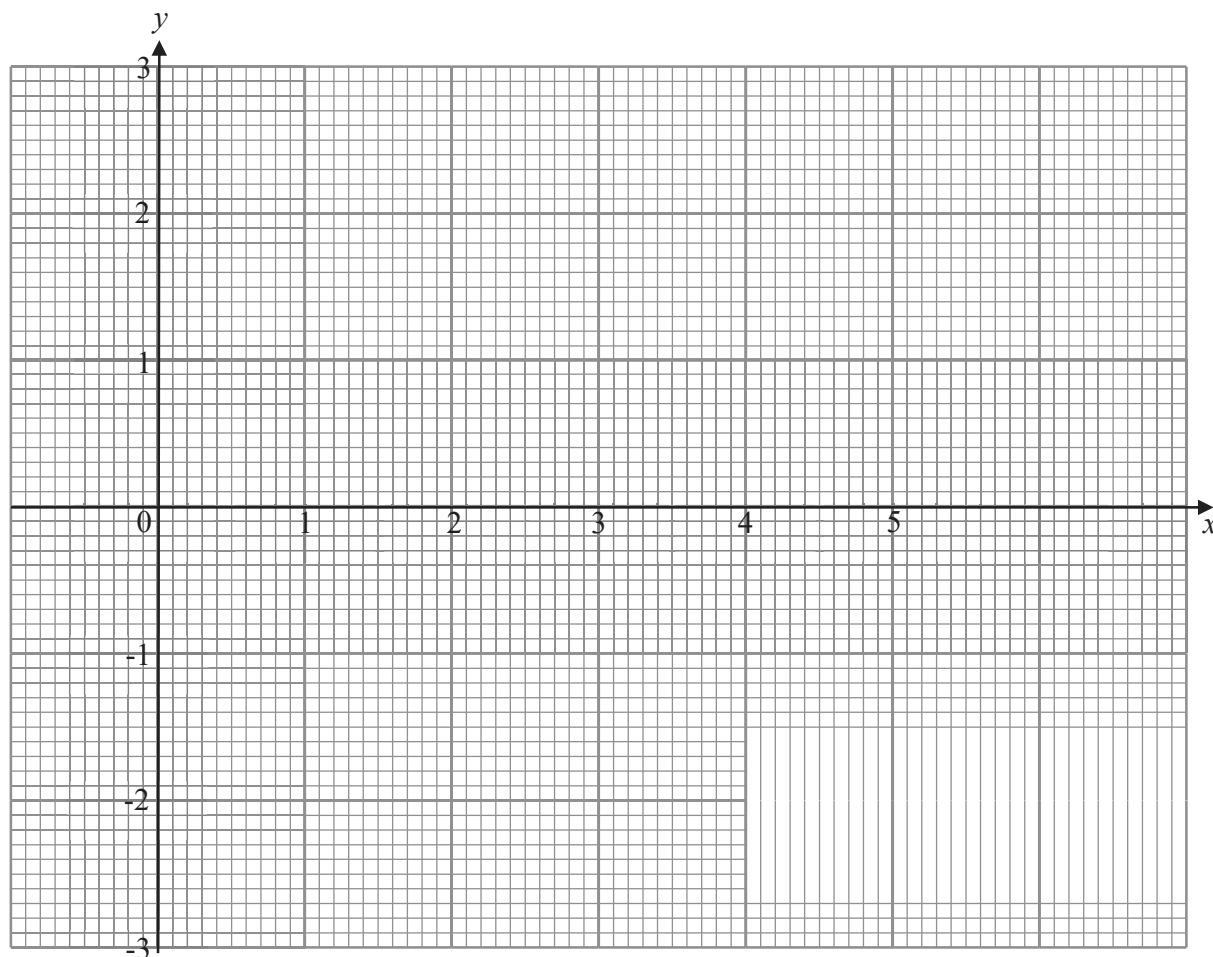
- (d) How far away was the boat from lighthouse  $R$  when it capsized? [2]

- 4 Complete the table of values for  $y = 4 - \frac{x^2}{10} - \frac{3}{x}$ .

$x$	0.5	1	1.5	2	3	4	5	6
$y$	-2.03		1.78	2.1	2.1	1.65	0.9	-0.1

[1]

- (a) On the grid, draw the graph of  $y = 4 - \frac{x^2}{10} - \frac{3}{x}$  for  $0.5 \leq x \leq 6$ .



[2]

**(b)** By drawing a tangent, find the gradient at the point when  $x = 4$ . [2]

**(c)** Use your graph to find  
**(i)** the  $x$ -coordinate of the point on the curve at which the gradient is 1, [2]

**(ii)** the values of  $x$ , in the range of  $0.5 \leq x \leq 6$  for which  $x^3 + 5x^2 - 60x + 30 = 0$  [3]

5 The points  $A$  and  $B$  are  $(-4, 2)$  and  $(2, 5)$  respectively.

(a) Find the length of the line segment  $AB$ . [2]

(b) Find the equation of the line  $AB$ . [2]

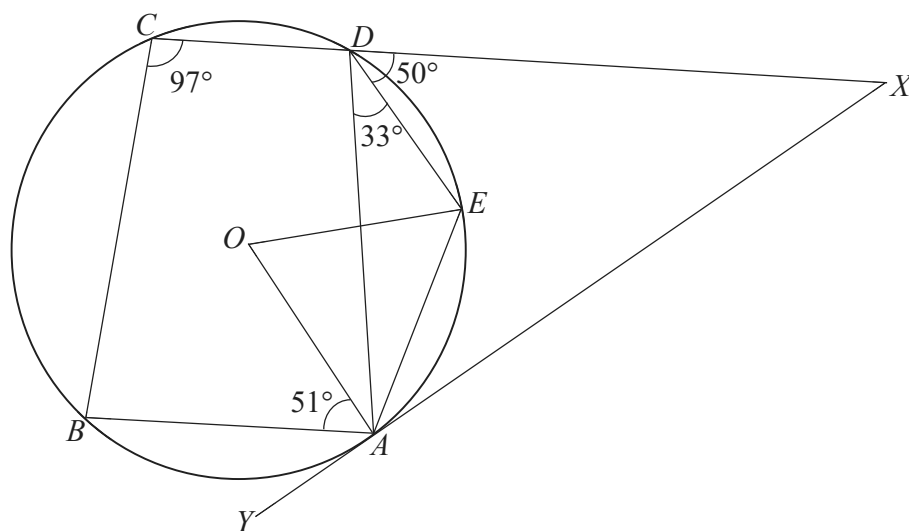
(c)  $P$  is a point on  $AB$  produced such that  $P$  is equidistant from the two axes.  
Find the coordinates of  $P$ . [2]

(d) Given that  $C$  is  $(2, -4)$  and length of  $AB$  and  $CD$  are equal, find the two possible coordinates of  $D$  if it lies on the vertical line passing through  $A$ . [2]



- (e) A trapezium  $ABCE$ , with  $AE$  parallel to  $BC$ , has an area of  $81 \text{ units}^2$ . Find the coordinates of  $E$ . [2]

6



The diagram shows a circle  $ABCDE$  with centre  $O$ .

$XY$  is a tangent to the circle at  $A$ .

$CDX$  is a straight line.

Angle  $ADE = 33^\circ$ , angle  $BAO = 51^\circ$ , angle  $BCD = 97^\circ$  and angle  $EDX = 50^\circ$ .

(a) Find angle  $AOE$ . State the reason clearly.

[1]

(b) Find angle  $XAE$ .

Give a reason for each step of your working.

[2]

- (c) Explain why  $BA$  is parallel to  $CX$ .  
Give a reason for each step of your working. [2]

- (d) Hence, or otherwise, find angle  $AXD$ . State the reasons clearly. [3]

7 The first four terms in a sequence of numbers,  $T_1, T_2, T_3, T_4, \dots$ , are given below.

(a) Write down an expression for  $T_7$  and evaluate it. [2]

(b) Find an expression, in terms of  $n$ , for the  $n^{\text{th}}$  term,  $T_n$  of the sequence. [2]

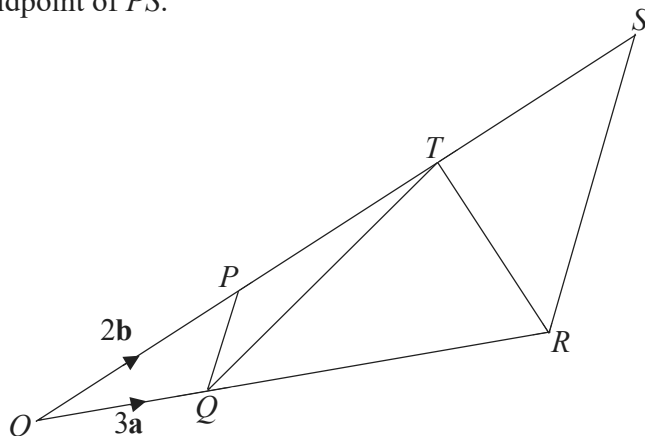
(c) Find, and simplify, an expression, in terms of  $n$ , for  $T_{n+1} - T_n$ . [2]

- (d) Hence explain why the difference between the two consecutive terms is always divisible by 4. [1]

- 8 (a) In the diagram,  $ORS$  is a triangle where  $Q$  is a point on  $OR$ .  $P$  and  $T$  are points on  $OS$ .

$$\overrightarrow{OQ} = 3\mathbf{a}, \overrightarrow{OP} = 2\mathbf{b}, \overrightarrow{TQ} = 3\mathbf{a} - 4\mathbf{b}, \overrightarrow{TR} = 9\mathbf{a} - 4\mathbf{b}.$$

$T$  is the midpoint of  $PS$ .



Express and simplify your answers in terms of  $\mathbf{a}$  and  $\mathbf{b}$ ,

(i)  $\overrightarrow{PQ}$ , [1]

(ii)  $\overrightarrow{QR}$ , [2]

(iii)  $\overrightarrow{SR}$ . [2]

- (iv) Show that triangles  $OPQ$  and  $OSR$  are similar.  
Give a reason for each statement you make. [2]

- (v) Find the ratio of the area of triangle  $OPQ$  to the area of triangle  $TSR$ . [2]

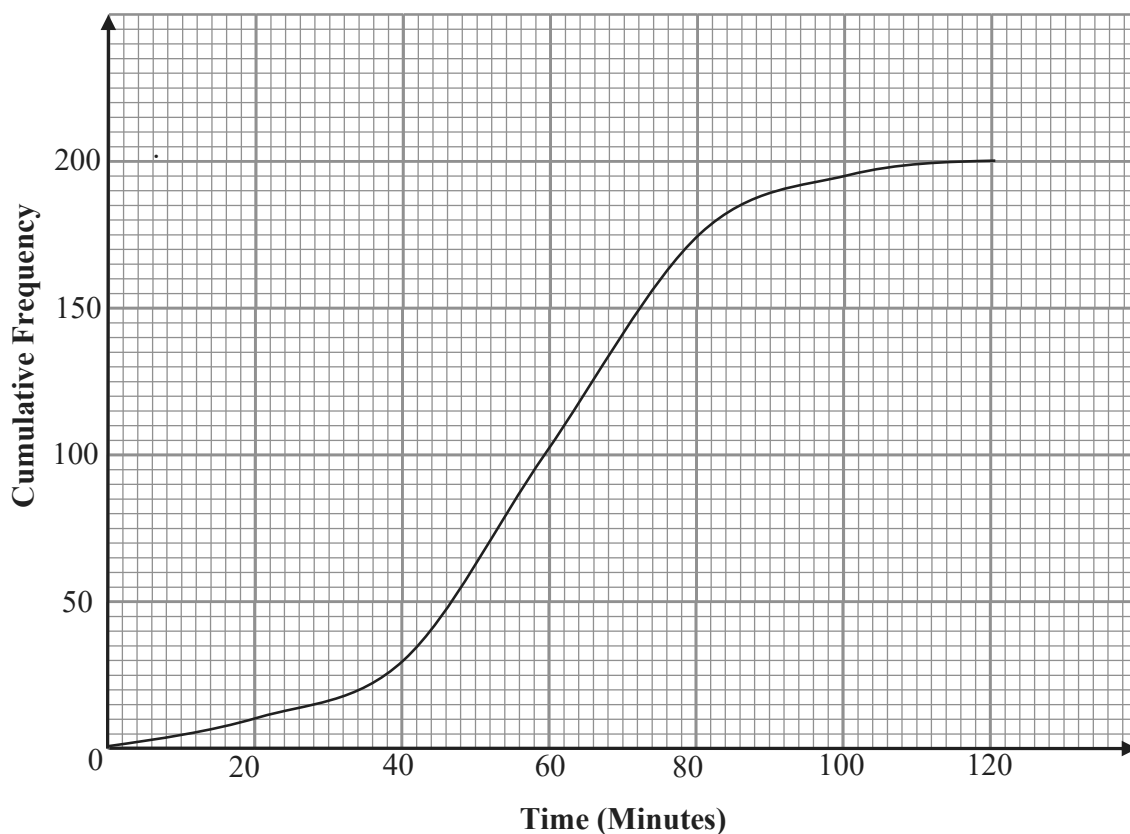
(b) It is given that  $\overrightarrow{PQ} = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$ ,  $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$  and  $\overrightarrow{RS} = \begin{pmatrix} k \\ 7.5 \end{pmatrix}$ .

(i) The coordinates of  $R$  are  $(-3, 2)$ . Find the coordinates of  $P$ . [2]

(ii) Given that  $\overrightarrow{RS}$  is parallel to  $\overrightarrow{PQ}$ , find the value of  $k$ . [2]



- 9 (a) The cumulative graph shows the time (in minutes) spent by 200 visitors at an exhibition.



Use the graph to estimate

- (i) the median time, [1]

- (ii) the interquartile range, [2]

- (iii) the value of  $T$  if 45% of the visitors spent more than  $T$  minutes at the exhibition. [2]

- (b) The organiser of the exhibition set up two boxes at the lucky draw booth. All the balls in the boxes are identical except colour.  
 Box *A* contains 15 coloured balls of which 8 are yellow, 5 are red and remaining balls are blue.  
 Box *B* contains 8 yellow and 4 red balls.  
 Visitors first draw a ball randomly from Box *A* and place in Box *B*. A second ball is then drawn from Box *B*. Below is the table for the prizes.

Two blue balls	Prize <i>X</i>
Two red balls	Prize <i>Y</i>
Two yellow balls	Prize <i>Z</i>
Two different coloured balls	Consolation prize

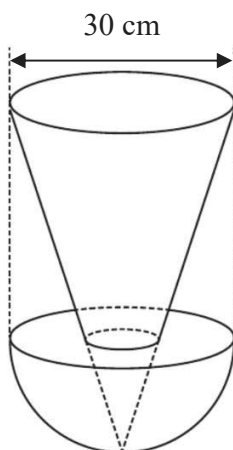
Find, as a fraction in its simplest form, the probability that a visitor wins

- (i) prize *X*, *Y* or *Z*, [2]

- (ii) a consolation prize. [2]

- (iii) The organiser wants most of the visitors to win the consolation prize. Do you agree with the current setup? Explain. [2]

- 10** Stephen came across beautiful concrete garden ornaments during his overseas trip recently. He decided to make his own concrete ornaments based on the dimensions below. The base diameter of a solid cone is 30 cm. A horizontal cut is made such that a smaller cone is removed. The remaining part of the cone is then attached to a hemisphere.



- (a)** The curved surface area of the entire solid cone is 12.25 times of the curved surface area of the smaller cone that is removed.  
Show that the height of the remaining part of the cone is 37.5 cm. [2]

- (b) Show that the volume of the concrete ornament is  $19\,200\text{ cm}^3$ , correct to the nearest 3 significant figures. [2]

Through his research, he found the following information.

- 1 m<sup>3</sup> of concrete weight around 2.4 metric ton (2400 kg)
- Typically, 1 m<sup>3</sup> of concrete is made up of about 350 kg cement, 700 kg sand, 1 200 kg aggregate\* and about 150 litres of water

The mass and cost (without 7% GST) per packet are shown in the table below.

Materials are sold in the following quantities only.

Item	Mass (kg) per packet	Price without 7% GST per packet
Cement	20	\$5.40
	50	\$7.80
Sand	4	\$5.86
Aggregate	4.5	\$16.80

Item	Volume (litres)**	Price without 7% GST
Water	1 000	\$1.20

\* Aggregates are composed of geological materials such as gravel, sand and crushed rock

\*\* 1 litre of water is equivalent to 1 kg

- (c) He would like to produce four of the concrete ornaments showed. He has a budget of \$500. The GST is 7%. Assuming there is no other cost incurred, comment if he can achieve his plan. Show all essential workings. [6]

**End Of Paper**