Name: _____ (   ) Class: _____

KRANJI SECONDARY SCHOOL
Preliminary Examination
Secondary 4 Express / 5 Normal Academic

MATHEMATICS   **4048/01**
Paper 1

Tuesday   **23 August 2022**   2 hours

READ THESE INSTRUCTIONS FIRST:

Do not open this question paper until you are told to do so.

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the
answer to three significant figures. Give your answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 80.

For Examiner's Use	
Total	80

Setter : Ms Madeleine Chew

This question paper consists of <u>21</u> printed pages, including the cover page.

[Turn over

Mathematical Formulae

Compound Interest

$$\text{Total amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

Trigonometry

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

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

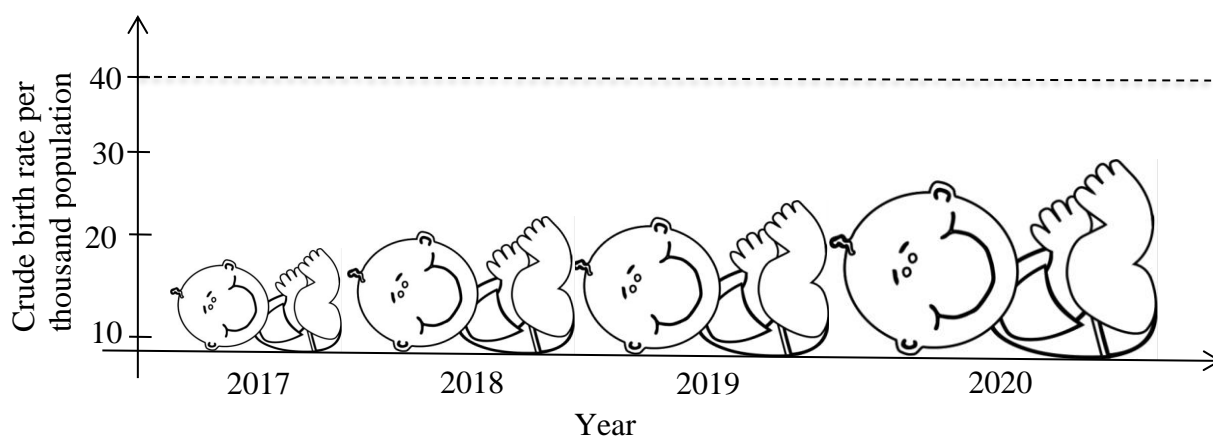*Statistics*

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

Answer **all** the questions.

1   A solid block has a mass of 70 grams when corrected to the nearest gram.
Write down the smallest possible mass of the block.

Answer ………..……………………….. g   [1]

2   The graph below shows the crude birth rate, live births per thousand population,
estimated at mid year in a Country G from the year 2017 to 2020.

Explain how the graph above may be misleading.

Answer ………..………………………………………………………..…………..……

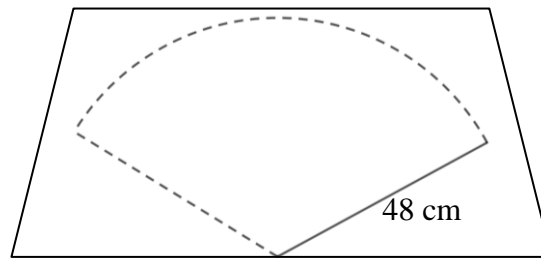………..…………………………………………………….………………………

………..…………………………………………………..………………………   [1]

3   The radius of a circular face is 0.000 905 74 mm.
Express the exact value of the diameter in metres, giving your answer in standard
form.

Answer ………..…………………… m   [2]

4   A windscreen wiper of a car is of length 48 cm and sweeps through an angle of 120°
each time it moves from one end to another.

On a rainy day, Oliver observed that the tip of the wiper moved from one end to
another in 0.8 seconds. Find the speed at which the tip of the wiper moves.
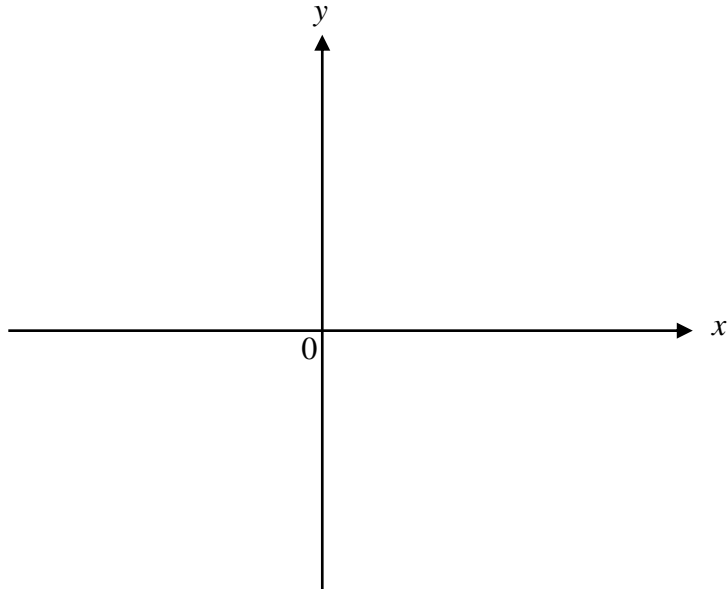
Answer …………..………………… cm/s   [2]

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5   The length of a blade, *L*, is directly proportional to the square of its flat surface area,
A. Given that the length of a particular blade is 15 cm for a flat surface area of 3 cm^2,
form an equation connecting *L* and *A*, expressing *L* in terms of *A*.

Answer …………..………………………   [2]

6 The equation of a curve is $y = (x - p)^2 + q$, where $p < 0$ and $q > 0$.

Sketch a possible curve of $y = (x - p)^2 + q$ in the axes below.

Answer

[2]

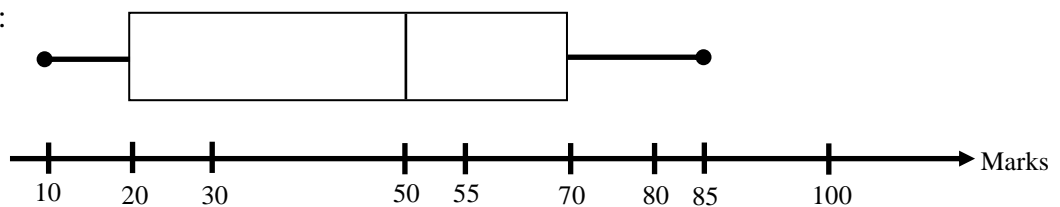
7 A class took a science test and a history test. The box-and-whisker plots below show their results.

Oliver scored 78 marks for both the science test and history test.
Explain whether Oliver did better for the history test or the science test.

Answer …………………………………………………………...………………………………

………………………………………………………...…………………………………………….

………………………………………………………...……………………………………………. [2]

8   The table below shows information collected by Maggie about her driving in 2021.

Total distance driven in 2021	18 723 km
Average price paid for petrol	USD 1.21 per litre
Average petrol consumption of her car	1.79 gallons per 100 km
	[1 gallon = 3.785 litres]

Calculate the total amount Maggie paid for petrol in 2021.
Correct your answer to the nearest dollar.

Answer USD ……..………………………… [3]

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9   **(a)**   The enrolment for a school in 2019 and 2020 are 1081 and 1115 respectively.
Find the percentage increase in the enrolment, giving your answer to 3 decimal
places.

Answer ..……..……………………… % [1]

(b)   In a class of 50 students, the ratio of the number of boys to the number of girls
is 9 : 16.
After some girls join the class, the ratio of the number of boys to the number
of girls become 6 : 13.
What is the total number of students in the class now?

Answer ………..……………… students [2]

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10 A model of a space shuttle is made using a scale of 1 : 20.

    (a) The actual length of the space shuttle is 38.2 m long.
        Find the length, in centimetres, of the model.

Answer ………..………………… cm [1]

    (b) On the model, the area of the tail section painted blue is 80 cm^2.
        Find the actual area of the tail section that is painted in blue, giving your
        answer in square metres.

Answer ………..……………………… m^2 [2]

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11 (a) Express 5832 as a product of its prime factors.

Answer ………..……………………… [1]

    (b) Using your answer to **part (a)**, explain why 5832 is a perfect cube.

Answer ………..………………………………………………………………..

………..………..………………………………………………...……………….. [1]

    (c) Find the smallest positive integer k such that 5832k is a perfect square.

Answer k = ………..……………………… [1]

12 The *n*th term of a sequence is given by *6n* + 3.

(a) List the first 4 terms in the sequence.

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

(b) Explain why the terms of this sequence are all multiples of 3.

Answer ……………………………………………...………………………
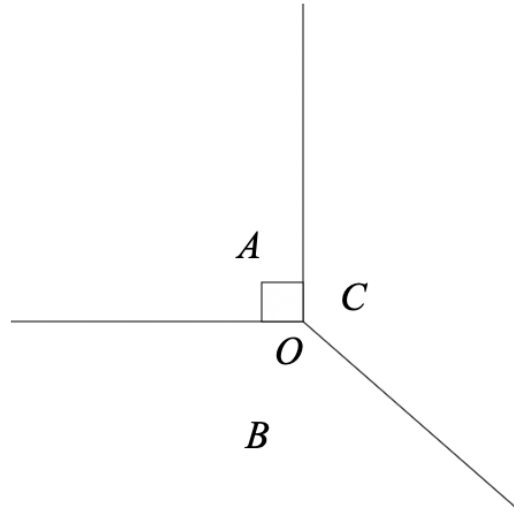
……………………………………………...………………………………. [1]

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13 (a) Solve the inequalities $3 - x < \dfrac{7 - 3x}{2} \le 5$.

Answer ………..……………………… [2]

(b) Write down all the integers that satisfies $3 - x < \dfrac{7 - 3x}{2} \le 5$.

Answer ………..……………………… [1]

14 The diagram shows one interior angle of three polygons, *A*, *B* and *C*.
The polygons fit together at the point *O*. *A* is a square.
The interior angle of the polygon *C* at the point *O* is 115°.

Explain why polygon *B* cannot be a regular polygon.

Answer

[3]

15 (a) $\xi = \{\text{integers } x : 1 \le x \le 20\}$
$A = \{\text{prime numbers}\}$
$B = \{\text{factors of 15}\}$
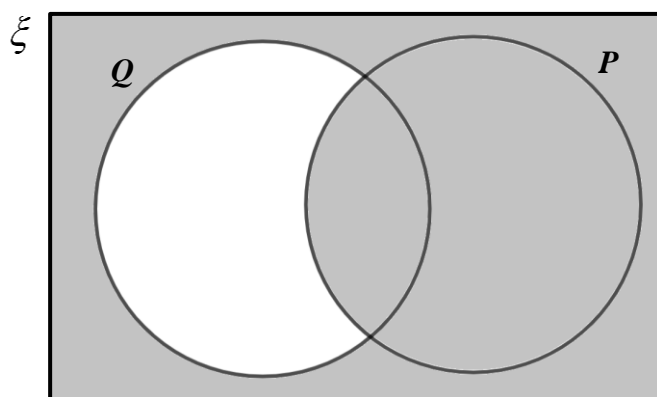
(i) List the element(s) in $A \cap B$.

Answer ………..……………………… [1]

(ii) Use one of the symbols below to complete each statement.

$$\in \quad \notin \quad \varnothing \quad \subset \quad \not\subset$$

(a) 8 …………….. A [1]

(b) {15}……………. B [1]

(b) Use set notation to describe the shaded region.

Answer ………..……………………… [1]

16 *R* is the point (4, 1) and the *S* is the point (5, – 2).

(a) Find the vector $\overrightarrow{RS}$.

Answer $\left(\right)$ [1]

(b) Using your answer in **part (a)**, find $\left|\overrightarrow{RS}\right|$.

Answer ………..………………… units   [2]

(c) $\overrightarrow{AB} = \begin{pmatrix} 0.8 \\ -2.4 \end{pmatrix}$.

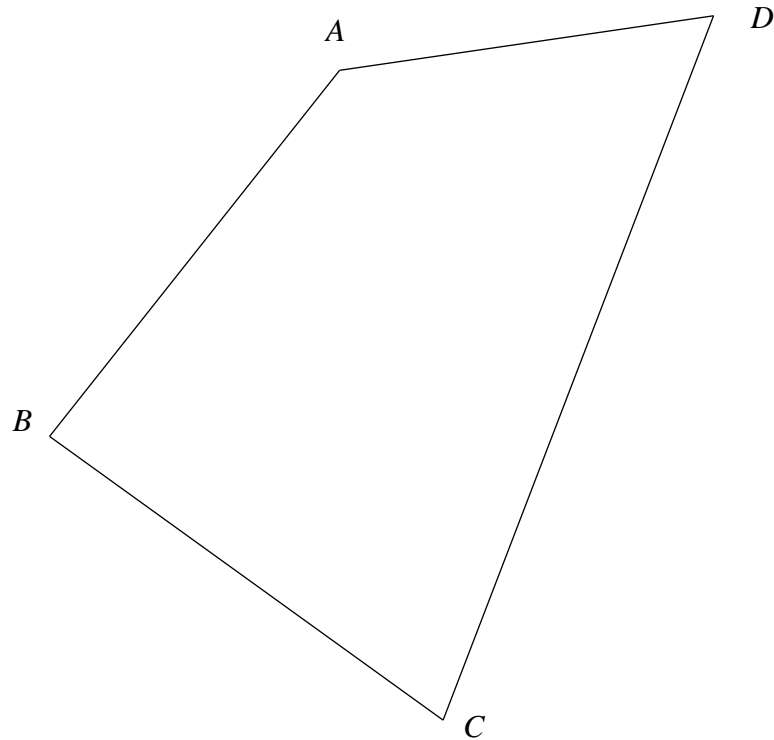Use vectors to show that $\overrightarrow{RS}$ and $\overrightarrow{AB}$ are parallel.

Answer …………………………………………...………………………

………………………………………………...………………………………….   [1]

17 The scale drawing in the answer space below shows a park *ABCD*.

On the diagram,

(a) construct the perpendicular bisector of *CD*, [1]

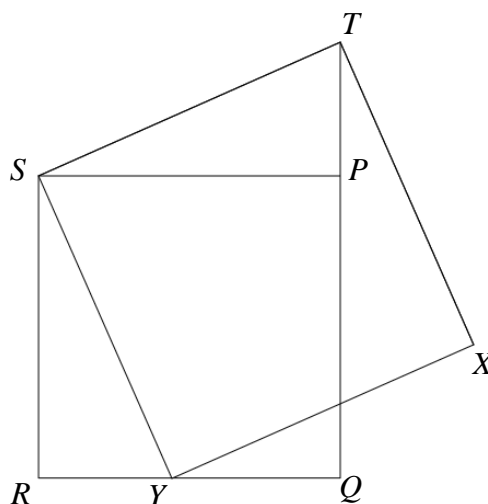**(b)** construct the bisector of angle *BAD*. [1]

Answer

(c) A playground is located at the intersection of the perpendicular bisector of *CD* and the bisector of angle *BAD*.

Complete the statement.

The playground is equidistant from the points …………..… and ….…………

and equidistant from lines ………..………… and ………..………..……….. [2]

18 In the diagram, *PQRS* and *STXY* are squares.
It is given that *QPT* and *RYQ* are straight lines.
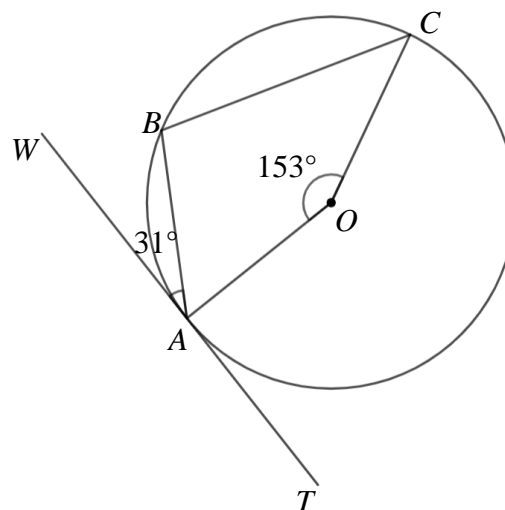

(a) Show that angle *RSY* = angle *PST*.

Answer ………..………………………………………………………………..

………..………..………………………………………………...………………..

………..………..………………………………………………...………………..   [1]

(b) Hence, prove that triangle *RSY* is congruent to triangle *PST*.

Answer ………..………………………………………………………………..

………..………..………………………………………………...………………..

………..………..………………………………………………...………………..   [2]

19 In the diagram, *A*, *B* and *C* lie on a circle with centre *O*.

WT is a tangent to the circle at the point *A*.

Given that angle *AOC* = 153° and angle *BAW* = 31°, find

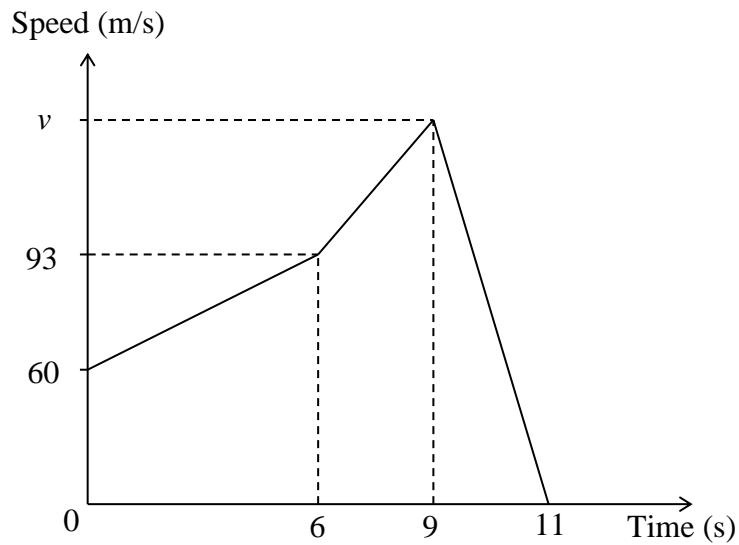**(a)** angle *ABC*,

Answer ………..……………………… [2]

(b) angle *BCO*.

Answer ………..……………………… [2]

20 The following diagram is the speed-time graph of a particle over a period of 11 seconds.

(a) Calculate the acceleration of the particle in the first 6 seconds.
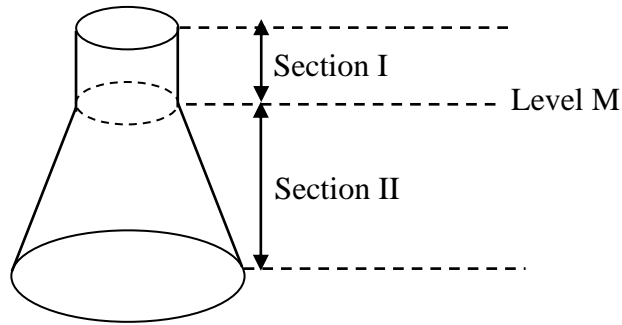
Answer ………..………………… m/s² [1]

(b) Calculate the speed of the particle at $t = 4$s.

Answer ………..………………… m/s [1]

(c) Calculate the greatest speed, v m/s, of the particle, given that the particle travelled 342 m from $t = 6$s to $t = 9$s.

Answer $v =$ ………..………………..… [2]

21 The diagram below shows a Flask X.
Flask X is made up of Section I and Section II.

**(a)** Flask X is initially completely filled with water.
There is a small hole at the bottom of Flask X and water is leaking through the hole at a constant rate.

It takes 13 minutes for the depth of the water to reach Level M.
It takes 52 minutes for Flask X to be empty.

On the axes in the answer space, sketch the graph showing how the depth of the water in Flask X varies over the 52 minutes.
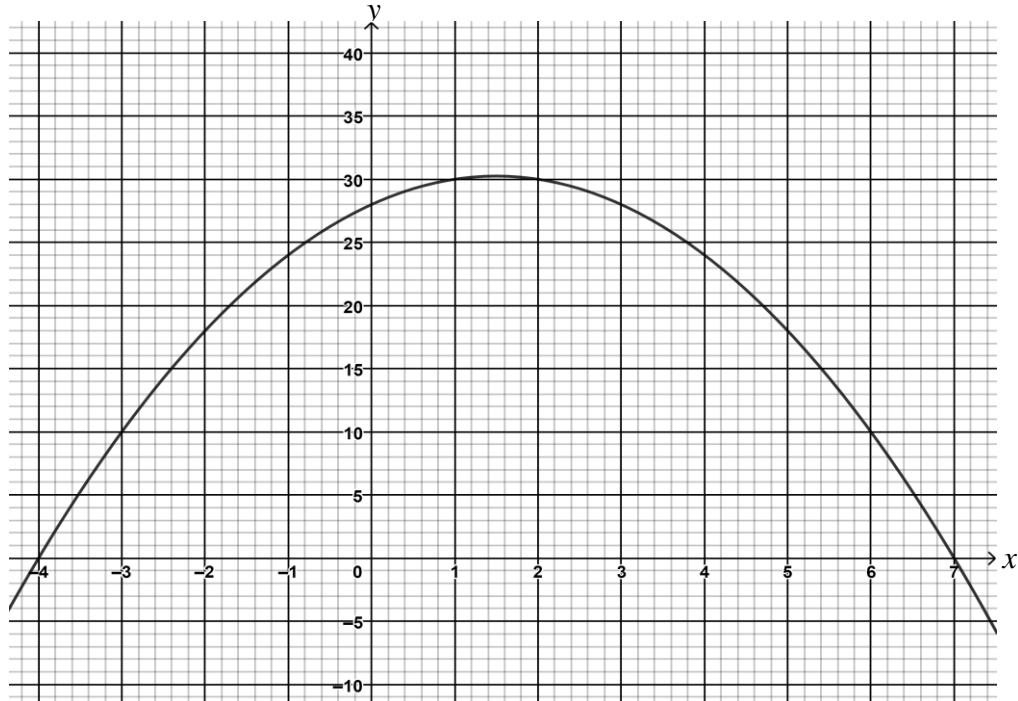
Answer
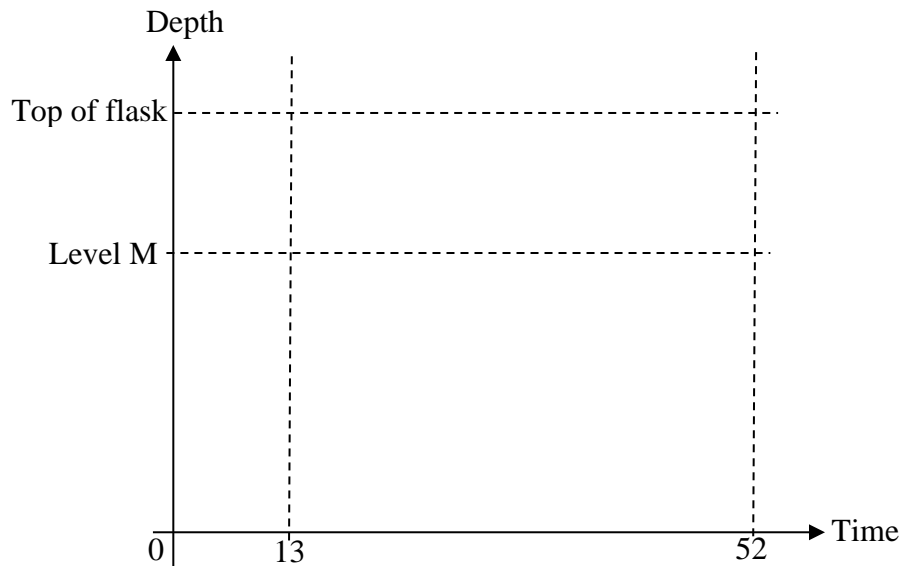
[2]

(b)   Flask X is geometrically similar to Flask Y.
The capacity of Flask X is 960 cm^3 and the capacity of Flask Y is 1875 cm^3.
Given that the base area of Flask Y is 50 cm^2, find the base area of Flask X.

Answer ………..…………..……… cm^2 [2]

22 In an experiment to study the projectile motion of a ball, a ball is thrown off the top of a tall building.

At any instance, the horizontal distance of the ball from the building is x metres and the height of the ball above the ground is y metres. x and y are related by the equation $y = -x^2 + 3x + 28$. The graph of $y = -x^2 + 3x + 28$ is shown below.

(a) Write down the equation of the line of symmetry of the curve.

Answer …………………………………… [1]

(b) By drawing a tangent, find the gradient of the graph at (3, 28).

Answer …………………………………… [2]

(c) By drawing a suitable line on the graph, explain why the height of the ball will never reach 35m.

Answer ……………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………… [2]

23 **(a)** Simplify

    (i) $7q - 2(q + 3)$,

Answer ………..………………………… [1]

    (ii) $\dfrac{xy^{-1}}{\left(2y^2\right)^3}$.

Answer ………..………………………… [2]

(b) Write as a single fraction in its simplest form $\dfrac{7y}{(y-3)^2} - \dfrac{1}{3-y}$.

Answer ………..……………………… [2]

24 Factorise completely

(a) $8y^2 + 20y - 12$,

Answer ………..……………………… [2]

(b) $x^3 + x^2 - 9x - 9$.

Answer ………..……………………… [3]

25 A box contains $4x$ blue balls and $3x$ red balls. A ball is to be drawn at random from the bag.

(a) Write down the probability that this ball is red.

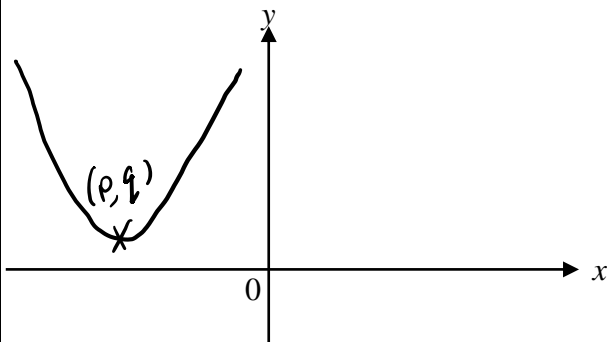*Answer* ………..………………………… [1]

This ball is red and is not replaced in the box.

(b) Write down an expression, in terms of x, for the probability that the next ball drawn from the box will be red.

Answer ………..………………………… [1]

(c) The probability that both balls are red is $\dfrac{6}{35}$. Find the value of x.

Answer ………..………………………… [3]

End of paper

Answers for checking:

Qn	Solution
1	69.5 g
2	The inconsistent scale on the vertical axis <u>exaggerates the differences</u> in crude birth rate between the years. **OR** It is <u>not clear whether the height or the area</u> of the baby picture <u>should be used</u> to compare the crude birth rate. **OR** The <u>area of each baby picture is not directly proportional to its height</u>.
3	1.81148×10^{-6} m
4	$126\ cm/s$
5	$L = \dfrac{5}{3} A^2$
6	
7	Oliver's **78 marks is within top 25% of the class for the history test but below the top 25% of the class for the science test**. Hence, Oliver did better for the **history test**. **OR** Oliver's **78 marks is above the 75th percentile for the history test but below the 75th percentile of the class for the science test**. Hence, Oliver did better for the **history test**.
8	USD 1535
9(a)	3.145%
9(b)	57 students
10(a)	191 cm
10(b)	3.2 m²
11(a)	$2^3 \times 3^6$
11(c)	k = 2
12(a)	9, 15, 21, 27
13(a)	$-1 \le x < 1$
13(b)	$-1, 0$
15(a)(i)	$A \cap B = \{3,5\}$
15(a)(ii)	**(a)** $8 \notin$ A **(b)** $\{15\} \subset$ B
15(b)	$P \cup Q'$
16(a)	$\begin{pmatrix} 1 \\ -3 \end{pmatrix}$
16(b)	3.16 units

17(c)	The playground is equidistant from the points **C** and **D** and equidistant from lines *AB* and *AD*.
19(a)	**103.5°**
19(b)	44.5°
20(a)	5.5m/s^2
20(b)	$p = 82\text{m/s}$
20(c)	$v = 135$

21(a)	
21(b)	32 cm^2
22(a)	$x = 1.5$
22(b)	-3
22(c)	the height of the ball will never reach 35m
23(a)(i)	$5q - 6$
23(a)(ii)	$\dfrac{x}{8y^7}$
23(b)	$\dfrac{8y - 3}{(y - 3)^2}$
24(a)	$4(2y - 1)(y + 3)$
24(b)	$(x + 1)(x + 3)(x - 3)$
25(a)	$\dfrac{3}{7}$
25(b)	$\dfrac{3x - 1}{7x - 1}$
25(c)	$x = 3$