KRANJI SECONDARY SCHOOL

2E
Session 1

END-OF-YEAR EXAMINATIONS 2021

MATHEMATICS 4052

PAPER 2

Level : Secondary Two **Date** : 4 October 2021

Stream : Express **Duration** : 1 hour 30 minutes

Name : _____ ( ) **Marks** : 60

Class : Secondary 2 _____

READ THESE INSTRUCTIONS FIRST:

Write your name, class and register number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use 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 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 60.

Set by: Ms Madeleine Chew

This question paper consists of 17 printed pages, including the cover page.
[Turn over

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

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

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

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

Trigonometry

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

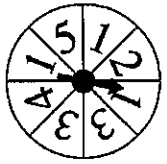
$$a^2 = b^2 + c^2 - 2bc\cos A$$

Statistics

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

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

1 The diagram shows a spinner with eight numbered sectors.
Each time the pointer is spun, it is equally likely to stop at any of the sectors.



The pointer is spun once.
Find, giving your answer as a fraction in its simplest form, the probability that

(a) the spinner stops at the number 4.

$\frac{1}{8}$

Answer ..... [1]

(b) the spinner stops at a prime number.

$\frac{4}{8} = \frac{1}{2}$

$\frac{1}{2}$

Answer ..... [1]

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2 The first four terms in a sequence are as follows:

93, 89, 85, 81, ...

(a) Write down the 6th term of the sequence.

93, 89, 85, 81, 77, 73 73

Answer ..... [1]

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

$97-4n$

Answer ..... [1]

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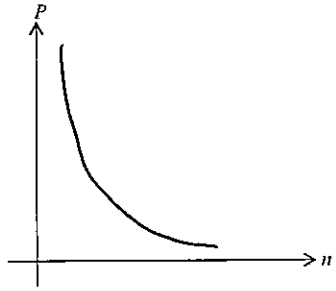
3 P is inversely proportional to n.

(a) Sketch the graph of P against n.

Answer [1]



It is given that $P = 120$ when $n = 5$.

(b) Form an equation connecting P and n.

let $P = \frac{k}{n}$, where k is a constant

$120 = \frac{k}{5}$

$k = 600$

$P = \frac{600}{n}$

OR $n = \frac{600}{P}$

$P = \frac{600}{n}$

Answer ..... [2]

(c) Find the value of n when $P = 150$.

$150 = \frac{600}{n}$

$n = \frac{600}{150}$

$= 4$

Answer $n =$ 4 ..... [2]

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4 (a) Expand and simplify $(3y-1)^2-(y+2)$.

$(3y-1)^2-(y+2)$

$= 9y^2-2(2y)+1-y-2$

$= 9y^2-7y-1$

Answer $9y^2-7y-1$ [2]

(b) Simplify $\frac{6a}{7bc} \div \frac{3a^2}{14c}$.

$\frac{6a}{7bc} \div \frac{3a^2}{14c}$

$= \frac{\cancel{2}6a}{7b\cancel{c}} \times \frac{\cancel{2}14\cancel{c}}{3a^{\cancel{2}}}$

$= \frac{4}{ab}$

Answer $\frac{4}{ab}$ [2]

(c) Write as a single fraction in its simplest form $\frac{5}{(2x+1)^2}+\frac{2}{2x+1}$.

$\frac{5}{(2x+1)^2}+\frac{2}{2x+1}$

$= \frac{5}{(2x+1)^2}+\frac{2(2x+1)}{(2x+1)^2}$

$= \frac{5+2(2x+1)}{(2x+1)^2}$

$= \frac{4x+7}{(2x+1)^2}$

Answer $\frac{4x+7}{(2x+1)^2}$ [2]

(d) Rearrange the formula $5bm = 2m + 3b$ to make m the subject.

$5bm = 2m + 3b$

$5bm - 2m = 3b$

$m(5b-2) = 3b$

$m = \frac{3b}{5b-2}$

Answer $m = \frac{3b}{5b-2}$ [2]

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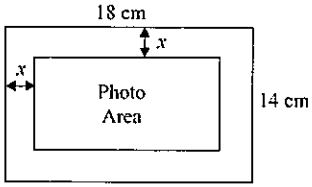
5 A rectangular photo frame measures 18 cm by 14 cm.
It has a border of uniform width x cm, as shown below.



(a) Write down an expression, in terms of x, for

(i) the length of the photo,

Answer $(18-2x)$ cm [1]

(ii) the width of the photo,

Answer $(14-2x)$ cm [1]

(b) The photo area is 140 cm^2.
Write down an equation in x to represent this information, and show that it reduces to $x^2 - 16x + 28 = 0$.

Answer

$(18-2x)(14-2x) = 140$

$252 - 28x - 36x + 4x^2 = 140$

$4x^2 - 64x + 112 = 0$

$x^2 - 16x + 28 = 0$ (shown)

[3]

(c) Solve the equation $x^2 - 16x + 28 = 0$.

$x^2 - 16x + 28 = 0$

$(x-14)(x-2) = 0$

$x = 14$ or $x = 2$

Answer $x =$ 14 or $x =$ 2 [2]

(d) Find the length of the photo.

reject $x = 14$ as length > 0

$\therefore$ length of photo $= 18 - 2(2)$
$= 14$ cm

Answer 14 cm [2]

6 The speed, v, in metres per second of a ball is modelled by the equation $v = 5 + 4t - t^2$, where t is the time in seconds travelled by the ball.

Some corresponding values of t and v are given in the table below.

t	0	1	2	3	4	5
v	5	s	9	8	5	0

(a) Calculate the value of s.

when $t = 1$,

$s = 5 + 4(1) - (1)^2$

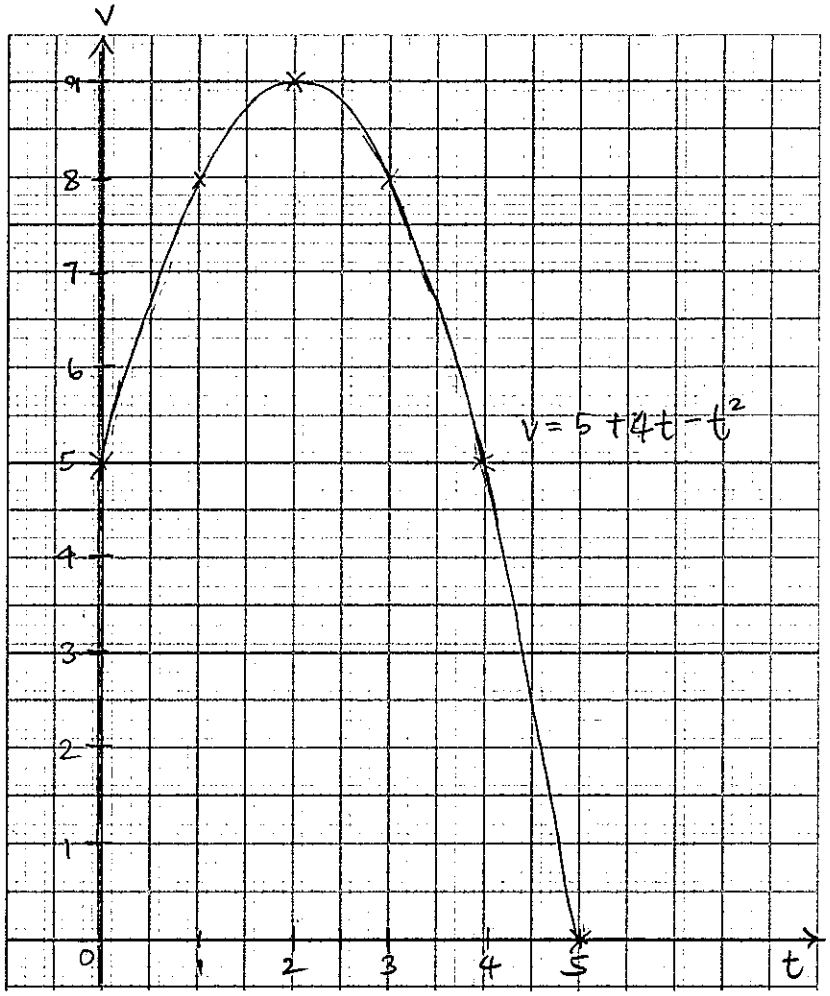
$= 8$

Answer $s =$ 8 [1]

(b) On the grid on page 9, using a scale of 2 cm to represent 1 second, draw a horizontal t-axis for $0 \le t \le 5$, and using a scale of 2 cm to represent 1 m/s, draw a vertical v-axis for $0 \le v \le 9$.
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 maximum speed of the ball.

Answer 9 m/s [1]



7 **(a)** In **Figure 1**, triangle ABC is congruent to triangle EDC.
$AB = ED$, $BC = DC$ and angle $ACB = 90°$.
DCB is a straight line.

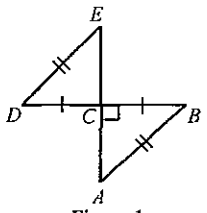


Figure 1

Explain why DE is parallel to AB by completing the following sentences.

Answer

Angle DEC = Angle ..... BAC .....

Hence, they form a pair of ..... alternate ..... angles between parallel lines. Thus DE is parallel to AB. [2]

(b) In **Figure 2**, triangle PQR is similar to triangle PTS.

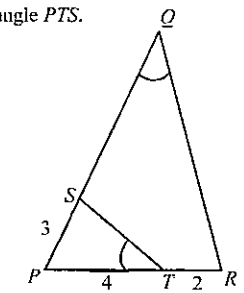


Figure 2

Given that $PS = 3$ cm, $PT = 4$ cm and $TR = 2$ cm, find the length of QS.

$\frac{PQ}{PT} = \frac{QR}{TS} = \frac{PR}{PS}$

$\frac{PQ}{PT} = \frac{PR}{PS}$

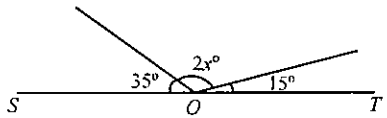
$\frac{PQ}{4} = \frac{4+2}{3}$

$PQ = \frac{6}{3} \times 4$
$= 8$ cm

$QS = 8 - 3$
$= 5$ cm

Answer ..... 5 ..... cm [2]

8 (a) In the diagram below, SOT is a straight line. Calculate the value of x.

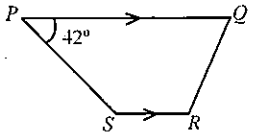


$35 + 2x + 15 = 180$

$x = 65$

Answer $x =$ 65 [2]

(b) $PQRS$ is a trapezium. PQ is parallel to SR and angle $QPS = 42°$.



(i) Find the value of angle PSR, stating your reason clearly.

$\angle PSR = 180° - 42°$

$= 138°$

Answer 138° [1]

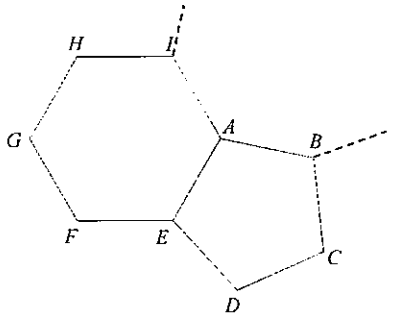
Reason: interior angles, PQ // SR [1]

(ii) It is given that $PQ = 13$ cm, $SR = 5$ cm and the perpendicular height from R to PQ is 7 cm. Find the area of the trapezium $PQRS$.

$\frac{1}{2} \times (13 + 5) \times 7 = 63$

Answer 63 cm² [2]

(c) A regular pentagon $ABCDE$ and a regular hexagon $AEFGHI$ are joined together along AE, the common side, to form the following figure.



Calculate the value of the angle BAI.

Interior angle (pentagon) $= \frac{(5-2) \times 180°}{5}$

$= 108°$

Interior angle (hexagon) $= \frac{(6-2) \times 180°}{6}$

$= 120°$

$\angle BAI = 360° - 108° - 120°$

$= 132°$

Answer 132° [3]

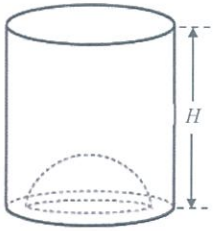
9 A soda can may be modelled as a cylinder with a closed top and a hollow hemisphere hollowed in at the base of the can as shown in the diagram below.

Information about the model of the soda can is given below.

Height (H) = 12.4 cm

Inner Diameter (D_1) of base = 6.7 cm

Outer diameter (D_2) of base = 7.9 cm



Using the model of the soda can in the diagram above, calculate

(a) the volume, in cubic centimetres, of the soda can.

Vol. of soda can $= \pi\left(\frac{7.9}{2}\right)^2(12.4) - \frac{2}{3}\pi\left(\frac{6.7}{2}\right)^3$

$= 529.067503$

$= 529\ cm^3$ (3 s.f.)

Answer 529 cm³ [3]

(b) the total surface area, in square centimetres, of the soda can.

Total surface area of soda can

$= \pi\left(\frac{7.9}{2}\right)^2 + 2\pi\left(\frac{7.9}{2}\right)(12.4) + \left[\pi\left(\frac{7.9}{2}\right)^2 - \pi\left(\frac{6.7}{2}\right)^2\right] + 2\pi\left(\frac{6.7}{2}\right)^2$

$= 441.0403387$

$= 441\ cm^2$ (3 s.f.)

Answer 441 cm² [5]

10 A cab fare is calculated using the distance travelled and the waiting time. Waiting time refers to the time when the cab is stationary. Depending on the time of travel, the cab fare is subjected to surcharges which are additional costs.

For Question 10, refer to the following rates and charges of a normal cab from the Comfort® Transportation Company.

Rates and Charges of a Normal Cab from Comfort® Transportation Company

Metered Fare	
The first 1 km or less (Flag Down)	
• Hyundai Sonata Taxis	$3.20
• Hyundai i-40 Taxis	$3.70
• Toyota Prius/ Hyundai Ioniq Taxis	$3.90
Every 400 m thereafter or less up to 10km	$0.22
Every 350 m thereafter or less after 10km	$0.22
Every 45 seconds of waiting or less	$0.22

Booking Charges		
Current Booking*		
Peak Period		$3.30
Monday to Friday (Except Public Holidays):	6.00 am – 9.29 am	
Monday to Sunday & Public Holidays:	6.00 pm – 11.59 pm	
All Other Times		$2.30

** Applicable at the time booking job is confirmed*

Surcharges		
Peak Period Surcharge		
Monday to Friday (Except Public Holidays):	6.00 am – 9.29 am	25% of metered fare
Monday to Sunday & Public Holidays:	6.00 pm – 11.59 pm	
Late Night Surcharges		
Midnight – Before 5.59am		50% of metered fare

Source: Comfort® Transportation Pte Ltd website: https://www.cdgtaxi.com.sg

10 On a Monday school day (non public holiday), Melanie flagged down a Toyota Prius cab at 7am. She travelled for 10 km. Throughout the journey, there was a total waiting time of 5 minutes.

(i) Calculate the amount of metered fare she paid for the 5 minutes waiting time.

Waiting time = $\frac{5 \times 60}{45}$

= 6.67 (3 s.f.)

∴ 7 sets of 45 sec.

7 × $0.22 = $1.54

Answer $ 1.54 [2]

(ii) Show that Melanie's total cab fare is $13.13, corrected to the nearest cent.

Answer

First 1 km = $3.90

Remaining dist. = 10 − 1

= 9 km

Remaining 9km

= $\frac{9 \times 1000}{400}$

= 22.5

∴ 23 sets of 400M

23 × $0.22 = $5.06

Peak hr surcharge = 25%

Total cab fare = $\frac{125}{100}$ × (3.90 + 5.06 + 1.54) [4]

= $13.125

= $13.13 (nearest cent), shown.

(iii) Comfort® Transportation Company has a promotion:

Enjoy 30% discount
when you book a cab and pay with a credit card.

For the same trip, will it be cheaper for Melanie to book a Toyota Prius cab and pay with a credit card?
Justify your answer with mathematical calculations.

Answer

Now total cab fare

$= \frac{70}{100} \times (13.13 + 3.30)$

$= \$11.50$ (nearest cent)

Since the promotion cost, $11.50, is less than the original cost, $13.13, it is cheaper for Melanie to book and pay with credit card.

[2]

End of paper