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GREENRIDGE SECONDARY SCHOOL
2024 PRELIMINARY EXAMINATION
SECONDARY 4 NORMAL (ACADEMIC)

CANDIDATE NAME

CLASS - INDEX NUMBER

MATHEMATICS SYLLABUS A 4045/02

Paper 2 6 August 2024

Setter: Mrs Goh-Kok Mei Leng 2 hours

Candidates answer on the Question Paper.

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

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

Answer **all** the questions.
The number of marks is given in brackets [ ] at the end of each question or part question.

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 total of the marks for this paper is 70.

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.

For Examiner's Use	
Total	70

[Turn over

This paper consists of **19** printed pages, including this cover page.

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 **(a)** Express $7\frac{1}{5}$ as a percentage.

$= 7.2 \times 100$

$= 720\ \%$

Answer 720 % [1]

(b) Express 40.4% as a fraction in its simplest form.

$\frac{40.4}{100}$

$= \frac{404}{1000}$

$= \frac{101}{250}$

Answer $\frac{101}{250}$ [1]

(c) Simplify $\frac{32x^3y^2}{8} \times \frac{5x^3}{20y^6}$.

$= \frac{32x^3y^2}{8} \times \frac{5x^3}{20y^6}$

$= \frac{x^6}{y^4}$

Im - numerical value

Im - variables

Answer $\frac{x^6}{y^4}$ [2]

(d) Simplify $\frac{25x^2-4}{6+15x}$.

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

$= \frac{(5x-2)(5x+2)}{3(2+5x)}$ (Im)

$= \frac{5x-2}{3}$ (Im)

Answer $\frac{5x-2}{3}$ [2]

2 **(a)** Write as a single fraction in its simplest form $\frac{5x}{6}-\frac{1-x}{4}$.

$= \frac{2(5x) - 3(1-x)}{12}$ (1m)

$\frac{10x - 3 + 3x}{12}$

$= \frac{13x - 3}{12}$ (1m)

Answer $\frac{13x-3}{12}$ [2]

(b) Solve the equation $\frac{6}{2-5x}=\frac{1}{3}$.

$6(3) = 1(2-5x)$ (1m)

$18 = 2 - 5x$

$5x = -16$

$x = \frac{-16}{5}$

$= -3\frac{1}{5}$ (1m)

Answer $-3\frac{1}{5}$ [2]

(c) It is given that $x=\frac{a^2-5}{b}$.

(i) Find the value of x when $a = 5$ and $b = 2$.

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

$= \frac{20}{2}$

$= 10$ (1m)

Answer 10 [2]

(ii) Express a in terms of b and x.

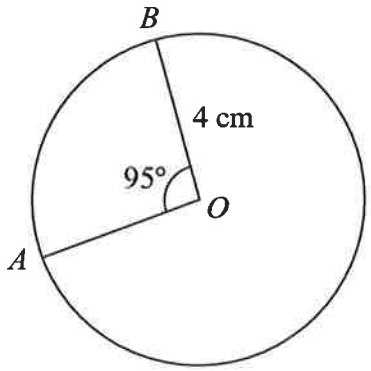
$a^2 - 5 = xb$

$a^2 = xb + 5$

$a = \pm\sqrt{xb+5}$

Answer $a = \pm\sqrt{xb+5}$ [1]

3 A circle with centre O has a radius of 4 cm. A and B are points on the circumference of the circle. Given that $\angle AOB = 95°$, calculate



(a) the circumference of the circle,

Circumference $= 2\pi r$
$= 2\pi(4)$
$= 8\pi$ or 25.133
$= 25.1$ cm (3sf)

Answer 25.1 cm [1]

(b) the perimeter of the minor arc AOB,

Arc AB $= \frac{95}{360} \times 2\pi(4)$
$= 6.632$ (1m)
Perimeter $= 6.632 + 4 + 4$
$= 14.632$
$= 14.6$ cm (3sf) (1m)

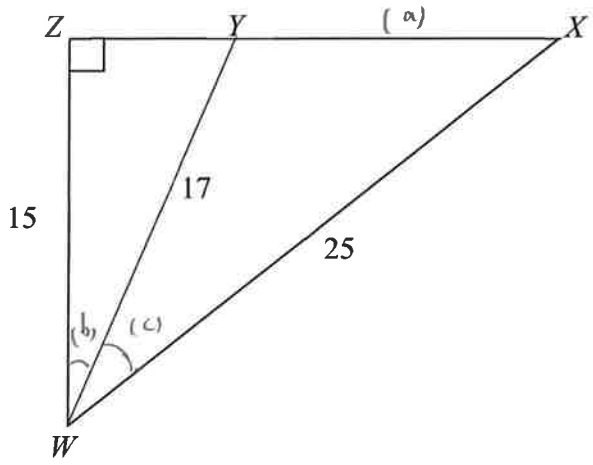
Answer 14.6 cm [2]

(c) the area of the minor sector AOB.

Area of sector $= \frac{95}{360} \times \pi(4)^2$ (1m)
$= 13.26$
$= 13.3$ cm^2 (3sf) (1m)

Answer 13.3 cm^2 [2]

4 In the diagram, XYZ is a straight line, $WX = 25$ cm, $WY = 17$ cm and $WZ = 15$ cm. It is given that angle $XZW = 90°$. Calculate



(a) the length of XY,

In if either YZ or XZ correct

$YZ^2 = 17^2 - 5^2$
$YZ = \sqrt{64}$
$= 8$ cm

$XZ^2 = 25^2 - 15^2$
$XZ = \sqrt{400} = 20$ cm

$\therefore XY = 20 - 8$
$= 12$ cm

Answer 12 cm [2]

(b) angle ZWY,

$\cos ZWY = \frac{15}{17}$

$\angle ZWY = 28.072°$
$= 28.1°$ (1 dp)

Answer Angle ZWY = 28.1 [1]

(c) angle YWX,

$\cos ZWX = \frac{15}{25}$

$\angle ZWX = 53.13°$

$\angle YWX = 53.13 - 28.07$
$= 25.06°$
$= 25.1°$ (1 dp)

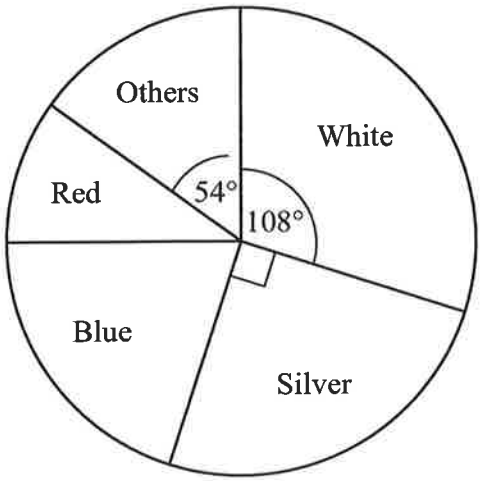
Answer Angle YWX = 25.1° [2]

(d) the area of triangle WXY.

Area of $\triangle WXY = \frac{1}{2} \times 12 \times 15$
$= 90$ cm^2

Answer 90 cm^2 [1]

5 Kevin recorded the colour of cars that entered a carpark in an hour.
The pie chart shows his results.



(a) There were twice as many blue cars as red cars.
Find the angle representing blue cars.

Blue : Red = 2 : 1

3 parts = 360° − 54 − 108 − 90

= 108°

∴ 1 part = $\frac{108°}{3}$ = 36° (1m)

Angle for blue cars = 36° × 2

= 72° (1m)

Answer 72° [2]

(b) Given that there were 66 white cars, find the total number of cars in the survey.

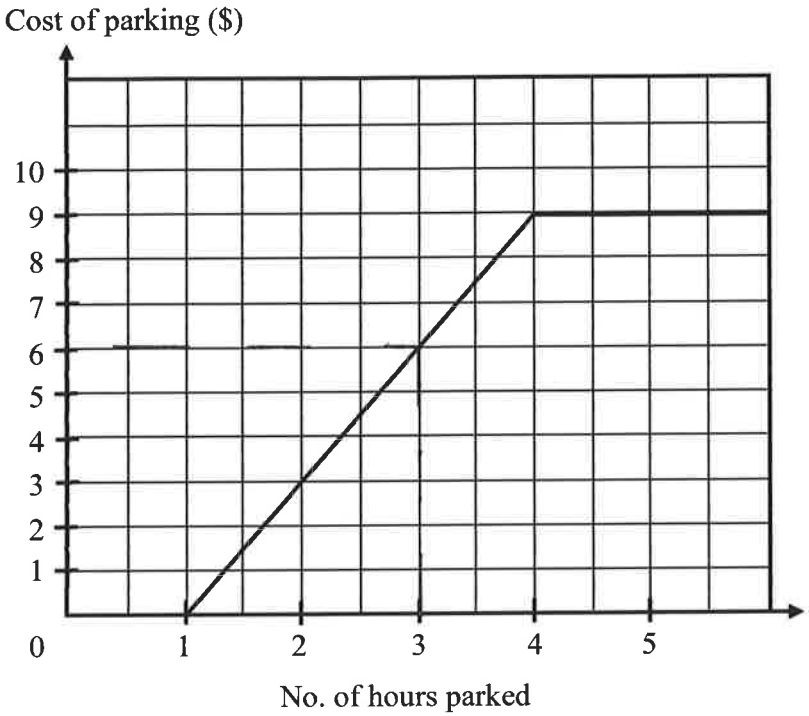
108° → 66 cars (1m)

Total no. of cars = $\frac{66}{108} \times 360$

= 220 (1m)

Answer 220 [2]

6 The graph shows the parking fees charged by a shopping mall. Find



(a) the maximum number of minutes that the shopping mall offered free parking,

Answer ..... 60 ..... minutes [1]

(b) the duration a car is in the carpark if the parking cost is $6,

Answer ..... 3 ..... hours [1]

(c) the cost of parking if a person parks his car for 4.5 hours,

Answer $ ..... 9.00 ..... [1]

(d) the least number of hours he has parked if the person has paid $9.00 for the parking.

Answer ..... 4 ..... hours [1]

7 **(a)** The scale of a map is 1 : 40 000.

(i) The distance between two railway stations is 8 cm on a map.
Find, in kilometres, the actual distance between the stations.

1 cm : 40 000 cm
1 m : 0.4 km (1m)
∴ 8 cm represents 8 × 0.4
= 3.2 km (1m)

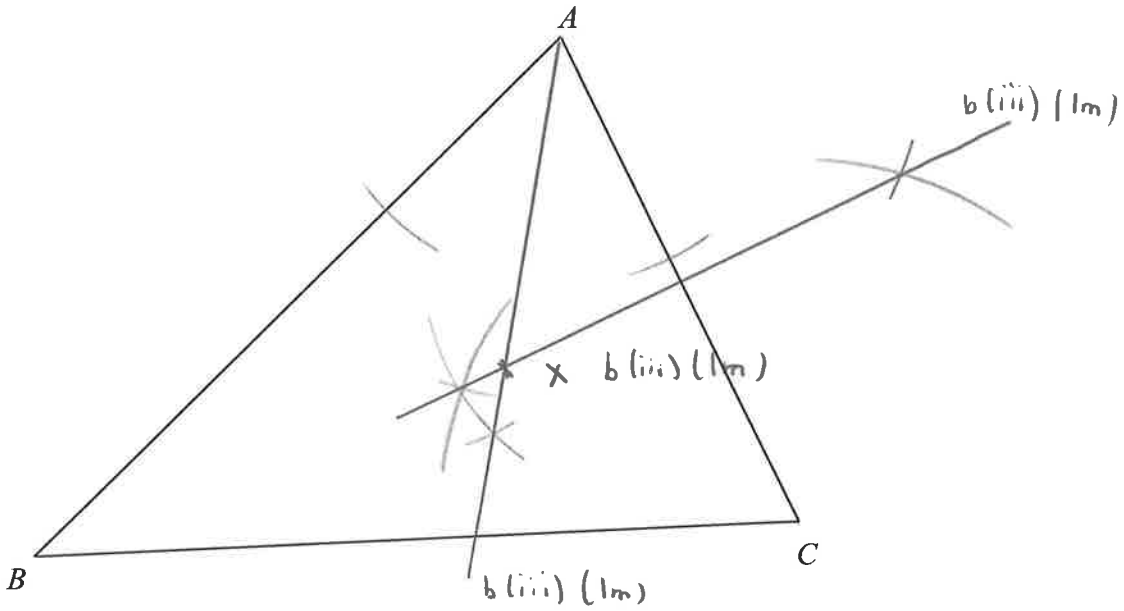
Answer 3.2 km [2]

(ii) A field has an area of 90 km^2.
Find the area of the field on the map in square centimetres.

0.4 km : 1 cm
1 km : $\frac{1}{0.4}$ = 2.5 cm
1 km^2 : 2.5^2 cm^2 (1m)
= 6.25 cm^2
∴ Area of track = 90 × 6.25
= 562.5 cm^2 (1m)

Answer 562.5 cm^2 [2]

7b



(b) The point X is the point of intersection of the bisector of angle CAB and the perpendicular bisector of AC.

(i) Measure angle ABC.

Answer angle ABC = ...42°.... [2]

(ii) Construct the bisector of angle CAB and the perpendicular bisector of AC. Hence, label the point X. [3]

(iii) Measure and write down the length of AX.

Answer AX = ...4.4 cm.... [1]

8 Mr Lim bought x shirts, each at the same price, for a total cost of \$168.

(a) Write down an expression for the cost of each shirt in terms of x.

Answer \$ $\frac{168}{x}$ [1]

Mr Lim bought $(x+5)$ pairs of slacks, each at the same price, for a total cost of \$450.

(b) Write down an expression for the cost of each pair of slacks in terms of x.

Answer \$ $\frac{450}{x+5}$ [1]

(c) If 2 shirts and a pair of slacks cost \$134 altogether, form an equation in x and show that it reduces to $67x^2 - 58x - 840 = 0$.

$2\left(\frac{168}{x}\right) + \left(\frac{450}{x+5}\right) = 134$ (1m)

$336(x+5) + 450x = 134x(x+5)$ (1m)

$336x + 1680 + 450x = 134x^2 + 670x$

$134x^2 + 670x - 786x - 1680 = 0$

$\div 2$ $67x^2 - 58x - 840 = 0$ (shown) (1m)

Answer ..... [3]

(d) Solve the equation $67x^2 - 58x - 840 = 0$.

$x = \frac{-(-58) \pm \sqrt{(-58)^2 - 4(67)(-840)}}{2(67)}$ (1m)

$= \frac{58 \pm \sqrt{228\,484}}{134}$

$= \frac{58 \pm 478}{134}$

$= 4$ or -3.134

$= -3.13$ (3 s.f.) (1m)

Answer 4 or -3.13 [2]

9 A ball was thrown from the top of a vertical tower.
The height, h metres, of the ball **above the top of the tower** at a time t seconds after it was thrown is given by the equation $h = 22t - 5t^2$.

This is a table of values for $h = 22t - 5t^2$.

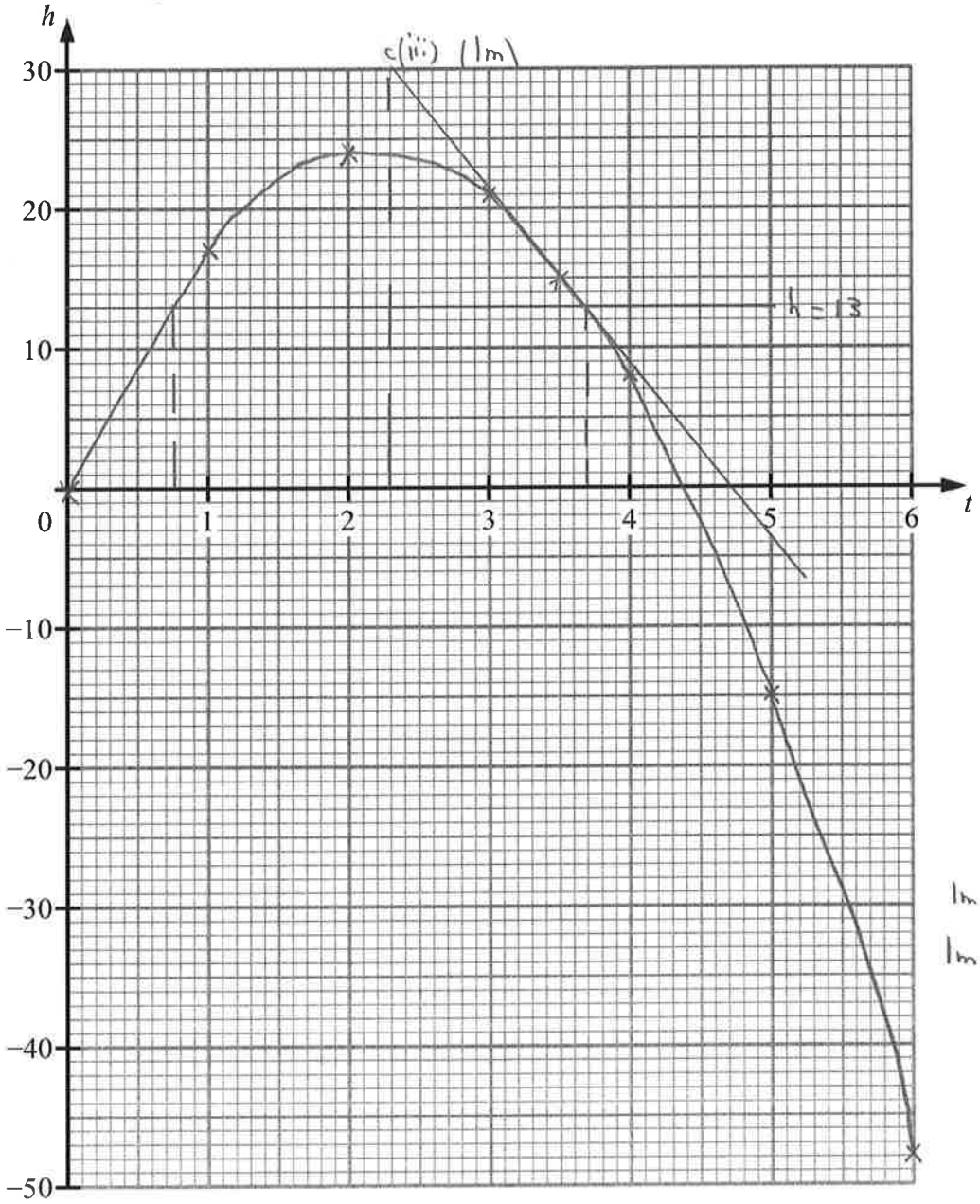
t	0	1	2	3	4	5	6
h	0	17	24	21	8	p	−48

(a) Calculate the value of p.

$p = 22(5) - 5(5)^2$
$= 110 - 125$
$= -15$

Answer $p =$ ..... −15 ..... [1]

(b) Draw the graph of $h = 22t - 5t^2$ for $0 \le t \le 6$.



1m - plotting 6 pts
1m - smooth curve

[2]

(c) Use your graph to find

(i) the greatest height of the ball above the top of the tower,

Answer ..... 24 ± 0.1 ..... m [1]

(ii) the time when the ball was 13 metres above the top of the tower.

Answer ..... 0.75 or 3.7 ± 0.1 ..... s [1]

(iii) By drawing a tangent, estimate the gradient of the graph of $h = 22t - 5t^2$ when $t = 3.5$.

$$m = \frac{30}{4.7 - 2.3}$$

$$= -12.5 \quad (\pm 1) \quad (1m)$$

Correct tangent – (1m)

Answer ..... -12.5 ..... [2]

10 Peter stays in Punggol and goes to school in Bukit Timah. He has to take the train every morning at Punggol MRT station to Tan Kah Kee MRT station. He wants to find the fastest route from home to school. Tables 1 and 2 are two possible routes that he can take.

Table 1

Route 1

	MRT Stations	Time taken (min)	Distance between the stations (km)
North East Line	Punggol → Serangoon	11	7.6
Circle Line	Serangoon → Botanic Gardens	14	9.3
East West Line	Botanic Gardens → Tan Kah Kee	2	1.1

Table 2

Route 2

	MRT Stations	Time taken (min)	Distance between the stations (km)
North East Line	Punggol → Little India	21	13.2
East West Line	Little India → Tan Kah Kee	10	5.4

(a) Find the average speed, in km/h, of

(i) Route 1,

Speed = $\frac{7.6 + 9.3 + 1.1}{11 + 14 + 2} \times 60$

$= \frac{18}{27} \times 60 = 40$ km/h (1m)

Answer 40 km/h [1]

(ii) Route 2.

Speed = $\frac{13.2 + 5.4}{21 + 10} \times 60$

$= \frac{18.6}{31} \times 60 = 36$ km/h

Answer 36 km/h [1]

(b) Which route should Peter choose? Explain your answer.

Answer Time for route 1 = 27 min

Time for route 2 = 31 min

Peter should choose route 1 as the total time taken is 4 min shorter

or Average speed is faster by 4 km/h [2]

1m - evidence

1m - conclusion

(c)

Train Service Frequencies (in minutes)	
	Monday – Friday
Peak (6.30 a.m. to 9 a.m. & 5 p.m. to 7.30 p.m.)	3
Off-peak	5

Given that the first train arrival at Punggol MRT station is 05 42.

Using your answer in part **(b)**, calculate the latest train time that Peter needs to take to arrive in school by 07 15.

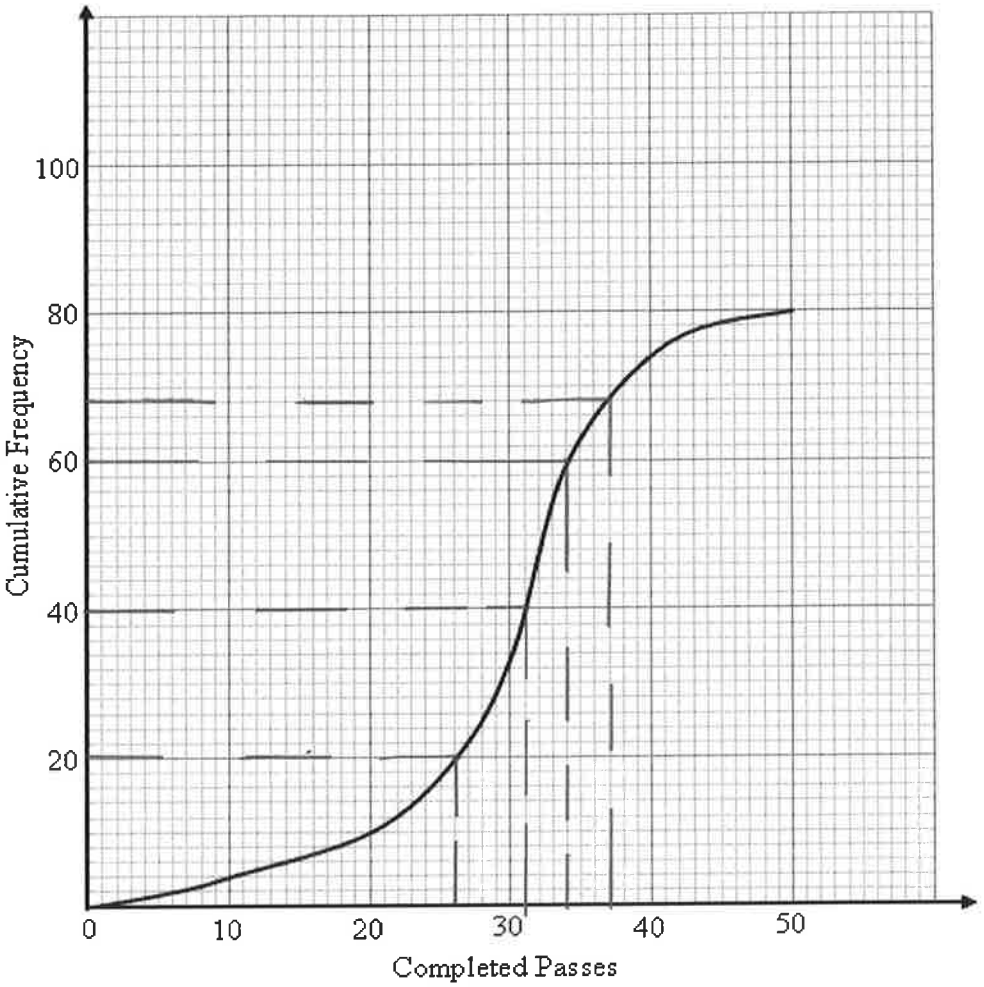
Latest time Peter has to be on the train = 07 15 − 00 27
= 06 48 (1m)

First train = 0542
Considering 5 min frequency for off peak (before 06 32)
= 0542 + 10(5) = 06 32
Considering 3 min frequency for peak (after 06 30)
= 06 32 + 5(3)
= 06 47 (1m)
∴ Latest train time Peter needs to take is 06 47

Answer ..... [2]

Section B (8 marks)
Answer **one** question from this section.

11 **(a)** The cumulative frequency graph shows the distribution of completed passes data taken from 80 different players in one of the World Cup Football Competition matches.



Use the graph to find

(i) the median,

Answer 31 [1]

(ii) the inter-quartile range,

Upper quartile = 34 } 1m
Lower quartile = 26 }
IQR = 34 - 26 = 8 (1m)

Answer 8 [2]

(iii) the number of players who scored at least 37 completed passes in their match.

No. scoring less than 37 passes = 68 (1m)
∴ No. scoring at least 37 passes = 80 - 68
= 12 (1m)

Answer 12 [2]

11 28 (6) The table below shows the marks obtained by 110 students from Alton Secondary School in the recent Science examinations.

Mark (x)	Frequency
$0 < x \leq 20$	4
$20 < x \leq 40$	16
$40 < x \leq 60$	45
$60 < x \leq 80$	30
$80 < x \leq 100$	15

(a) Calculate an estimation of the mean mark.

Mean $= \dfrac{10(4) + 30(16) + 50(45) + 70(30) + 90(15)}{110}$

$= \dfrac{6220}{110}$

$= 56\frac{6}{11}$ or 56.6 (3 sf)

Answer $56\frac{6}{11}$ or 56.6 ..... [1]

(b) Calculate the standard deviation.

$SD = \sqrt{\dfrac{4(10)^2 + 16(30)^2 + 45(50)^2 + 30(70)^2 + 15(90)^2}{110} - \left(\dfrac{6220}{110}\right)^2}$

$= 20.02$

$= 20.0$ marks (3 sf)

Answer 20.0 ..... [1]

(c) For Hilton Secondary, the mean mark was 53 and the standard deviation was 19. Which school's students performed more consistently for the examinations? Give a reason for your answer.

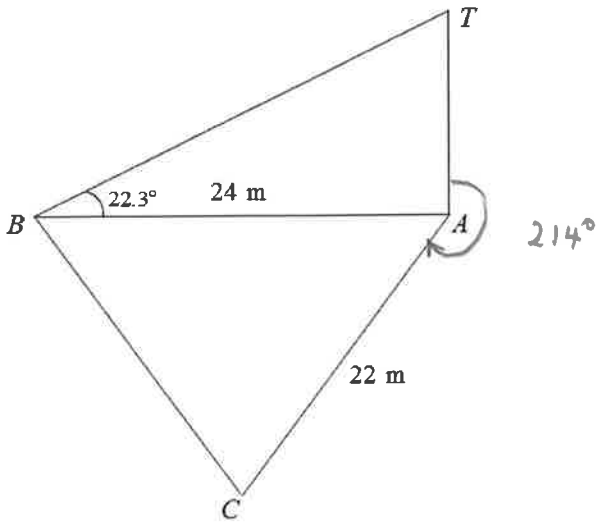
Answer

Students from Hilton Sec performed more consistently as the standard deviation of Hilton which is 19 is lower than that of Alton Sec which is 20.2 marks

1m- evidence
1m- conclusion [2]

End of Paper

12 (a) In the diagram, A is the foot of a cliff and B and C are boats in the sea. A is due east of B and the bearing of C from A is 214°. $AB = 24$ m and AC = 22 m.



(i) The angle of elevation of the top of the cliff, T, from B is 22.3°. Find the height of the cliff, TA.

$\tan 22.3° = \frac{TA}{24}$

$TA = 24 \tan 22.3°$

$= 9.843$

$= 9.84$ m (3 s.f.)

Answer 9.84 m [1]

(ii) Calculate angle BAC.

$\angle BAC = 360° - 214° - 90°$

$= 56°$

Answer angle BAC = 56° [1]

(iii) Find the distance BC.

$BC^2 = 24^2 + 22^2 - 2(24)(22) \cos 56°$ (1m)

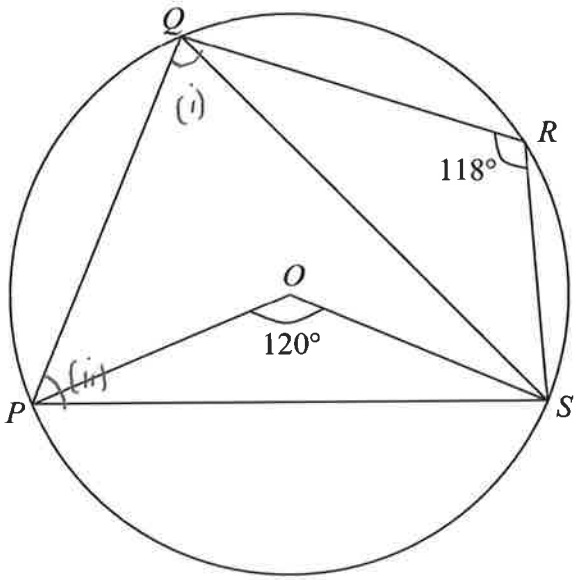
$= 469.49$

$\therefore BC = 21.67$

$= 21.7$ m (3 s.f.) (1m)

Answer BC = 21.7 m [2]

12 (b) In the diagram P, Q, R and S are four points on the circle centre, O. Given that angle $POS = 120°$ and angle $QRS = 118°$.
Find these angles, giving a reason for each.



(i) Angle PQS

Angle PQS = $\frac{120°}{2} = 60°$ Reason L at centre = twice L at circumference [2]

(ii) Angle QPS,

Angle QPS = $180° - 118° = 62°$ Reason Ls in opposite segment, cyclic quad: lateral [2]

End of Paper