



THE SCIENCE
ACADEMY

SECONDARY 3 ELEMENTARY MATHEMATICS TRIAL

E-

S3 E-MATHS

THE SCIENCE ACADEMY



Simple and Compound Interest - 1

James has gotten a job that pays him a salary of \$60 000 annually. He plans to purchase a car but calculates that he can only afford to set aside 30% of his monthly salary for the expenses incurred in owning the car.

- (a) Calculate the sum of money that James can afford to set aside monthly for the expenses incurred in owning the car.



Simple and Compound Interest - 2

Andy wants to buy a camera that costs \$4000. He was given two options to pay for the camera by the shop.

Option A:

A loan of \$4000 at a rate of 12% per annum compounded monthly.

- (a) Calculate
- (i) the interest Andy has to pay for one year,
 - (ii) the equivalent annual simple interest rate.



Simple and Compound Interest - 2

A 25% deposit, followed by 12 equal monthly payments of \$287.50.

- (b) Calculate
- (i) the deposit Andy has to pay under this option,
 - (ii) the extra amount Andy has to pay under this option.
- (c) Give a reason why Andy might choose
- (i) **Option A,**
 - (ii) **Option B.**

Andy's employer agrees to give him an interest free loan of \$4000 to buy the camera. The employer is to recover the money by making the following deductions from Andy's salary:

\$ x in the first month,

\$ y every subsequent month.

The total deductions after 20 months is \$1540 and after 30 months it is \$2140.

- (d) Find the value of x and of y .
- (e) How many months will it take for Andy to completely pay off the \$4000 loan?



Simple and Compound Interest - 1

He has set his eyes on two cars. He decides to take a loan from a bank for the purchase. He will repay the loan on a monthly basis. The details are given below:

	Brand A (used car)	Brand B (new car)
Engine capacity	1600 cc	1400 cc
Cost	\$80 000	\$90 000
Intended loan amount	50% of cost price	60% of cost price
Intended loan period	5 years	5 years
Type of interest	compound interest at 2.5% per year, compounded yearly	simple interest at 3% per year

The other major expenses in maintaining a car are as follows:

	Brand A (used car)	Brand B (new car)
Monthly parking fees	\$90	\$90
Monthly petrol expenditure	\$300	\$250
Annual road tax	\$744	\$626
Annual insurance	\$800	\$700
Car servicing (twice a year)	\$600 each round	\$500 each round

- (b) Recommend the brand of car that James can purchase, based on the sum of money he can afford to set aside monthly. Justify the decision you make and show your calculations clearly.



Trigonometry - 1

Figure 1 shows the three-dimensional layout of Roy's living room. The room is shaped like a cuboid with dimensions 4 m by 3.6 m by 3 m, where path MN lies across the centre of the room.

- A television is fixed on the wall $QRVU$ such that Y , the centre of the television, is 1.6 m above N .
- Two speakers are fixed at corners P and T respectively.

Figure 1

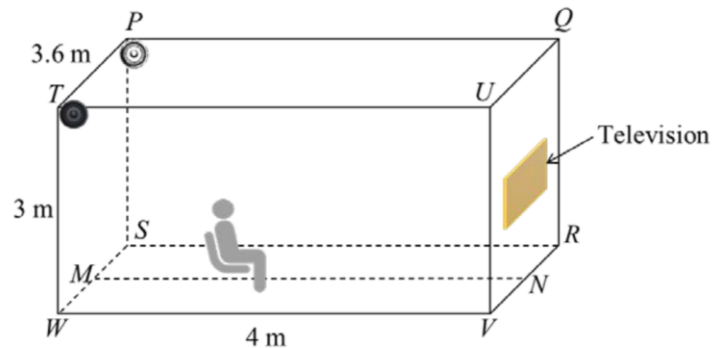
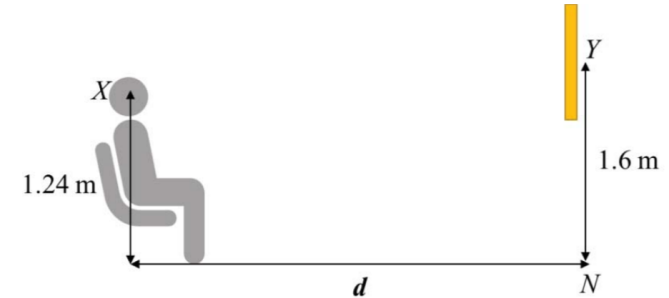


Figure 2 shows Roy's eye level at X , which is 1.24 m when seated at distance d from the television. It is given that $1.8 \text{ m} \leq d \leq 3.8 \text{ m}$ for Roy to have an optimal view of the television.

Figure 2



For this question, the dimensions of the television and speakers are negligible.

- (a) If Roy chose to place the armchair at the furthest possible optimal distance, find
- TX , [3]
 - $\angle PXT$, [2]
 - the angle of elevation of Y from X . [2]
- (b) When the angle of elevation of Y from X is 12° , will Roy still have an optimal view of the television? Justify your answer. [2]



Trigonometry - 2

(a) ABC is a triangle with $AB = 5$ cm, $AC = 8$ cm and $\angle ACB = 10^\circ$.

- (i) Find the obtuse $\angle ABC$.
- (ii) Calculate the area of triangle ABC .

A map is drawn to a scale of 1: 20 000.

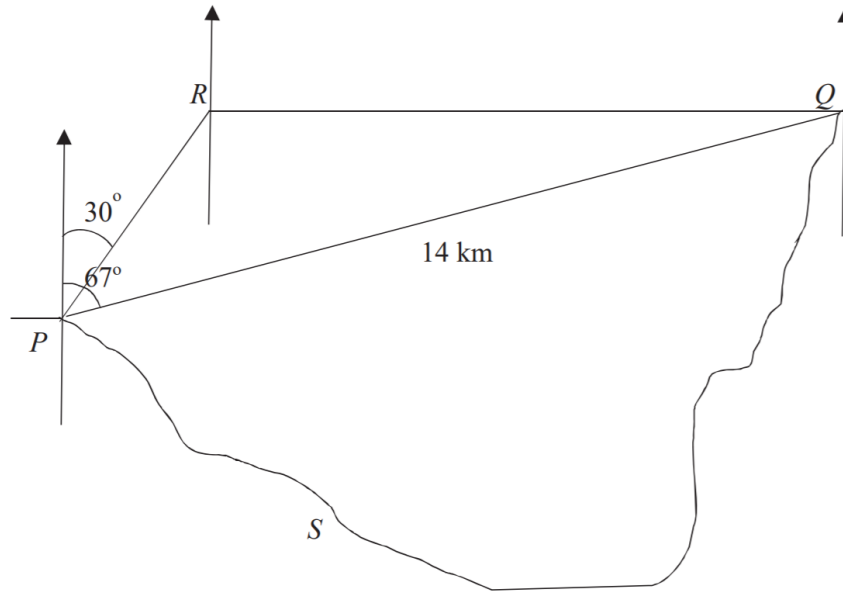
Triangle ABC represents the surface area of a reservoir on this map.

- (iii) Calculate the actual surface area, in m^2 , of the reservoir.



Trigonometry - 2

- (b) P , Q and R are three points on the sea. Q is 14 km from P . The bearing of Q from P is 067° . R is due west of Q . A kayak, X , sails from P to R .
The bearing of R from P is 030° . Find the distance sailed by kayak X . [2]

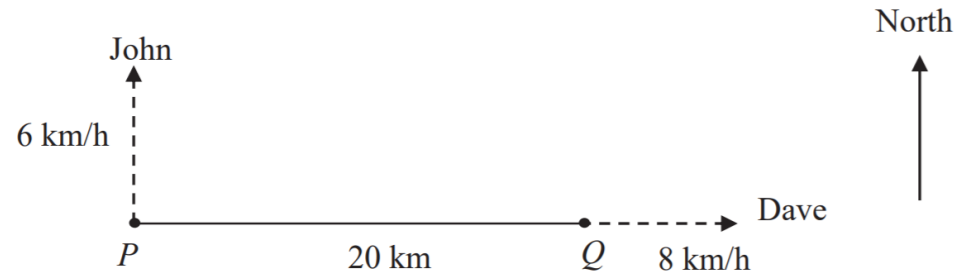


- (c) In the diagram, point S is 9 km from P and 11 km from Q , calculate the bearing of S from Q . [3]
- (d) A sea gull is hovering vertically above S .
The angle of elevation of the sea gull from P is 16° .
Another kayak Y sails along PQ .
Find the greatest possible angle of elevation of the sea gull from Y . [3]



Quadratic Equations - 1

Q is 20 km due east of P . John starts from P and walks at a constant speed of 6 km/h due North. At the same time, Dave starts from Q and walks at a constant speed of 8 km/h due east.



- (a) Write an expression, in terms of t ,
- (i) the distance of John from P after t hours, [1]
 - (ii) the distance of Dave from P after t hours. [1]
- (b) After t hours, the men are 40 km apart. Write down an equation in t to represent this information and show that it reduces to
- $$5t^2 + 16t - 60 = 0. \quad [3]$$
- (c) Solve the equation $5t^2 + 16t - 60 = 0$. [3]
- (d) Hence, find the bearing of Dave from John when they are 40 km apart. [3]



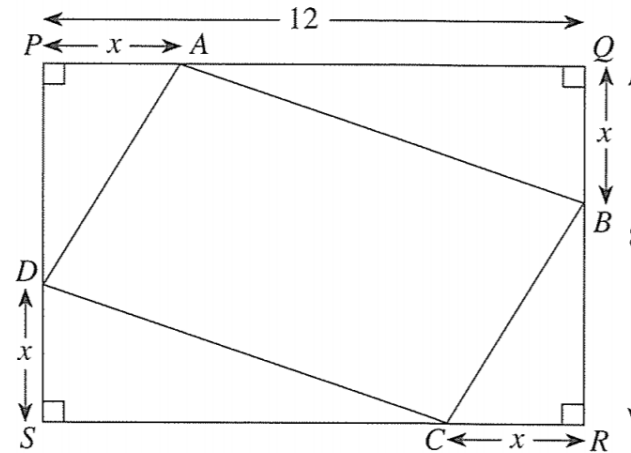
Quadratic Equation - 2

In the diagram, $PQRS$ is a rectangle.

$PQ = 12$ cm and $QR = 8$ cm.

$AP = BQ = CR = DS = x$ cm.

- (a) Find an expression, in terms of x , for
- the length of BR ,
 - the area of triangle BRC .
- (b) Hence, show that the area of the quadrilateral $ABCD$ is $(2x^2 - 20x + 96)$ cm^2 .
- (c) Write down the special name given to the quadrilateral $ABCD$.
- (d) If the area of quadrilateral $ABCD$ is 62 cm^2 , form an equation in x and show that it simplifies to $x^2 - 10x + 17 = 0$.
- (e) Solve the equation $x^2 - 10x + 17 = 0$, giving each answer correct to 2 decimal places.
- (f) It is given that $2x^2 - 20x + 96 = a(x - h)^2 + k$.
- Find the values of a , h and k .
 - Hence, write down the smallest possible area of the quadrilateral $ABCD$ and the value of x at which it occurs.





Linear Inequalities - 1

Find the integer values of x which satisfy the inequalities

$$3 \leq x - 3 \leq 7 \text{ and } \frac{x - 1}{3} < \frac{2x + 1}{5} < 4.$$

Illustrate your answer with a number line.



Linear Inequalities - 2

A preliminary round of a Mathematics competition consists of 40 multiple choice questions. 3 points are awarded for a correct answer, 1 point is deducted for the wrong answer and no points are awarded or deducted for non-attempted question. To qualify for the final round, a total score of at least 80 points is required. A participant did not attempt 5 questions. By forming an inequality, find the minimum number of correct answers the participant needed to obtain in order to qualify for the final round.



Indices and Surds - 1

Solve the following equations.

(a) $(2^x)(5^{y-1}) = 20^{2x+3}$

(b) $3^{38} - 3^{37} = \frac{2}{3^x}$



Indices and Surds - 2

- (a) Show that $2^{3m+2} + \left(\frac{1}{8}\right)^{-1-m} - \sqrt{64^m}$ is divisible by 11 for all positive integer values of m .
- (b) Evaluate $\frac{2^{n+4} - 9(2^n)}{10(2^{n-1})}$, giving your answer as a fraction.