Entrance to year 3 sample questions (calculator required)

Q1.

(a) (i) Work out the value of $\dfrac{4.5 \times 8.43}{\sqrt{7.4 + 2.3}}$

Vypočítej hodnotu výrazu

Give your answer to part (i) correct to 3 significant figures./*Uveď odpověď s přesností na dvě platné číslice.*

(b) Find the cube root of 9261 /*Vypočítej třetí odmocninu čísla 9261*

Q2.

Green paint can be made by mixing yellow paint and blue paint in the ratio 2 : 3
Wendy makes 15 litres of green paint. /*Zelená barva se připravuje smísením žluté a modré barvy v poměru 2 : 3. Wendy připravila 15 litrů zelené barvy.*

Work out how many litres of blue paint Wendy uses./*Vypočítej, kolik litrů modré barvy Wendy použila.*

Q3.

The table shows some information about the five Great Lakes in North America./*V tabulce jsou uvedeny informace o pěti jezerech v severní Americe.*

Name	Surface area (m^2)	Volume of water (m^3)
Lake Erie	2.57×10^{10}	4.80×10^{11}
Lake Huron	6.01×10^{10}	3.52×10^{12}
Lake Michigan	5.80×10^{10}	4.87×10^{12}
Lake Ontario	1.91×10^{10}	1.64×10^{12}
Lake Superior	8.21×10^{10}	1.22×10^{13}

(a) Work out the total surface area of the five Great Lakes. /*Vypočítej celkovou plochu všech pěti jezer.*
Give your answer in standard form. /*Uveď odpověď ve standardní formě*.

Loch Ness is the largest lake in Scotland. /*Jezero Loch Ness je největší jezero ve Skotsku.*
The lake has a volume of water of 7.45×10^9 m^3 / *Objem vody je* 7.45×10^9 m^3

The volume of water in Lake Superior is k times the volume of water in Loch Ness./*Objem vody v jezeře Superior tvoří* $\underline{k}$*-tý násobek objemu vody v jezeře Loch Ness.*

(b) Work out the value of k. /*Vypočítej hodnotu* $\underline{k}$
Give your answer correct to 3 significant figures. /*Uveď odpověď s přesností na 3 platné číslice.*

Q4.

Wendy travelled on the Eurostar train from St Pancras station to the Gare du Nord station./*Wendy cestovala vlakem Eurostar z nádraží St Pancreas do nádraží Gare du Nord.*
The Eurostar train travelled a distance of 495 km./*Vlak urazil vzdálenost 495 km.*
The journey time was 2 hours 15 minutes./ *Cesta trvala 2 hodiny a 15 minut.*

Work out the average speed of the Eurostar train in kilometres per hour./*Vypočítej průměrnou rychlost vlaku v kilometrech za hodinu.*

Q5.

The population of a country increased by 2% to 9.792 million. What was the population before the increase?/*Počet obyvatel země se zvýšil o 2% a dosáhl počtu 9,792 miliónu. Kolik obyvatel měla země před zvýšením počtu obyvatel?*

Algebra

Q1.

$f = 5p - 4v$

Work out the value of $\underline{p}$ when $f = -22$ and $v = -5$

Vypočítej hodnotu $\underline{p}$, jestliže $f = -22$ a $v = -5$

Q2.

Solve the simultaneous equations
/*Vyřeš následující soustavu rovnic*

$$3x + y = 13$$
$$x - 2y = 9$$

Q3.

a) Make r the subject of the formula $A = 4\pi r^2$ where r is positive.
/*Vytvoř rovnici pro $\underline{r}$ ze vzorce $A = 4\pi r^2$, kde $\underline{r}$ je pozitivní*

b) Make x the subject of $2t = 5(3 - 2x)$
/*Vyjádři hodnotu x na základě rovnice*

c) Make x the subject of $\frac{x^2-5}{2t} = 7$
/*Vytvoř vzorec pro x*

Q4.

(a) Factorise fully $18e^3f + 45e^2f^4$
/*Rozlož na činitele*

(b) Solve $x^2 - 5x + 6 = 0$
/*Vyřeš rovnici*

Q5.

W is directly proportional to F. If W = 45 when F = 3, find the following. /*W je přímo úměrné F. Jestliže platí, že W = 45 když F = 3, vypočítej následující:*

a) W when F = 5 — *W jestliže F = 5*

b) F when W = 90 — *F jestliže W = 90*

Q6.

If A is proportional to r^2 and A = 20 when r = 2, find the value of A when r = 5./*Jestliže platí, že A je úměrné r^2 a A = 20 když r = 2, vypočti hodnotu A když r = 5.*

Q7.

Solve $x^2 + 12x + 3 = 0$, giving your answers correct to 1 decimal place.
/*Vypočti rovnici a uveď výsledek s přesností na jedno desetinné místo.*

Geometry

Q1.

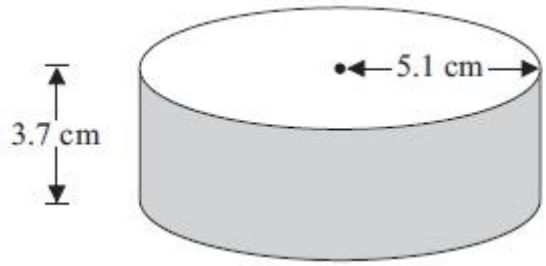


Diagram **NOT** accurately drawn

A solid cylinder has a radius of 5.1 cm and a height of 3.7 cm./*Válec má poloměr 5,1 cm a výšku 3,7 cm*.
Work out the **total** surface area of the cylinder./*Vypočti celkovou plochu povrchu válce.*
Give your answer correct to 3 significant figures./*Uveď výsledek s přesností na 3 platné číslice.*

Q2.

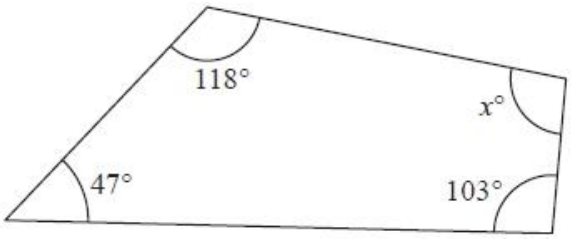


Diagram **NOT** accurately drawn

Work out the value of *x*./*Vypočti hodnotu x*.

Q3.

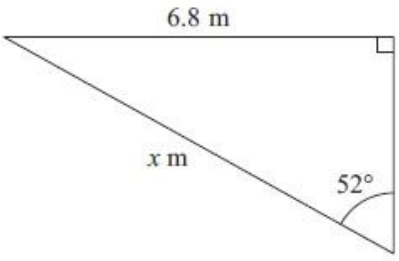


Diagram **NOT** accurately drawn

Calculate the value of *x*.
Give your answer correct to 3 significant figures.
/*Vypočti hodnotu x.*
Uveď výsledek s přesností na 3 platné číslice.

Q4. Find the value of x and y in the following:/*Vypočti hodnotu x a y v následujícím obrazci:*

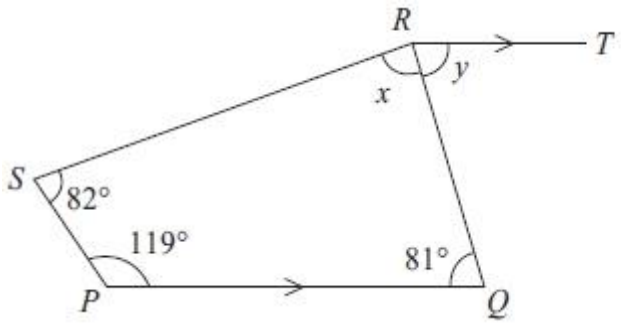


Diagram **NOT** accurately drawn

Q5.

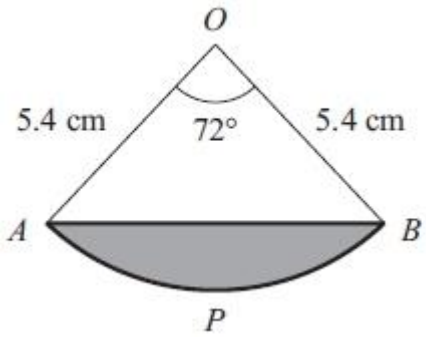


Diagram **NOT** accurately drawn

Calculate the area of the shaded segment *APB./Vypočti plochu šedě zbarveného obrazce APB.*
Give your answer correct to 3 significant figures./*Uveď výsledek s přesností na 3 platné číslice.*

Q6.

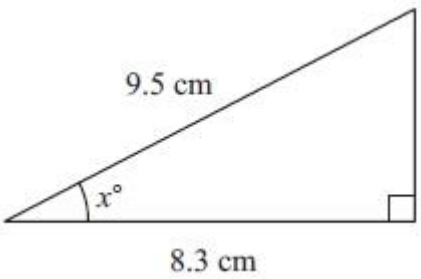


Diagram **NOT** accurately drawn

Work out the value of *x./Vypočti hodnotu x*
Give your answer correct to 1 decimal place./*Uveď výsledek s přesností na jedno desetinné místo.*

Graphs

Q1.

The point *A* has coordinates (0, 2) /*Bod A má souřadnice (0, 2)*
The point *B* has coordinates (–4, –1) /*Bod B má souřadnice (–4, –1)*

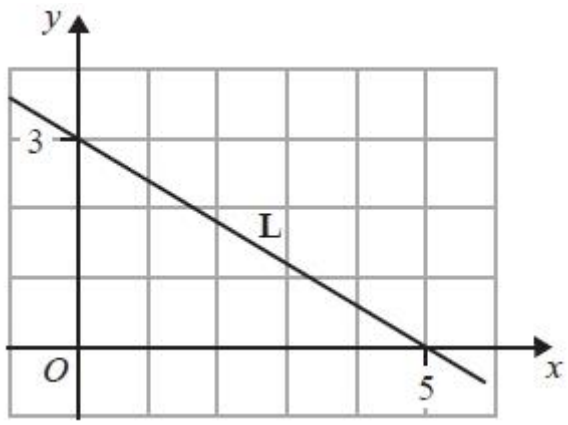
(a) Find the coordinates of the midpoint of *AB*. /*Najdi souřadnice bodu v poloviční vzdálonosti mezi A a B.*

(b) Work out the gradient of the line *AB*./*Vypočti gradient úsečky AB.*

(c) Find an equation of the line *AB*./*Vytvoř rovnici pro úsečku AB.*

Q2.

The straight line **L** is shown on the grid./*Na diagramu je zobrazena přímka **L**.*



Find an equation of **L**./*Vytvoř rovnici pro **L**.*

Data

Q1.

The average height of a group of 10 boys is 140cm . The average height of a group of 6 girls is 150cm. Find the average height of all the boys and girls together.
/*Průměrná výška skupiny 10 chlapců je 140 cm. Průměrná výška skupiny 6 dívek je 150 cm. Vypočti průměrnou výšku všech chlapců a dívek dohromady.*

Year 3 — Solutions

Calculator Required / S kalkulačkou

NUMBER, RATIOS & STANDARD FORM / ČÍSLA A STANDARDNÍ FORMA

Question 1: Numerical Calculations

(a) Work out (4.5 × 8.43) ÷ (√7.4 + 2.3):
• Numerator: 4.5 × 8.43 = 37.935
• Denominator: √7.4 + 2.3 ≈ 2.72029 + 2.3 = 5.02029
• Division: 37.935 ÷ 5.02029 ≈ 7.5563...
• 3 s.f.: **7.56**

(b) Cube root of 9261:
$\sqrt[3]{9261}$ = **21** (since $21^3 = 9261$)

(a) 7.56 (3 s.f.) | (b) 21

Question 2: Ratio (Paint Mixture)

Žlutá : Modrá = 2 : 3. Celkem 15 litrů zelené barvy. Kolik litrů modré?

• Total parts = 2 + 3 = 5 parts
• 1 part = 15 litres ÷ 5 = 3 litres
• Blue paint (3 parts) = 3 × 3 = 9 litres

Blue paint used = 9 litres

Question 3: Standard Form & Great Lakes Comparison

Name	Surface Area (m^2)	Volume of Water (m^3)
Lake Erie	2.57×10^{10}	4.80×10^{11}
Lake Huron	6.01×10^{10}	3.52×10^{12}
Lake Michigan	5.80×10^{10}	4.87×10^{12}
Lake Ontario	1.91×10^{10}	1.64×10^{12}
Lake Superior	8.21×10^{10}	1.22×10^{13}

(a) Total Surface Area (Standard Form):
Sum = (2.57 + 6.01 + 5.80 + 1.91 + 8.21) × 10^{10}
= 24.50 × 10^{10} = **2.45×10^{11} m²**

(b) Multiplier k (Superior vs Loch Ness):
Loch Ness Volume = 7.45×10^9 m³
k = (1.22×10^{13}) ÷ (7.45×10^9) ≈ 1637.58...
To 3 s.f.: **1640** (or 1.64×10^3)

(a) 2.45×10^{11} m² | (b) k = 1640 (to 3 s.f.)

Question 4: Average Speed

Distance = 495 km, Time = 2h 15m (2.25 hours).

Speed = Distance ÷ Time
Speed = 495 km ÷ 2.25 h = 220 km/h

Average Speed = 220 km/h

Question 5: Reverse Percentage

Population increased by 2% to 9.792 million. Original?

102% of original = 9.792 million
Original = 9.792 ÷ 1.02 = 9.6 million

Original Population = 9.6 million

ALGEBRA SOLUTIONS / ALGEBRA

Algebra Q1: Formula Substitution

$f = 5p - 4v$. Find p when $f = -22$ and $v = -5$.

$-22 = 5p - 4(-5)$
$-22 = 5p + 20 \Rightarrow 5p = -42 \Rightarrow p = -8.4$

Value of p = −8.4 (or $-\frac{42}{5}$)

Algebra Q2: Simultaneous Equations

1) $3x + y = 13$ | 2) $x - 2y = 9$

From (2): $x = 9 + 2y$
Substitute in (1): $3(9 + 2y) + y = 13$
$27 + 6y + y = 13 \Rightarrow 7y = -14 \Rightarrow$ **y = −2**
$x = 9 + 2(-2) \Rightarrow$ **x = 5**

x = 5, y = −2

Algebra Q3: Rearranging Formulas (Making x / r the subject)

(a) Subject r from $A = 4\pi r^2$:
$r^2 = A \div (4\pi)$
$r = \sqrt{(\frac{A}{4\pi})}$ (or $\frac{\sqrt{A}}{2\sqrt{\pi}}$)

(b) Subject x from $2t = 5(3 - 2x)$:
$2t = 15 - 10x \Rightarrow 10x = 15 - 2t$
$x = \frac{(15 - 2t)}{10}$

(c) Subject x from $(x^2 - 5) / 2t = 7$:
$x^2 - 5 = 14t \Rightarrow x^2 = 14t + 5$
$x = \pm\sqrt{(14t + 5)}$

Algebra Q4(a): Factorise Fully

$18e^3f + 45e^2f^4$

- HCF of 18 and 45 is 9.
- Common powers: e^2 and f.
- Factor out $9e^2f$: **$9e^2f(2e + 5f^3)$**

$9e^2f(2e + 5f^3)$

Algebra Q4(b): Solve Quadratic

Solve $x^2 - 5x + 6 = 0$

- Find two numbers that multiply to +6 and add to −5: (−2 and −3).
- $(x - 2)(x - 3) = 0$
- $x = 2$ or $x = 3$

x = 2 or x = 3

Algebra Q5 & Q6: Direct Proportionality

Q5. $W \propto F$ (W=45 when F=3):
$W = kF \Rightarrow 45 = k(3) \Rightarrow k = 15$.
(a) $F=5 \Rightarrow W = 15 \times 5 =$ **75**
(b) $W=90 \Rightarrow 90 = 15F \Rightarrow F =$ **6**
Q6. $A \propto r^2$ (A=20 when r=2):
$A = kr^2 \Rightarrow 20 = k(2^2) \Rightarrow k = 5$.
When $r=5 \Rightarrow A = 5(5^2) =$ **125**

Q5: (a) 75, (b) 6 | Q6: A = 125

Algebra Q7: Quadratic Formula (1 d.p.)

Solve $x^2 + 12x + 3 = 0$

Using quadratic formula $x = [-b \pm \sqrt{(b^2 - 4ac)}] \div 2a$:
a=1, b=12, c=3
$x = [-12 \pm \sqrt{(144 - 12)}] \div 2 = [-12 \pm \sqrt{132}] \div 2$
$\sqrt{132} \approx 11.489...$
$x_1 = (-12 + 11.489) / 2 =$ **−0.3**
$x_2 = (-12 - 11.489) / 2 =$ **−11.7**

x = −0.3 or x = −11.7

GEOMETRY, GRAPHS & DATA SOLUTIONS

Geometry Q1, Q2, Q3: Surface Area, Angles & Trigonometry

Q1. Cylinder Total Surface Area:
r = 5.1 cm, h = 3.7 cm
Area = $2\pi r^2 + 2\pi rh$
$= 2\pi(5.1)^2 + 2\pi(5.1)(3.7)$
$= 52.02\pi + 37.74\pi = 89.76\pi$
≈ 281.99 cm² ⇒ **282 cm²** (3 s.f.)

Q2. Quadrilateral Angle x:
Sum of angles in 4-sided polygon = 360°
118° + 47° + 103° + x = 360°
268° + x = 360°
x = 92°

Q3. Right Δ Trigonometry (x):
Hypotenuse = x, Opposite = 6.8 m, Angle = 52°
sin(52°) = 6.8 ÷ x
x = 6.8 ÷ sin(52°)
x ≈ 6.8 ÷ 0.78801 = **8.63 m** (3 s.f.)

Geometry Q4: Parallel Lines & Polygon Angles

Trapezoid/Polygon with parallel lines PQ and RT.

- Since PQ ∥ RT, co-interior angles sum to 180°:
  ∠RQP + y = 180° ⇒ 81° + y = 180° ⇒ **y = 99°**
- Sum of interior angles of quadrilateral PQRS = 360°:
  119° + 82° + x + 81° = 360° ⇒ 282° + x = 360°
  ⇒ **x = 78°**

x = 78°, y = 99°

Geometry Q5 & Q6: Circular Segment & Angle

Q5. Shaded Segment APB Area (r=5.4, θ=72°):
- Sector Area = (72/360) × π × 5.4² = 0.2 × 29.16π ≈ 18.322 cm²
- Triangle Area = $^1/_2$ × 5.4 × 5.4 × sin(72°) ≈ 13.886 cm²
- Segment Area = 18.322 − 13.886 = **4.44 cm²** (3 s.f.)

Q6. Trigonometry Angle x° (Adj=8.3, Hyp=9.5):
cos(x) = 8.3 ÷ 9.5 ≈ 0.87368 ⇒ x = $\cos^{-1}(0.87368)$ = **29.1°**

Q5 Segment = 4.44 cm² | Q6 Angle = 29.1°

Graphs Q1: Midpoint, Gradient & Line AB

A = (0, 2), B = (−4, −1)

(a) **Midpoint:** ((0 − 4)/2, (2 − 1)/2) = **(−2, 0.5)**
(b) **Gradient m:** [2 − (−1)] / [0 − (−4)] = $^3/_4$ = **0.75**
(c) **Equation:** y = mx + c ⇒ **y = $^3/_4$x + 2**

(a) (−2, 0.5) | (b) m = 0.75 | (c) y = 0.75x + 2

Graphs Q2: Equation of Line L

Line passes through (0, 3) and (5, 0).

- y-intercept c = 3
- Gradient m = (0 − 3) ÷ (5 − 0) = $-^3/_5$ = −0.6
- Equation: **y = $-^3/_5$x + 3** (or 3x + 5y = 15)

y = −0.6x + 3

Data Q1: Combined Mean Height

10 boys (mean 140 cm), 6 girls (mean 150 cm). Combined mean?

- Total height of boys = 10 × 140 = 1400 cm
- Total height of girls = 6 × 150 = 900 cm
- Combined total height = 1400 + 900 = 2300 cm
- Total children = 10 + 6 = 16
- Combined Mean = 2300 ÷ 16 = **143.75 cm**

Combined Average Height = 143.75 cm