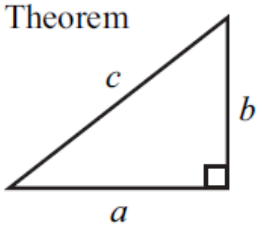
ENGLISH COLLEGE
ANGLICKÉ GYMNÁZIUM IN PRAGUE

YEAR 3

Mathematics Entrance Examination Practice set (A)
Total marks - 74

FORMULAE SHEET (*only some of these will be needed)

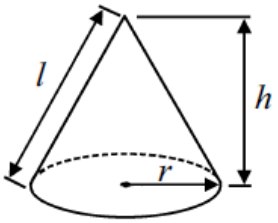
Pythagoras' Theorem



$a^2 + b^2 = c^2$

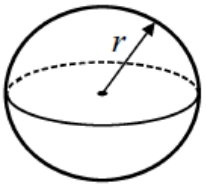
Volume of cone $= \frac{1}{3}\pi r^2 h$

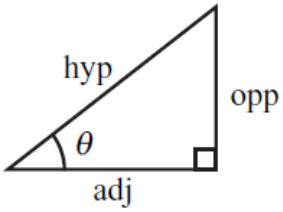
Curved surface area of cone $= \pi r l$



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

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





$\text{adj} = \text{hyp} \times \cos\theta$

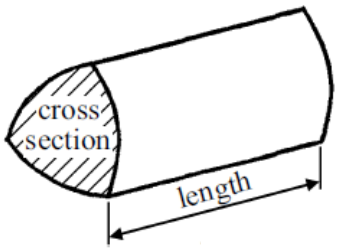
$\text{opp} = \text{hyp} \times \sin\theta$

$\text{opp} = \text{adj} \times \tan\theta$

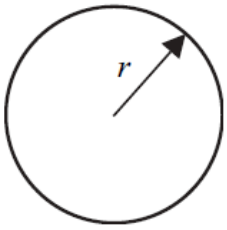
or $\sin\theta = \dfrac{\text{opp}}{\text{hyp}}$

$\cos\theta = \dfrac{\text{adj}}{\text{hyp}}$

$\tan\theta = \dfrac{\text{opp}}{\text{adj}}$

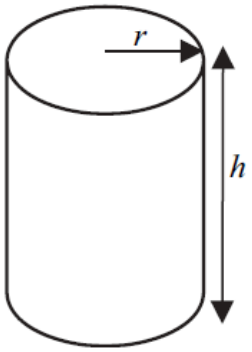


Volume of prism = area of cross section × length



Circumference of circle = $2\pi r$

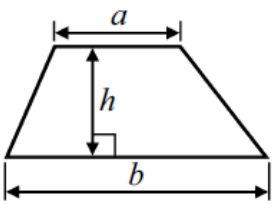
Area of circle = πr^2



Volume of cylinder = $\pi r^2 h$

Curved surface area of cylinder = $2\pi rh$

Area of a trapezium = $\frac{1}{2}(a+b)h$



The Quadratic Equation
The solutions of $ax^2+bx+c=0$, where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

Questions

Q1.

a) Find 30% of 240

.....
(1)

b) Increase 400 by 40%

.....
(1)

c) 45% of the students in a class are girls. If there are 18 girls in the class, calculate how many boys there are in the class.

.....
(2)

(Total for Question is 4 marks)

Q2.
In a sale normal prices are reduced by 20%.

A washing machine has a sale price of £464

By how much money is the normal price of the washing machine reduced?

£ .....

(Total for Question is 3 marks)

Q3.

Calculate $4(\frac{3}{5}+\frac{2}{7})$ showing all the steps in your working

.....

(Total for Question is 3 marks)

Q4. Without a calculator (need to show full working)

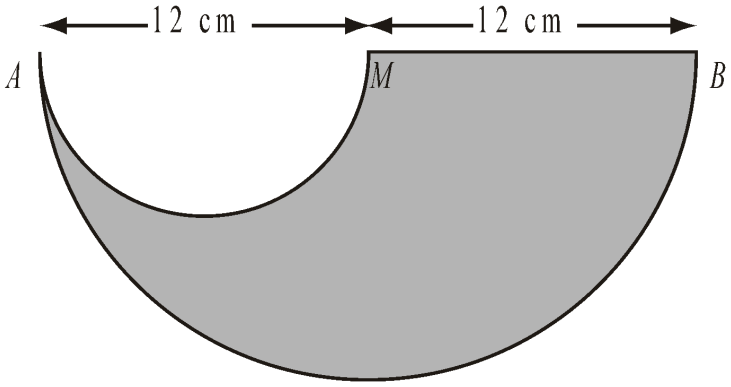
Question:(a) Simplify $\sqrt{75}+2\sqrt{12}-\sqrt{27}$, writing your answer in the form $a\sqrt{3}$ where a is an integer.

(b) Expand and simplify $(3+\sqrt{2})(5-2\sqrt{2})$.

(c) Rationalise the denominator of $\dfrac{6}{4-\sqrt{10}}$.

(Total for Question is 6 marks)

Q5.



The shape above is made by removing a small semi-circle from a large semi-circle.
AM = MB = 12 cm
Calculate the area of the shape.

..... cm^2

(Total for Question is 4 marks)

Q6.

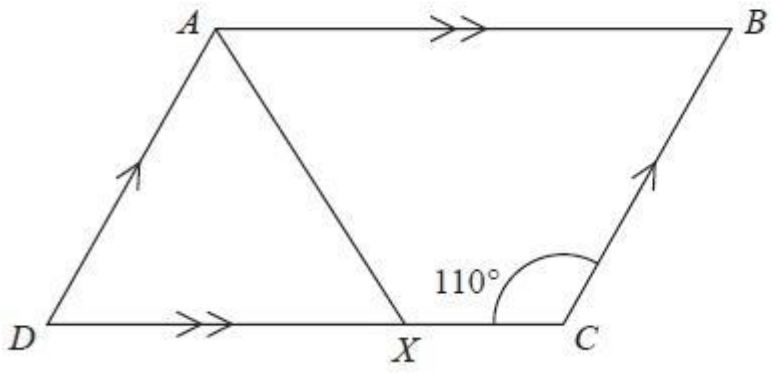


Diagram **NOT** accurately drawn

ABCD is a parallelogram.
Angle *DCB* = 110°
X is the point on *DC* such that *AX* bisects the angle *DAB*.

Calculate the size of angle *AXC*.

..... °

(Total for Question is 3 marks)

Q7.

(a) When x = –3 find the value of

$$x^3 + 2x^2.$$

.....

(1)

(b) Make s the subject of the formula

$$p = st - q.$$

s= .....

(2)

(c) Expand the bracket and simplify the expression

$$7x + 5 - 3(x - 4)$$

.....

(2)

(d) Factorise $e^2 + 4e$

.....

(1)

(e) Solve $7x + 8 = 2x - 3$
Show clear algebraic working.

x = ...

(3)

(f) Expand and simplify $(3y + 10)(y - 2)$

.....

(2)

(g) Factorise $x^2 + 3x - 18$

( ) ( )

(2)

(h) Solve $x^2 - 4x - 12 = 0$

Show clear algebraic working.

.....

(3)

(i) Make x the subject of $\frac{5-3x^2}{b} = t$

.....

(2)

Q8. Solve the following simultaneous equation:

$$2x + 3y = 1$$
$$x - 2y = 4$$

$x =$ ..... $y =$ .....

(Total for Question is 4 marks)

Q9.

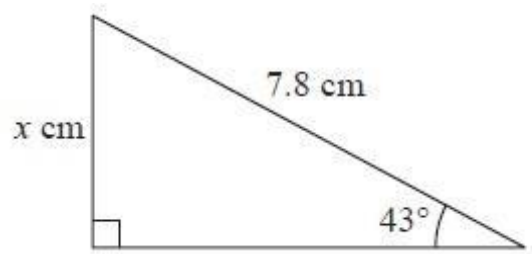


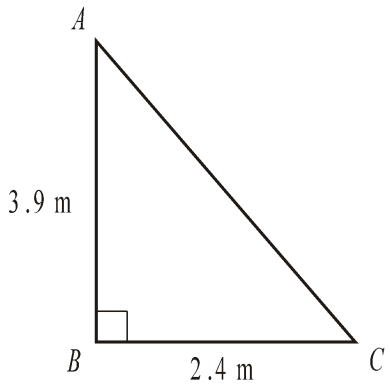
Diagram **NOT** accurately drawn

Work out the value of *x*.
Give your answer correct to 3 significant figures.

x = ...

(Total for Question is 3 marks)

Q10.



ABC is a right-angled triangle.
AB = 3.9 m and BC = 2.4 m.
Calculate the length of AC.

AC = ……..…… m

(Total for Question is 3 marks)

Q11.

The force F between two objects is inversely proportional to the square of the distance d between them.

When $d = 3$ m, the force is $F = 20$ N.

(a) Find a formula for F in terms of d.

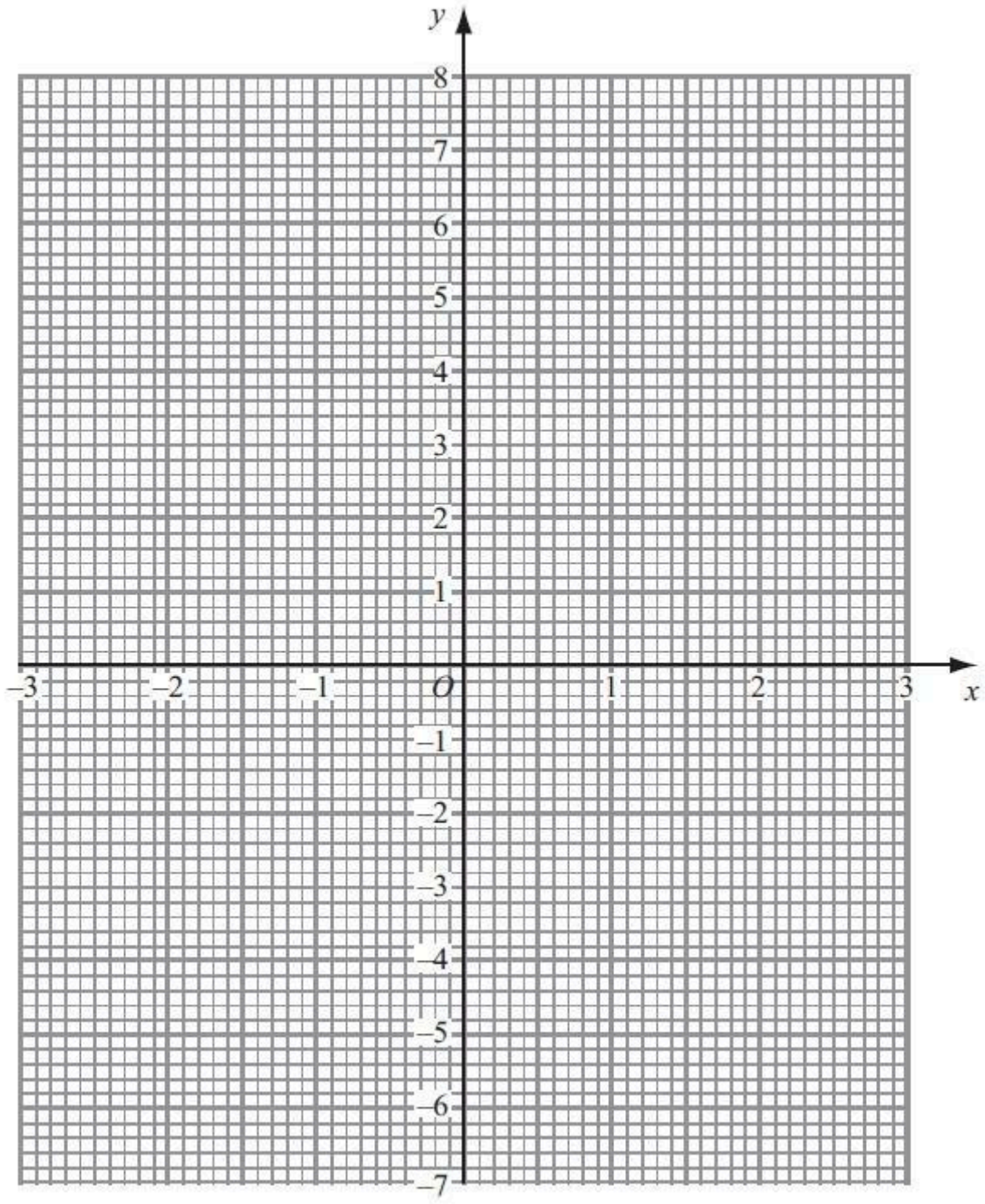
(b) Calculate the value of F when $d = 5$ m.

(c) Calculate the distance d when $F = 45$ N.

(Total for Question is 6 marks)

Q12.

On the grid, draw the graph of $y = 2x - 1$



(Total for question = 4 marks)

Q13.

If 6 hens lay 18 eggs in 4 days, calculate how many eggs 10 hens lay in 8 days.

eggs = ...

(Total for question = 4 marks)

Q14.

Here are some patterns made from dots.



Pattern number 1



Pattern number 2



Pattern number 3

(a) How many dots are needed for Pattern number 5?

..... **(1)**

(b) How many dots are needed for Pattern number 20?

..... **(2)**

(c) Find a formula which shows the relationship between the number of dots n and the pattern number p

$n =$..... **(2)**

(d) Which is the first pattern which has more than 100 dots?

..... **(2)**

(Total for question = 7 marks)

Q15. a)

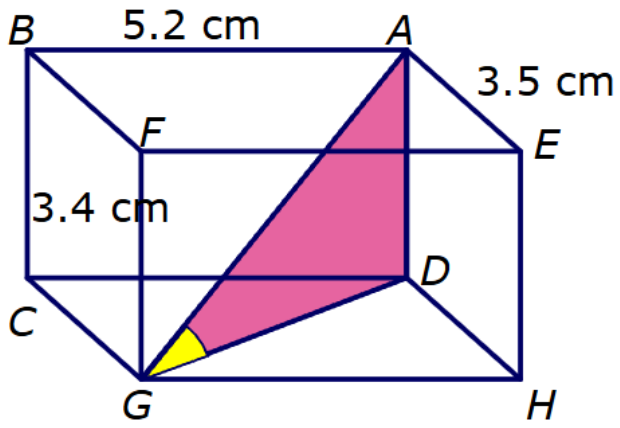
Natasha is 50 m due east of Michelle. Natasha walks 20 m due north, and Michelle walks 10 m due south. Find the distance and bearing of Michelle from Natasha now.

..... (4)

b)

In this cuboid,
work out the angle *AGD*.

Answer to the nearest °.



AGD = ☐ ° [3]

(Total for question = 7 marks)

THE END / *KONEC*

Year 3 Practice Set (A) — Model Solutions

English College in Prague — Entrance Examination (74 Marks Total)

Total: 74 Marks

ARITHMETIC, PERCENTAGES, SURDS & GEOMETRY (Q1 – Q6)

Q1. Percentages [4 Marks]

(a) 30% of 240: 0.30 × 240 = **72**
(b) Increase 400 by 40%: 400 × 1.40 = **560**
(c) Girls = 45% = 18 students:
• Total class = 18 ÷ 0.45 = 40 students
• Boys = 40 − 18 = **22 boys** (or 55% of 40 = 22)

(a) 72 | (b) 560 | (c) 22 boys

Q2. Reverse Percentage Reduction [3 Marks]

Sale price = £464 (reduced by 20% ⇒ 80% of normal price):
• Normal price = 464 ÷ 0.80 = £580
• Reduction amount = £580 − £464 = **£116**

Reduction Amount = £116

Q3. Fraction Operations (Non-Calculator Working) [3 Marks]

$4 \times (^{3}/_{5} + {}^{2}/_{7})$
• Common denominator inside bracket = 35:
$^{3}/_{5} + {}^{2}/_{7} = {}^{21}/_{35} + {}^{10}/_{35} = {}^{31}/_{35}$
• Multiply by 4: $4 \times {}^{31}/_{35} = {}^{124}/_{35} = \mathbf{3\ {}^{19}/_{35}}$

Answer: $^{124}/_{35}$ (or $3\ {}^{19}/_{35}$)

Q4. Surds Operations (Non-Calculator Full Working) [6 Marks]

(a) Simplify surds:
√75 = 5√3
2√12 = 2(2√3) = 4√3
√27 = 3√3
5√3 + 4√3 − 3√3 = **6√3**

(b) Expand & simplify:
(3 + √2)(5 − 2√2)
= 15 − 6√2 + 5√2 − 4
= **11 − √2**

(c) Rationalise denominator:
$^{6}/_{(4-\sqrt{10})} \times {}^{(4+\sqrt{10})}/_{(4+\sqrt{10})}$
$= {}^{(24+6\sqrt{10})}/_{(16-10)}$
$= {}^{(24+6\sqrt{10})}/_{6} = \mathbf{4 + \sqrt{10}}$

(a) 6√3 | (b) 11 − √2 | (c) 4 + √10

Q5. Composite Area (Semi-Circles) [4 Marks]

AM = MB = 12 cm ⇒ AB = 24 cm
• Large semi-circle diameter = 24 cm (r = 12 cm):
Area = $^{1}/_{2} \times \pi \times 12^2 = 72\pi$ cm²
• Small semi-circle diameter = 12 cm (r = 6 cm):
Area = $^{1}/_{2} \times \pi \times 6^2 = 18\pi$ cm²
• Shaded Area = 72π − 18π = **54π cm² ≈ 169.65 cm²**

Area = 54π cm² (169.65 cm²)

Q6. Parallelogram Angles [3 Marks]

ABCD is a parallelogram, ∠DCB = 110°:
• Co-interior ∠DAB = 180° − 110° = 70°
• AX bisects ∠DAB ⇒ ∠DAX = ∠BAX = 35°
• Alternate angles: ∠AXC = 180° − ∠AXD.
In ΔADX, ∠ADC = 110° ⇒ ∠AXD = 180° − (110° + 35°) = 35°
• Angle on straight line: ∠AXC = 180° − 35° = **145°**

Angle AXC = 145°

ALGEBRA, TRIGONOMETRY & PROPORTION (Q7 – Q11)

Q7. Algebraic Manipulations & Equations [17 Marks]

(a) Substitution (1m):
$x = -3 \Rightarrow x^3 + 2x^2$
$= (-3)^3 + 2(-3)^2$
$= -27 + 18 = \mathbf{-9}$

(b) Subject s (2m):
$p = st - q$
$p + q = st$
$\mathbf{s = (p + q) / t}$

(c) Expand & Simplify (2m):
$7x + 5 - 3(x - 4)$
$= 7x + 5 - 3x + 12$
$= \mathbf{4x + 17}$

(d) Factorise (1m):
$e^2 + 4e$
$= \mathbf{e(e + 4)}$

(e) Linear Solve (3m):
$7x + 8 = 2x - 3$
$5x = -11$
$\mathbf{x = -^{11}/_5 = -2.2}$

(f) Expand Quadratic (2m):
$(3y + 10)(y - 2)$
$= 3y^2 - 6y + 10y - 20$
$= \mathbf{3y^2 + 4y - 20}$

(g) Factorise Quadratic (2m):
$x^2 + 3x - 18$
$= \mathbf{(x + 6)(x - 3)}$

(h) Solve Quadratic (3m):
$x^2 - 4x - 12 = 0$
$(x - 6)(x + 2) = 0$
$\mathbf{x = 6 \text{ or } x = -2}$

(i) Subject x (2m):
$(5 - 3x^2)/b = t \Rightarrow 5 - 3x^2 = bt$
$3x^2 = 5 - bt$
$\mathbf{x = \pm\sqrt{[(5 - bt)/3]}}$

Q8. Simultaneous Equations [4 Marks]

1) $2x + 3y = 1$ | 2) $x - 2y = 4$

From (2): $x = 4 + 2y$
Substitute in (1):
$2(4 + 2y) + 3y = 1$
$8 + 4y + 3y = 1 \Rightarrow 7y = -7 \Rightarrow \mathbf{y = -1}$
$x = 4 + 2(-1) = \mathbf{2}$

x = 2, y = −1

Q9. Right-Angled Trig (SOH) [3 Marks]

Hyp = 7.8 cm, Angle = 43°. Find Opposite x.

$\sin(43°) = x \div 7.8$
$x = 7.8 \times \sin(43°)$
$x = 7.8 \times 0.681998...$
$x \approx 5.3195... \approx \mathbf{5.32 \text{ cm}}$ (3 s.f.)

x = 5.32 cm

Q10. Pythagoras' Theorem [3 Marks]

AB = 3.9 m, BC = 2.4 m. Find Hypotenuse AC.

$AC^2 = AB^2 + BC^2$
$AC^2 = 3.9^2 + 2.4^2$
$AC^2 = 15.21 + 5.76 = 20.97$
$AC = \sqrt{20.97} \approx \mathbf{4.58 \text{ m}}$ (3 s.f.)

AC = 4.58 m

Q11. Inverse Square Proportion (Force vs Distance) [6 Marks]

$F \propto 1/d^2$. When d = 3 m, F = 20 N.

(a) Formula for F in terms of d:
$F = k \div d^2 \Rightarrow 20 = k \div (3^2)$
$20 = k \div 9 \Rightarrow k = 180$
Formula: $\mathbf{F = 180 / d^2}$

(b) Calculate F when d = 5 m:
$F = 180 \div (5^2)$
$F = 180 \div 25 = \mathbf{7.2 \text{ N}}$

(c) Calculate d when F = 45 N:
$45 = 180 \div d^2 \Rightarrow d^2 = 180 \div 45$
$d^2 = 4 \Rightarrow \mathbf{d = 2 \text{ m}}$ (since d > 0)

(a) $F = 180/d^2$ | (b) 7.2 N | (c) 2 m

GRAPHS, SEQUENCES & 3D TRIGONOMETRY / BEARINGS (Q12 – Q15)

Q12. Linear Graph Construction [4 Marks]

Draw graph of **y = 2x − 1**:
• Y-intercept (0, −1)
• X-intercept (0.5, 0)
• Coordinates table:
x = −2 ⇒ y = −5; x = 0 ⇒ y = −1;
x = 2 ⇒ y = 3; x = 3 ⇒ y = 5.
Plot points and draw a continuous straight line across the grid.

Straight line plotted through (0,−1) with slope 2

Q13. Compound Proportion (Hens & Eggs) [4 Marks]

6 hens lay 18 eggs in 4 days. How many eggs do 10 hens lay in 8 days?

• Egg rate per hen per day = 18 ÷ (6 × 4) = $^{18}/_{24}$ = 0.75 eggs/hen-day
• Total hen-days for 10 hens in 8 days = 10 × 8 = 80 hen-days
• Total eggs = 80 × 0.75 = **60 eggs**

Number of eggs = 60

Q14. Linear Sequences & Pattern Rules (Dots Pattern) [7 Marks]

Pattern 1 = 4 dots, Pattern 2 = 7 dots, Pattern 3 = 10 dots... Linear rule (+3 per step).

(a) Pattern 5 dots:
Sequence: 4, 7, 10, 13, 16...
Pattern 5 = **16 dots**

(b) Pattern 20 dots:
n = 3(20) + 1
= 60 + 1 = **61 dots**

(c) Formula for n(p):
Common diff = 3
n = 3p + 1

(d) First pattern > 100 dots:
3p + 1 > 100 ⇒ 3p > 99
p > 33 ⇒ **Pattern 34**
(Check: p=33 ⇒ 100; p=34 ⇒ 103)

(a) 16 | (b) 61 | (c) n = 3p + 1 | (d) Pattern 34

Q15. Bearings, 2D Vector Distance & 3D Cuboid Trigonometry [7 Marks]

(a) Bearings & Distance (3m):
• Initial position: N is 50 m East of M.
• Movement: N moves 20 m North (y_N = +20), M moves 10 m South (y_M = −10).
• Relative position of M from N:
Δx = −50 m (West), Δy = −30 m (South).
• Distance = √[(−50)² + (−30)²] = √3400 ≈ **58.3 m**
• Bearing of M from N:
Angle south of west: θ = tan⁻¹(30/50) ≈ 30.96°
Bearing = 270° − 30.96° = 239.04° ≈ **239°**

(b) 3D Angle AGD in Cuboid (4m):
Dimensions: AB = 5.2 cm (length), AE = 3.5 cm (width), BF = 3.4 cm (height).
• Look at base triangle CDG (right-angled at D):
CD = 5.2 cm, CG = 3.5 cm
DG = √(5.2² + 3.5²) = √(27.04 + 12.25) = √39.29 ≈ 6.268 cm
• Look at right-angled ΔADG (right-angled at D):
AD = 3.4 cm (height), DG = √39.29 cm
tan(∠AGD) = AD ÷ DG = 3.4 ÷ 6.268 ≈ 0.5424
∠AGD = tan⁻¹(0.5424) ≈ 28.47° ⇒ **28°** (nearest degree)

(a) Distance = 58.3 m, Bearing = 239° | (b) Angle AGD = 28°