

<b>Part D</b>	Problems 22-30 which require complete solutions.
<b>Test time</b>	120 minutes.
<b>Resources</b>	Digital resources, formula sheet and ruler.

**Level requirements**

The test consists of three written parts (Part B, Part C and Part D). Together they give a total of 59 points consisting of 21 E-, 22 C- and 16 A-points.

Level requirements for test grades

E: 15 points

D: 23 points of which 7 points on at least C-level

C: 30 points of which 12 points on at least C-level

B: 39 points of which 5 points on A-level

A: 47 points of which 9 points on A-level

The number of points you can have for a complete solution is stated after each problem. You can also see what knowledge level(s) (E, C and A) you can show in each problem. For example (3/2/1) means that a correct solution gives 3 E-, 2 C- and 1 A- point.

For problems labelled “*Only answer is required*” you only have to give a short answer. For other problems you are required to present your solutions, explain and justify your train of thought and, where necessary, draw figures and show how you use your digital resources.

**Write your name, date of birth and educational programme on all the sheets you hand in.**

Name: \_\_\_\_\_

Date of birth: \_\_\_\_\_

Educational programme: \_\_\_\_\_

**Part D:** Digital resources are allowed. Write your solutions on separate sheets of paper.

22. How many degrees are 1.4 radians? *Only answer is required* (1/0/0)

23. Tide is a phenomenon that occurs due to the gravitational forces the moon exerts on the sea level. In the course of one day there are both low tide and high tide. The largest differences between high and low tide on Earth can be found in Newfoundland on the east coast of Canada.

According to a simplified model, the sea level in Newfoundland on a certain day can be described by the function

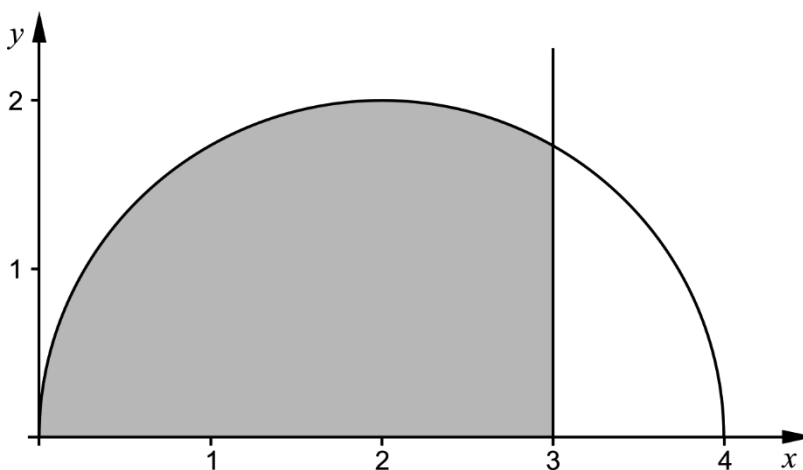
$$y = 8.0 + 8.0 \cos 0.52x$$

where  $y$  is the height of the water in metres compared to the lowest water level and  $x$  is the number of hours after 03.00

a) Calculate the difference in height between the highest and lowest water level according to the model above. *Only answer is required* (1/0/0)

b) Use the above model and calculate at what rate the height of the water changes at 13.00 (1/1/0)

24. The figure below shows a shaded region bounded by the curve  $y = \sqrt{4x - x^2}$ , the line  $x = 3$  and the  $x$ -axis.



When the shaded region is rotated around the  $x$ -axis a solid of revolution is formed. Calculate the volume of the solid of revolution and answer to at least three significant figures.

(2/0/0)

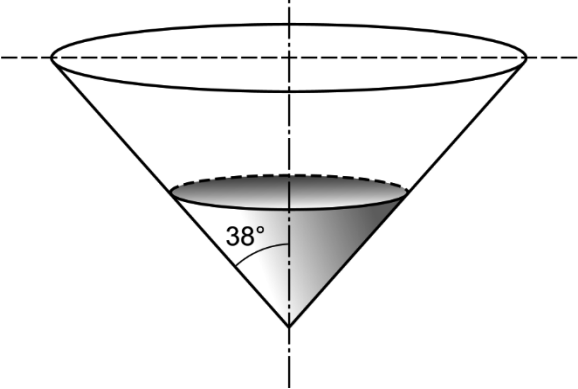
25. Find all roots to the equation  $x^3 - 8x = 7.6$   
 Answer to at least three significant figures. *Only answer is required* (2/0/0)

26. A water tank containing 18 500 litres is emptied at a rate of  $v(t)$  litres/minute, where  $v(t) = 890 - 12t$  and  $t$  is the time in minutes from the start of the emptying.

How many litres pour out of the tank during the first 15 minutes? (0/2/0)

27. Anna has been given the task of solving the following problem:

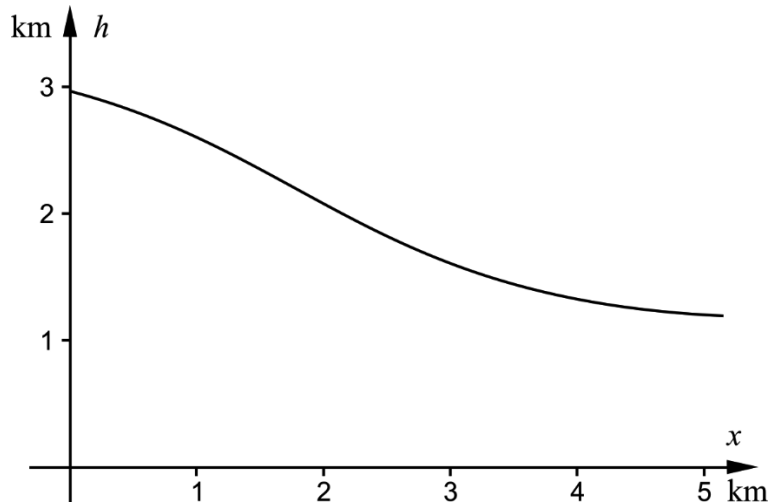
A container has the shape of a right circular cone, see figure.  
 Water pours into the container at a rate of 15 litres/min.  
 At what rate does the height of the water level increase when it is 3.0 dm?



Anna concludes that the relationship is  $V = 0.64h^3$ , where  $V$  is the volume in litres and  $h$  is the height of the water level in dm.  
 She does not know how to proceed from there.

- a) Help Anna complete the solution. (0/2/0)
- b) Show what Anna may have done to find the relationship  $V = 0.64h^3$  (0/3/0)

28. A company is building a cabin in the Alps and wants to know the slope of the hill. According to a simplified model, the shape of the hill can be described by the relation  $h(x) = 4.1 - \frac{5 + 3e^x}{6 + e^x}$  where  $h(x)$  is the height in km above sea level and  $x$  is the horizontal distance in km.



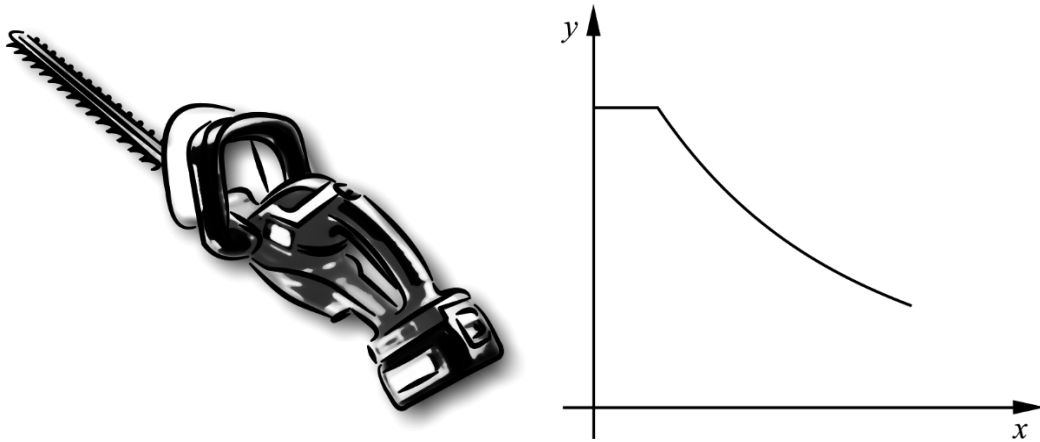
The company is building the cabin at a part of the hill that is 1.4 km above sea level. Calculate the slope of the hill where the cabin will be built. Answer to at least two significant figures.

(0/2/0)

29. A trigonometric curve has a maximum point at  $\left(\frac{2\pi}{3}, 5\right)$  and a minimum point at  $\left(\frac{5\pi}{3}, 1\right)$ . There are no stationary points between these two points. Find an equation to the curve.

(0/0/3)

30. Jakob goes to his cottage to cut the rose hedge. The battery to his cordless hedge trimmer is completely empty and needs recharging.



During the first hour when the battery is charged, the charging current is at a constant 1.5 Ampere. According to a simplified model, the charging current then changes at a rate of  $\frac{dy}{dx} = -0.468e^{-0.36(x-1)}$  where  $y$  is the charging current in Ampere and  $x$  is the time in hours from when the charging of the hedge trimmer starts. The battery is considered fully charged when the charging current has decreased to 0.40 Ampere.

How long does it take from the start of the charging until the battery is fully charged?

(0/1/2)