Instructions:	Begin each question on a new sheet Show all your methods clearly
Permitted Materials:	Graphical calculator with the programme memory cleared Calculator instruction booklet Formula book
Marks:	Each of the five questions has a maximum score of 10 marks

1 Given the function $f(x) = \frac{x^3 + x^2 + 4}{2x^2}$, $x \neq 0$

a Calculate, **without using the graphing facility** of the calculator:
(i) the co-ordinates of the intercept with the x-axis
(ii) the co-ordinates of the minimum (x_{min} ,y_{min})
(iii) the equation g(x) of the non-vertical asymptote 2,0

b Using the results from a) where necessary, calculate by hand the area of the region between the curve f(x) and the line $x = x_{min}$ and the asymptote g(x). 2,0

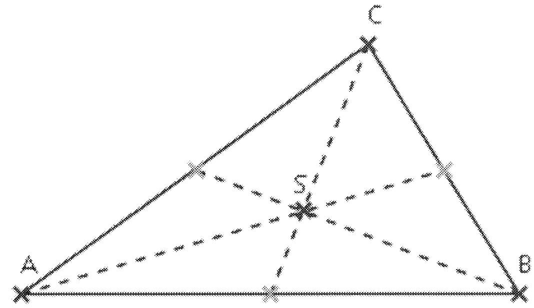
c Find the equation of the parabola $p(x) = ax^2 + bx + c$ which crosses the x – axis at the same point as f(x) and whose stationary point touches the minimum of the curve of f(x), 2,0

d A straight line with equation y = 0,5x + t (where t > 0,5) cuts f(x) at 2 points P_t and Q_t.
(i) Find the co-ordinates of P_t and Q_t (in terms of t) 1,0

(ii) Consider the triangle formed by joining the origin (0/0) with P_t and Q_t.
Show that the y-axis always divides this triangle into 2 equal areas. 1,5

e A function h(x) has the form $h(x) = \frac{x^3 + bx^2 + c}{dx^2}$
Find values for b, c and d so that the curve will have an asymptote with equation
y = 1/3 x –1 **and** a stationary point at x = 3 1,5

Fig 1



2 The triangular base of a pyramid has vertices (corners) at A (-2 / 3 / 1), B (4/ -1 / 2) and C (1 / -2/ -3) and S is the centre point S of the triangle (see Fig 1)

D is the apex (top point) of the pyramid and lies on plane E : $3x - 2y + z - 6 = 0$.
Point D lies on the plane E so that the line DS is perpendicular to the base ABC of the pyramid.

a Draw a sketch of the plane E on x, y and z axes projected obliquely. 1,5

b Calculate the angle BAC (the angle of the vertex A at the base of the pyramid) 1,0

c Calculate the area of the triangle ABC 1,0

d Find the co-ordinates of point S. 1,0

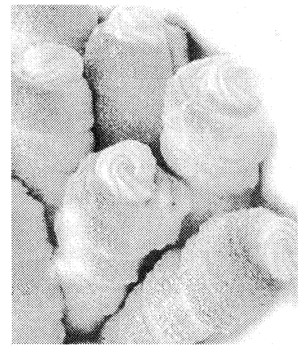
For the following questions, if you have not found the co-ordinates of S use S (1/0/0)

e Give the cartesian equation of the plane containing points A,B and C 1,5

f What are the co-ordinates of point D the apex of the pyramid. 1,5

g Find the volume of the pyramid ABCD 1,0

h The pyramid is now rotated so that the face ACD lies on the x-y plane. A tiny sphere (ball) is placed at point B, and allowed to roll down face ABC until it touches the line AC at the point F. Calculate the distance FA. 1,5



3 The pastry shell of a cornet has the shape of a regular cone.
To form the cornet, the pastry is wrapped around a metal cone form which has a circular base of radius 1,7 cm and a height of 12 cm. When the cornet shell has been baked, it is filled with vanilla crème so that the crème forms a hemisphere on top (the hemisphere also has a radius of 1,7 cm).

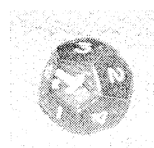
a Calculate the outer surface area of the metal cone form and the total volume of the crème filling, giving your answers to the nearest whole number.

3,0

b The baker, Mr B wants to improve the design of the metal form and gives you the following instructions: "I want my cornets to contain the maximum volume of vanilla crème.
The outer surface area of the metal cone form is fixed at 65,0 cm^2 , but what height and radius should I choose so that the volume of crème is maximum? What total volume of crème is now in the cornet?"
Help Mr B by making suitable calculations and advising him of the dimensions of the metal cone form he might wish to use.
(Tip: make sure your calculator is in 'approx' mode for this question)

7,0

4 A regular twelve-sided die (dodecahedron) has the following numbers on its faces:



"1", "1", "2", "2", "2", "3", "3", "4","4", "4", "4", "5

a The dodecahedron is rolled **twice**. Calculate the probability that :
(i) no "4's" appear. 1,0

(ii) the sum of the two numbers is even. 2,0

b The dodecahedron is rolled 7 times.
Calculate the probability of obtaining exactly 2 "3's". 2,0

c How many times must you roll the dodecahedron so that the probability of at least one "5" is greater than 99,9% 2,0

d A gambling game is played with the dodecahedron which costs Fr 2 per game.
A player rolls the dodecahedron twice. If the number obtained on the second roll is higher than on the first the player receives Fr 5, otherwise he loses his Fr 2 stake.
What is the average profit or loss in this game? 3,0

5a A regular, five pointed star circumscribed by a circle radius 20cm is shown in Fig 2.(not drawn to scale).
The shaded area of the star is **half the area of the regular pentagon**, which is formed by joining the vertices of the star, also shown in Fig 2.
Calculate

(i) the area of the star 2,0

(ii) angle α. 2,0

(iii) the perimeter (total external length) of the star 2,0

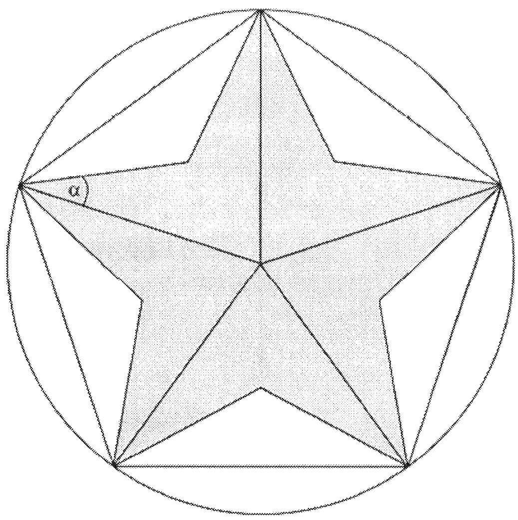


Fig 2

5b

Show all your methods clearly. The use of the calculator **solve** function is not permitted.

At time t minutes after an oven is switched on, its temperature θ °C is given by the equation:

$$\theta = 200 - 180\, e^{-0,1t}$$

(i) Find the time for the oven to reach a temperature of 150°C. 1,0

(ii) Find the rate at which the temperature is increasing at the instant the temperature reaches 150°C 1,0

(iii) At what temperature is the rate of increase of temperature 10°C/min? 2,0