18. For $X \sim B(6, p)$, $P(X = 5) = 0.393216$. Find p.
19. For $X \sim P(3.2)$, find $P(X = 2)$, $P(X \leq 4)$, $P(X \geq 5)$.
20. If $X \sim N(100, 5^2)$, find $P(X < 112)$, $P(X < 91)$, $P(95 < X < 101)$.
21. X is a Normally distributed variable with $m = 18$. If $P(X > 20) = 0.115965$, find the standard deviation.
22. For a certain type of potato, those with weight less than 100g are branded "small", and those with a weight over 125g are branded "large". In one batch, 2.55% of potatoes are small, 13.61% are large. Assuming the weights are Normally distributed, calculate the mean and standard deviation of the batch.

CALCULUS

1. Differentiate $f(x) = x^3$ and $f(x) = 2x^2 - 3x$ from first principles.
2. Differentiate these functions: (a) xe^{-x} (b) $3\sin^{-1}x$ (c) $\cos^2 2x$ (d) $4\sqrt{x} - 5$ (e) $2\ln(\cos x)$ (f) $\dfrac{x^2-2}{x}$ (g) $\dfrac{3x^3}{(x+1)}$ (h) $\sqrt{x^3-2}$ (i) $\sec^2 x$ (j) 3×4^x (k) $x^2\log_3 x$ (l) $\dfrac{x^2}{\tan x}$ (m) $\ln(3 - x^2)$
3. If $y = \arccos(1 - 2x^2)$, find $\dfrac{dy}{dx}$, simplifying your answer.
4. Given that $y = \dfrac{x^2-1}{2x^2+1}$, find the set of values of x for which $\dfrac{dy}{dx} > 0$. Find the coordinates of any stationary points.
5. Find the equations of the tangent and normal to $y = 3\ln x$ at the point with x-coordinate 3.
6. Find the equations of the tangents to the curve $y^2 + 3xy + 4x^2 = 14$ at the points where $x = 1$.
7. Find the first and second derivatives of $y = xe^x$.
8. Find the coordinates of all stationary points and the point of inflexion on the graph of the function $f(x) = x^3 - 3x^2 + 1$. What is the gradient at the point of inflexion?
9. For the graph of the function $f(x) = \dfrac{x^2-1}{x}$ find: any axis intercepts; the vertical asymptote; the behaviour for large $|x|$; any turning points. Hence sketch the graph.
10. A circular oil slick is increasing in radius at the rate of 2m/min. Find the rate at which the area of the slick is increasing when its radius is 30m.
11. Integrate these functions: (a) $\int \sin 3x\,dx$ (b) $\int \dfrac{2}{x^2-1}dx$ (c) $\int \dfrac{1}{4+x^2}dx$ (d) $\int x\sqrt{2x-3}\,dx$ (e) $\int \dfrac{1+x}{\sqrt{1-x^2}}dx$ (f) $\int 3\cos^2 x\,dx$ (g) $\int xe^{2x}dx$ (h) $\int \dfrac{1}{(2-x)^2}dx$ (i) $\int e^x \sin x\,dx$
12. Find the real number $k > 1$ for which $\int_1^k \left(1 + \dfrac{1}{x^2}\right)dx = \dfrac{3}{2}$
13. Find the area enclosed by the curve $y = 4x - x^2$ and the x-axis.
14. Find the area enclosed between the graph of $y = x\cos(x^2)$, the x-axis, $x = 0$ and the next positive x-intercept.
15. Find the area enclosed between the curves $y = 2x^2 + 3$ and $y = 10x - x^2$.
16. Find the volume enclosed when the area lying in the first quadrant and bounded by the curve $y = 2x^2 + 1$ between $y = 2$ and $y = 4$ is rotated 360º around the y-axis.
17. Find the solution of the differential equation $\dfrac{dy}{dx} = 2x(5 - x)$ given that $y = 3$ when $x = 0$.
18. Find the general solution of the differential equation $tx\dfrac{dx}{dt} = 1 + x^2$.
19. The displacement s of a particle from an origin O at time t seconds is $s = 2t^2 - 3t + 6$. Find the displacement, the velocity and the acceleration of the particle when $t = 1.5$.
20. A particle moves in a straight line. At time t secs its acceleration is given by $a = 3t - 1$. When $t = 0$, the velocity of the particle is 2 ms^{-1} and it is 3m from the origin. Find expressions for v and s in terms of t. Show that the particle is always moving away from the origin.