1 Differentiate each of the following with respect to x.

(a) $(1+4x)^{10}\cos x$ [2]

(b) $\dfrac{4x-5}{\tan x}$ [2]

2 The function f is defined by $\mathrm{f}(x) = \frac{1}{3x+2} + x^2$ for $x < -1$.

Determine whether f is an increasing or a decreasing function. [3]

3 The point A lies on the curve $y = 3x^2 - 7x + 11$. The line $5y + x = k$ is a normal to the curve at point A. Find the coordinates of A and the value of k. [4]

4 A balloon in the shape of a sphere is being inflated by a pump.
The volume of the balloon is increasing at a constant rate of 500 cm^3 per second.
The balloon was empty at the start of the pumping.

[The volume of sphere is $\frac{4}{3}\pi r^3$.]

(i) Find the radius of the balloon after 20 seconds. [2]

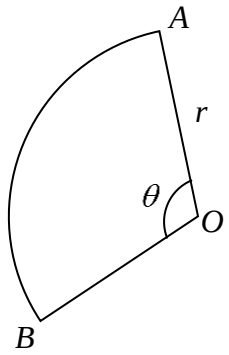
(ii) Find the rate of increase of the radius after 20 seconds. [3]

5 The equation of a curve is $y = (1+\sin 3x)^4$, where $0 \leq x \leq \frac{\pi}{2}$.

(i) Express $\frac{\mathrm{d}y}{\mathrm{d}x}$ in the form $k\cos 3x(1+\sin 3x)^3$, where k is a constant to be found. [1]

(ii) Find the exact x-coordinate(s) of the point(s) at which the tangent to the curve is parallel to the x-axis. [5]

6



The diagram shows a pond *OAB* that is designed in a shape of a sector of a circle, where its radius is *r* m and angle *AOB* is θ radians. The area of the pond is 10 m^2.

[The arc length of a sector is $r\theta$ and area of a sector is $\frac{1}{2}r^2\theta$.]

(i) Given that the perimeter of the pond is *P* m, show that $P = 2r + \frac{20}{r}$. [3]

Given that *r* and θ can vary,

(ii) find the value of *r* for which *P* has a stationary value, [3]

(iii) determine whether this value of P is a maximum or a minimum. [2]

END OF PAPER

Answer Key

1a	$-(1+4x)^{10}\sin x+40(1+4x)^{9}\cos x$
1b	$\dfrac{4\tan x-(4x-5)(\sec^2 x)}{\tan^2 x}$
2	$f'(x)=\dfrac{-3}{(3x+2)^2}+2x$ For $x<-1$, $(3x+2)^2>0$ then $\dfrac{-3}{(3x+2)^2}<0$ For $x<-1$, $2x<-2<0$ $\therefore f'(x)<0$ Hence, f is a decreasing function.
3	$A(2,\ 9);\quad k=47$
4i	13.4 cm
4ii	0.223 cm/s
5i	$12\cos 3x(1+\sin 3x)^3$
5ii	$\dfrac{\pi}{6}$ and $\dfrac{\pi}{2}$
6ii	r = 3.16
6iii	P is maximum