ALL questions should be attempted.

Marks

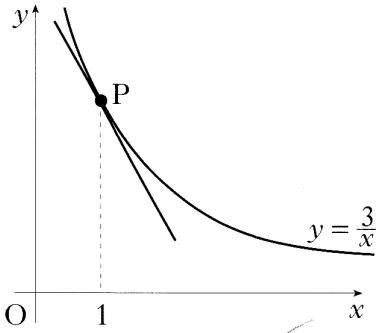
1. (*a*) Find the equation of the straight line through the points A(−1, 5) and B(3, 1). **2**

(*b*) Find the size of the angle which AB makes with the positive direction of the x-axis. **2**

2. (*a*) If $\boldsymbol{u} = \begin{pmatrix} 1 \\ 7 \\ -2 \end{pmatrix}$ and $\boldsymbol{v} = \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$, write down the components of $\boldsymbol{u} + 3\boldsymbol{v}$ and $\boldsymbol{u} - 3\boldsymbol{v}$. **2**

(*b*) Hence, or otherwise, show that $\boldsymbol{u} + 3\boldsymbol{v}$ and $\boldsymbol{u} - 3\boldsymbol{v}$ are perpendicular. **2**

3. Find the equation of the tangent to the curve with equation $y = \frac{3}{x}$ at the point P where $x = 1$. **5**



4. (*a*) Write down the exact values of $\sin\left(\frac{\pi}{3}\right)$ and $\cos\left(\frac{\pi}{3}\right)$. **1**

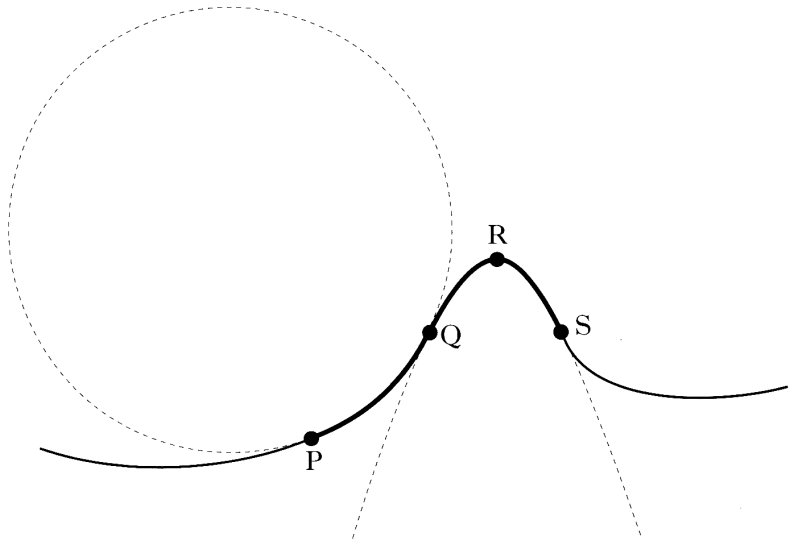
(*b*) If $\tan x = 4\sin\left(\frac{\pi}{3}\right)\cos\left(\frac{\pi}{3}\right)$, find the exact values of x for $0 \leq x \leq 2\pi$. **2**

5. Given that $(x - 2)$ and $(x + 3)$ are factors of $f(x)$ where $f(x) = 3x^3 + 2x^2 + cx + d$, find the values of c and d. **5**

[Turn over

Marks

6. The side view of part of a roller coaster ride is shown by the path PQRS.
The curve PQ is an arc of the circle with equation $x^2 + y^2 + 4x - 10y + 9 = 0$.
The curve QRS is part of the parabola with equation $y = -x^2 + 6x - 5$.
The point Q has coordinates (2, 3).



(*a*) Find the equation of the tangent to the circle at Q. **4**

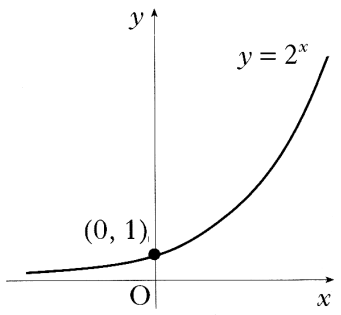
(*b*) Show that this tangent to the circle at Q is also the tangent to the parabola at Q. **2**

7. Find $\int\left(\sqrt[3]{x} - \frac{1}{\sqrt{x}}\right)dx$. **4**

8. The diagram shows part of the graph of $y = 2^x$.

(*a*) Sketch the graph of $y = 2^{-x} - 8$. **2**

(*b*) Find the coordinates of the points where it crosses the x and y axes. **2**



Marks

9. The function f, defined on a suitable domain, is given by $f(x) = \frac{3}{x+1}$.

(*a*) Find an expression for $h(x)$ where $h(x) = f(f(x))$, giving your answer as a fraction in its simplest form. **3**

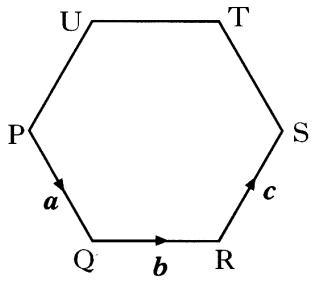
(*b*) Describe any restriction on the domain of h. **1**

10. A function f is defined by $f(x) = 2x + 3 + \frac{18}{x-4}$, $x \neq 4$.

Find the values of x for which the function is increasing. **5**

11. PQRSTU is a regular hexagon of side 2 units. $\overrightarrow{PQ}$, $\overrightarrow{QR}$ and $\overrightarrow{RS}$ represent vectors $\boldsymbol{a}$, $\boldsymbol{b}$ and $\boldsymbol{c}$ respectively.

Find the value of $\boldsymbol{a}.(\boldsymbol{b} + \boldsymbol{c})$. **3**



12. If $\log_a p = \cos^2 x$ and $\log_a r = \sin^2 x$, show that $pr = a$. **3**

[END OF QUESTION PAPER]