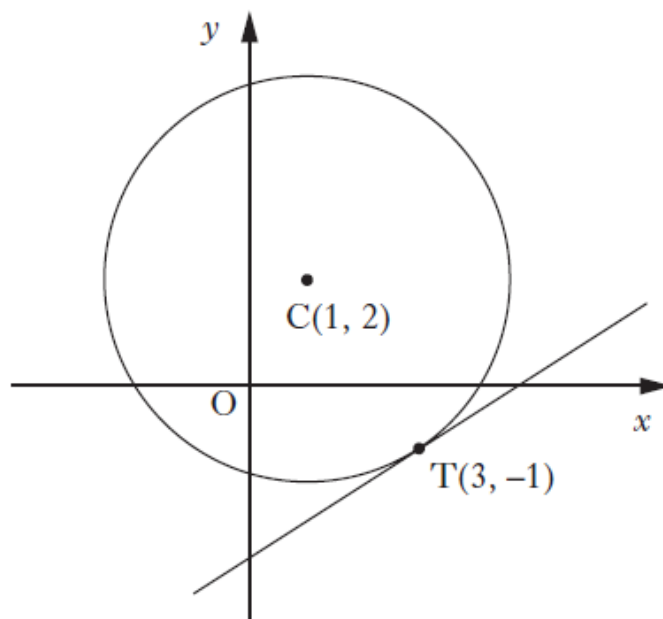


Higher Maths 2014 paper 1

Q1-20 were originally multiple choice questions worth 2 marks each.

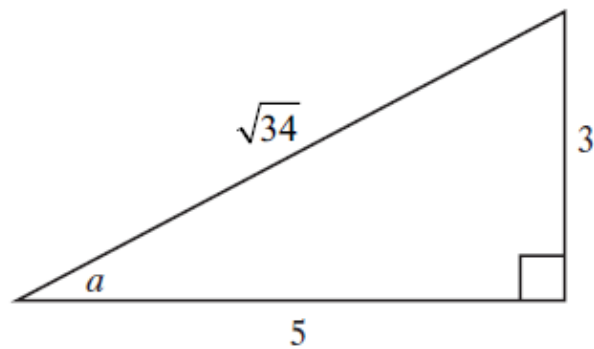
1. A sequence is defined by the recurrence relation $u_{n+1} = \frac{1}{3}u_n + 1$, with $u_2 = 15$.
What is the value of u_4 ?
2. The diagram shows a circle with centre $C(1, 2)$ and the tangent at $T(3, -1)$.



What is the gradient of this tangent?

3. If $\log_4 12 - \log_4 x = \log_4 6$, what is the value of x ?
4. If $3\sin x - 4\cos x$ is written in the form $k\cos(x - a)$, what are the values of $k\cos a$ and $k\sin a$?
5. Find $\int (2x + 9)^5 dx$.
6. Given that $\mathbf{u} = \begin{pmatrix} -3 \\ 1 \\ 0 \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$, find $2\mathbf{u} - 3\mathbf{v}$ in component form.

7. A right-angled triangle has sides and angles as shown in the diagram.



What is the value of $\sin 2a$?

8. What is the derivative of $(4 - 9x^4)^{\frac{1}{2}}$?

9. $\sin x + \sqrt{3} \cos x$ can be written as $2 \cos\left(x - \frac{\pi}{6}\right)$.

The maximum value of $\sin x + \sqrt{3} \cos x$ is 2.

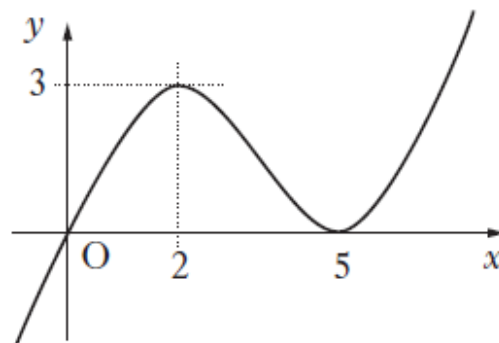
What is the maximum value of $5 \sin 2x + 5\sqrt{3} \cos 2x$?

10. A sequence is defined by the recurrence relation

$$u_{n+1} = (k - 2)u_n + 5 \quad \text{with } u_0 = 3.$$

For what values of k does this sequence have a limit as $n \rightarrow \infty$?

11. The diagram shows part of the graph of $y = f(x)$.



Draw the graph of $y = 2f(x) + 1$

12. A function f , defined on a suitable domain, is given by $f(x) = \frac{6x}{x^2 + 6x - 16}$.

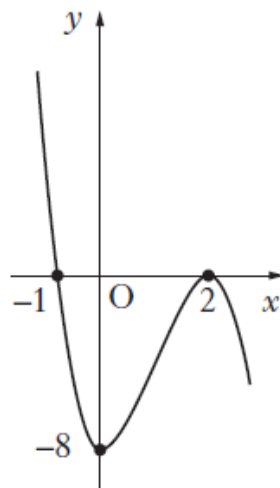
What restrictions are there on the domain of f ?

13. What is the value of $\sin\left(\frac{\pi}{3}\right) - \cos\left(\frac{5\pi}{4}\right)$

14. The vectors $\mathbf{u} = \begin{pmatrix} 1 \\ k \\ k \end{pmatrix}$ and $\mathbf{v} = \begin{pmatrix} -6 \\ 2 \\ 5 \end{pmatrix}$ are perpendicular.

What is the value of k ?

15. The diagram shows a cubic curve passing through $(-1, 0)$, $(2, 0)$ and $(0, -8)$.

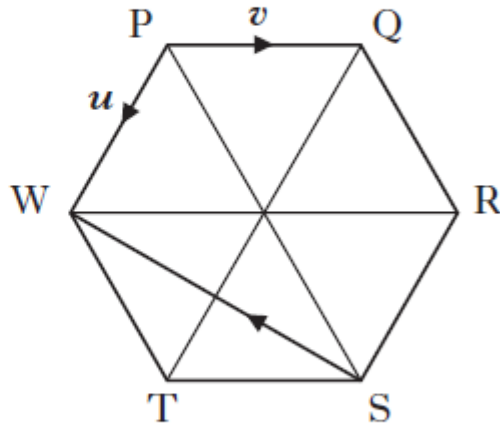


What is the equation of the curve?

16. The unit vectors \mathbf{a} and \mathbf{b} are such that $\mathbf{a} \cdot \mathbf{b} = \frac{2}{3}$. Determine the value of $\mathbf{a} \cdot (\mathbf{a} + 2\mathbf{b})$.
17. $3x^2 + 12x + 17$ is expressed in the form $3(x + p)^2 + q$.
What is the value of q ?
18. What is the value of $1 - 2\sin^2 15^\circ$?

19. The diagram shows a regular hexagon PQRSTW.

\vec{PW} and \vec{PQ} represent vectors u and v respectively.



What is \vec{SW} in terms of u and v ?

20. Evaluate $2 - \log_5 \frac{1}{25}$.

SECTION B

Marks

ALL questions should be attempted.

21. A curve has equation $y = 3x^2 - x^3$.

(a) Find the coordinates of the stationary points on this curve and determine their nature. 6

(b) State the coordinates of the points where the curve meets the coordinate axes and sketch the curve. 2

22. For the polynomial $6x^3 + 7x^2 + ax + b$,

- $x + 1$ is a factor
- 72 is the remainder when it is divided by $x - 2$.

(a) Determine the values of a and b . 4

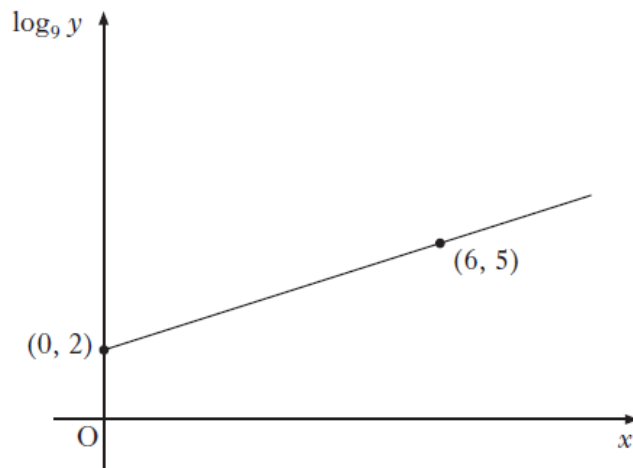
(b) Hence factorise the polynomial completely. 3

23. (a) Find P and Q, the points of intersection of the line $y = 3x - 5$ and the circle C_1 with equation $x^2 + y^2 + 2x - 4y - 15 = 0$. 4
- (b) T is the centre of C_1 .
Show that PT and QT are perpendicular. 3
- (c) A second circle C_2 passes through P, Q and T.
Find the equation of C_2 . 3

24. Two variables, x and y , are related by the equation Marks

$$y = ka^x.$$

When $\log_9 y$ is plotted against x , a straight line passing through the points (0, 2) and (6, 5) is obtained, as shown in the diagram.



- Find the values of k and a . 5

[END OF SECTION B]

[END OF QUESTION PAPER]