# Higher Prelim Revision 2018

1. The vertices of a triangle are P(-1,-1), Q(2,1) and R(-6,2).
   Find the equation of the altitude drawn from Q.

2. Simplify   a) $2 \log_9 2 + 3 \log_9 3 - \log_9 36$

   b) $\log_2 3 + \log_2 4 + \log_2 5 - \log_2 30$

3. Factorise fully $2x^3 + 5x^2 - 4x - 3$.

4. Solve the equation $2\sin3x - 1 = 0$, for $0 < x < 180°$.

5. Express $x^2 + 6x + 11$ in completed square form and state the minimum.

   Hence state the maximum value of g(x) = $\dfrac{1}{x^2 + 6x + 11}$.

6. Find the value of θ for which the function $8\cos(2\theta - \dfrac{\pi}{4})$ has its

   maximum value.

7.

(1,-3)
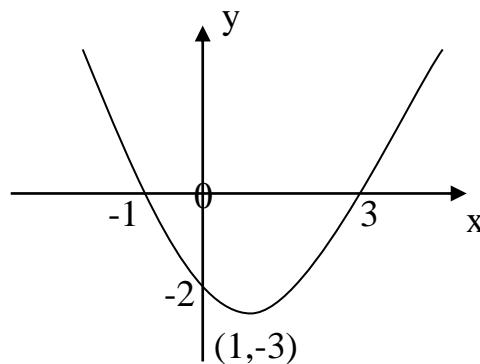
   The diagram shows a sketch of the function y = f(x).
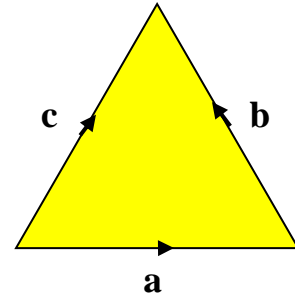   On separate diagrams draw the graphs of
   a) -f(x)   b) f(x+2)   c) 3 + f(x)   d) 2 - f(x)

8 Express f(x) = $5\cos x + 4\sin x$ in the form $k\cos(x - \alpha)$.
   (i) State the max/min values of f and the values of x at which
        the max/min occur.
(ii) Solve the equation $5\cos x + 4\sin x = 3$.

9. The equilateral triangle shown has side
   of length 1 unit.
   Evaluate $\underline{a}.(\underline{a}+\underline{b}-\underline{c})$

10. Find p if x+3 is a factor of $x^3 - x^2$ + px + 15

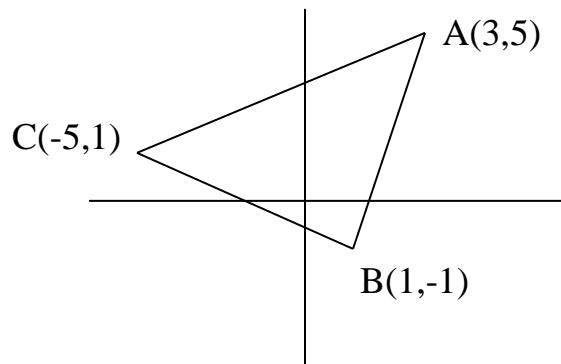11. If f(x) = 2x + 1 and g(x) = 1 – 5x find

   a) f(g(x))   b) g(f(x))

   Hence solve the equation   f(g(x)) - g(f(x)) = 8x + 7

12. Given that $\dfrac{x^2 + 4x + 10}{2x + 5} = n$, form a quadratic equation in x and hence
    show that if $n \le -3$ or $n \ge 2$ then the roots will be real.

13. If sinA = $\dfrac{8}{17}$ and A is acute, find the exact values of

    a) sin2A   b) cos2A

14. In the diagram shown, find the equation of the altitude from A and the
    median from B.

15. The number of bacteria present in a beaker, during an experiment can be measured using the formula $N(t) = 30e^{1.25t}$ where t is the number of hours passed.
  (a) How many bacteria are in the beaker at the start of the experiment?
  (b) Calculate the number of bacteria present after 5 hours.
  (c) How long will it take for the number of bacteria present to treble?

16. Solve for $x > 0$
  (a) $\log_a 5 + \log_a 2x = \log_a 60$ (b) $2\log_a 3 + \log_a x = \log_a 36$
  (c) $\frac{1}{2}\log_x 64 + 2\log_x 2 = 5$ (d) $2\log_x 6 - \frac{2}{3}\log_x 8 = 2$

17. Find where the following curves cut the x-axis.
  (a) $y = \log_4 x - 2$ (b) $y = \log_2 (x - 4) - 1$

18. Find where the following curves cut the y-axis.
  (a) $y = \log_2 (x + 4) + 1$ (b) $y = \log_3 (x + 27) + 5$

19. The mass, M grams, of a radioactive isotope after a time of t years, is given by the formula $M = M_o e^{-kt}$ where Mo is the initial mass of the isotope.
  In 5 years a mass of 10 grams of the isotope is reduced to 8 grams.
  (a) Calculate k.
  (b) Calculate the half-life of the substance i.e. the time taken for half the substance to decay.

20. If $f(x) = \frac{1}{2}x + 8$ find $f^{-1}(x)$

21. If $f(x) = x^3 - 6$ find $f^{-1}(x)$ and state the domain and range of f.

22. If $f(x) = 2\sqrt{x} + 5$, state a suitable domain for f. Find the inverse function.

23. Using Rsin(x – a) find the maximum values of f and g, and the corresponding values of x for $0 \leq x \leq 2\pi$.

  (a) $f(x) = 1 + \sqrt{2}\cos x - \sqrt{2}\sin x$ (b) $g(x) = 2 + \sqrt{3}\sin x - \cos x$.

24. Solve the equation $2\cos(x + \dfrac{\pi}{6}) = 1$, for $0 < x < 2\pi$

25. The diagram shows part of the graph of a function f.
    On separate diagrams sketch the graphs of
    a) f(x+3)   b) -f(x)   c) 2 + f(x-1)
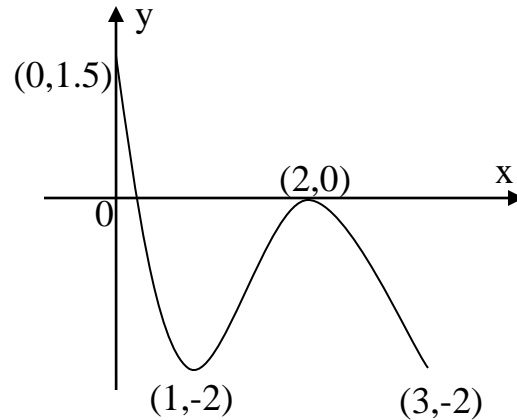
26. The line joining the points (2,3) and (8,k) is perpendicular to the line with
    equation 2y – 3x + 5 = 0. Find the value of k.

27. Find algebraically the **exact** value of the expression
    $$\sin\theta^{\circ} + \sin(\theta + 120)^{\circ} + \cos(\theta + 150)^{\circ}$$

28. If P(3,4,1), Q(9,1,-5) and R(11,0,-7) , prove that P, Q and R are collinear.
    If M(4,7,1), find the size of angle PMQ.

29. The vector $a\underline{i} + b\underline{j} + \underline{k}$ is perpendicular to both
    $\underline{i} - \underline{j} + \underline{k}$ and $2\underline{i} + \underline{j} + \underline{k}$. Find the values of a and b.

30.
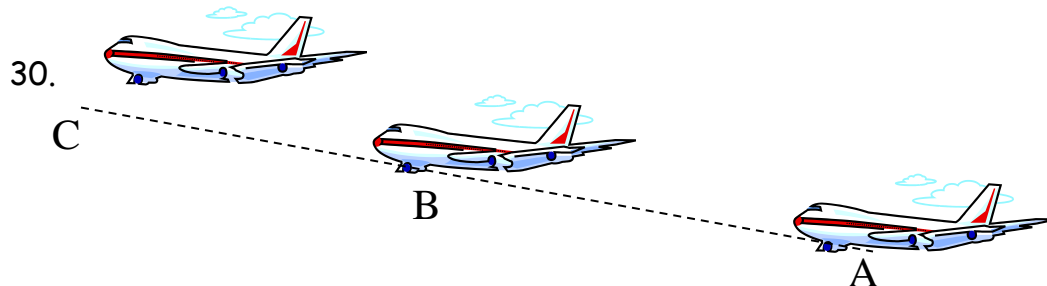
An aircraft flying at a constant speed in a straight flight path takes 2
minutes to fly from A to B and 1 minute to fly from B to C. Relative to a
suitable set of axis A is the point (-1,3,4) and B is the point (3,1,-2). Find the
coordinates of the point C.