Maths Diagnostic Test 2022

To be completed by all students. Calculators are *not* allowed. Please write your answers on a sheet of paper and submit a photograph.

Topic 1: Numbers: operations, fractions, exponents, decimals, surds

1. Add $\frac{3}{7}+\frac{1}{4}$ Decimals answers will not be accepted. 1 mark

2. Express the following in scientific notation: 0.001234. 1 mark

3. Find an exact value for $\sqrt{(3)}\sqrt{(12)}$ and show your work. 2 marks

4. Mutliply $3\times10^{14}\times2\times10^{12}$. 1 mark

Topic 2: Sets: descriptions, operations

5. If $S_1=\{1,3,5,7\}$ and $S_2=\{3,9,12\}$ what is the intersection ($S_1\cap S_2$) of these sets? 2 marks

Topic 3: Solving equations and inequations
6. Solve $3x-7=5$ 2 marks

7. Solve $x^2+3x+2=0$ by factorizing or by using the quadratic formula. 2 marks

8. Solve $3x<9$ 1 mark

Topic 4: Solving linear equations in 2 variables
9. $3x+4y=9$ and $3x-4y=3$ 2 marks

Topic 5: Coordinate geometry: Distance, lines (slope-intercept form), parallel & perpendicular lines. Not need to simplify answers – just get correct expressions.

10. Find the distance between the points (1,2) and (4,5) in the *xy* plane. 2 marks

11. Find a formula for a line that passes through the points (1,3) and (4,9) 2 marks

Topic 6: Trigonometry: angles, trig functions, sine and cosine rules, compound angles

12. Find the hypotenuse of the triangle below and the sine of the angle θ . 2 marks
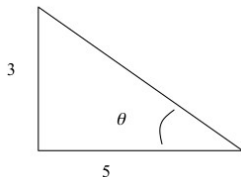

13. Find 190º + 315º and express your result as an angle between 0º and 360º . 1 mark

14. An angle describing a full circle is 360 degrees or 2 π radians. Convert 60 degrees to radians. You may leave π in your answer. 1 mark

Topic 7: Functions: Polynomials, inverses, graphs.
15. Find the inverse of the function $y=3x+2$. In other words, make x the subject of the equation. 1 mark

16. Sketch a graph of the function $y = x^2 + 4$ using a few data points between $x = $ -10, 10. 3 marks

17. Find a function that describes the following graph. Don't worry about very accurate reading of the graph – show you know how to do the problem. 2 marks
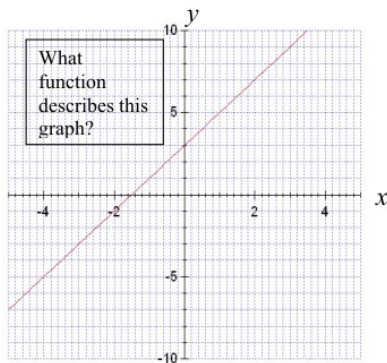
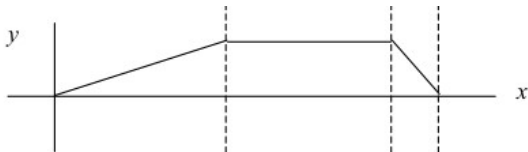**Topic 8. Differentiation: Basic rules, optimisation problems, second derivative and inflection points.**

Differentiate the following functions. In other words, find *dy/dx*.

18. $y = 4x^2 + 5$ 2 marks

19. $y = 2\sin(3x)$ 2 marks

20. $y = \dfrac{2x - 1}{x + 4}$ 2 marks

21. Consider the function below. Sketch its derivative. 3 marks

22. If the profits of a company P depend on sales price S as $P = S(100 - S)$ what is the price that maximizes the profit? 2 marks

Topic 9: Sequences and Series

23. Find $\displaystyle\sum_{n=0}^{\infty} \dfrac{1}{10^n}$

An answer in decimal form is acceptable. 1 mark

Topic 10: Algebra

24. Expand the brackets: $(2x + 3)(y - 2)$. 1 mark

25. Simplify $\dfrac{6x^4}{3xy^2}$ 1 mark

26. Solve $\dfrac{4x-1}{x+1}=5$ 2 marks

27. Consider the following three expressions for power dissipated by a resistor R in a circuit where the voltage across the resistor is V and the current though the circuit is I.

$$P=I^2R=\frac{V^2}{R}=IV$$

Use Ohm's Law $V = IR$ to show that these are all equivalent. 3 marks

28. The position of a mass oscillating on a spring can be described by $x=A\cos(\frac{2\pi}{T}+\varphi)$. Where A is the amplitude, T is the period, and φ is the phase constant. Describe what A, T, and φ mean in physical terms. 3 marks

29. A particular mass oscillating on a spring is described by $x=3\cos\left(2t+\frac{\pi}{4}\right)$. Find the amplitude, period, and phase constant of the motion. Include units in your answers assuming x is in metres and t is in seconds. 3 marks

Topic 11: Logs and Exponentials
**NOTE: Unless otherwise stated, log$x$ means $\log_{10}(x)$ and ln$x$ means $\log_e(x)$.**

30. Solve the following for x: $1042 = 2^x$ You can leave your answer in terms of logs. 1 mark

31. Simplify $10^{\log(9)}$. 1 mark

32. Simplify log($10x$) − log(x) assume base 10. 1 mark

Topic 12: Vectors

33. Find the x and y components of the force vector below. The magnitude of the force is 100 N and the angle to the x-axis is 30 degrees. You can leave your answers in terms of sine and cosine. 2 marks
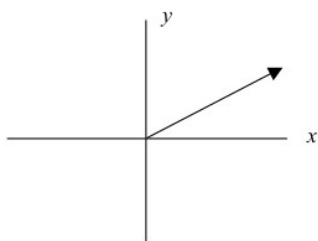
34. Which of the following blue vectors best approximates the sum of the two red vectors. 1 mark