

## **Mini Assessment Questions A2**

Q1.

In an arithmetic series

- the first term is 16
- the 21st term is 24

(a) Find the common difference of the series.

(b) Hence find the sum of the first 500 terms of the series.

(2)

(2)

(Total for question = 4 marks)



Q2.

A curve has equation

$$y = 3x^2 + \frac{24}{x} + 2 \qquad x > 0$$

$$\frac{dy}{dy}$$

(a) Find, in simplest form, dx

(b) Hence find the exact range of values of x for which the curve is increasing.

(3)

(2)

(Total for question = 5 marks)



$$g(x) = (2 + ax)^8$$

where a is a constant

Given that one of the terms in the binomial expansion of g(x) is  $3402x^5$ 

(a) find the value of *a*.

(4)

Using this value of *a*,

(b) find the constant term in the expansion of

$$\left(1+\frac{1}{x^4}\right)(2+ax)^8$$

(3)

Online Maths Teaching

A circle C has equation

$$x^2 + y^2 - 4x + 8y - 8 = 0$$

(a) Find

- (i) the coordinates of the centre of C,
- (ii) the exact radius of C.

The straight line with equation x = k, where k is a constant, is a tangent to C.

(b) Find the possible values for *k*.

(3)

Q4.





Figure 4

Figure 4 shows a sketch of the graph of y = g(x), where

$$g(x) = \begin{cases} (x-2)^2 + 1 & x \le 2\\ 4x - 7 & x > 2 \end{cases}$$

(a) Find the value of gg(0).

(b) Find all values of x for which

g(x) > 28

(2)

The function h is defined by

$$h(x) = (x - 2)^2 + 1$$
  $x \le 2$ 

(c) Explain why h has an inverse but g does not.

(d) Solve the equation

$$h^{-1}(x) = -\frac{1}{2}$$

(3)

www.onlinemathsteaching.co.uk

(Total for question = 10 marks)

Online Maths Teaching

(1)





Figure 2

Figure 2 shows a sketch of part of the graph y = f(x), where

 $f(x) = 2|3 - x| + 5, x \ge 0$ 

(a) State the range of f

(b) Solve the equation

$$f(x) = \frac{1}{2}x + 30$$

(1)



Given that the equation f(x) = k, where k is a constant, has two distinct roots,

(c) state the set of possible values for *k*.

(2)

(Total for question = 6 marks)

Q7.

Using the laws of logarithms, solve the equation

 $\log_3 (12y + 5) - \log_3 (1 - 3y) = 2$ 

(Total for question = 3 marks)

www.online mathsteaching.co.uk



A curve C has parametric equations

$$x = \frac{t^2 + 5}{t^2 + 1}$$
  $y = \frac{4t}{t^2 + 1}$   $t \in \mathbb{R}$ 

Show that all points on C satisfy

$$(x-3)^2 + y^2 = 4$$

(Total for question = 3 marks)

www.onlinemathsteaching.co.uk

Q8.





Figure 1

Figure 1 shows the design for a structure used to support a roof.

The structure consists of four steel beams, AB, BD, BC and AD.

Given AB = 12m, BC = BD = 7m and angle  $BAC = 27^{\circ}$ 

(a) find, to one decimal place, the size of angle ACB.

The steel beams can only be bought in whole metre lengths.

(b) Find the minimum length of steel that needs to be bought to make the complete structure.

(3)

# (Total for question = 6 marks) www.onlinemathsteaching.co.uk

Online Maths Teaching

π

#### Q10.

(a) Express  $2\cos \theta - \sin \theta$  in the form  $R \cos (\theta + \alpha)$ , where R > 0 and  $0 < \alpha < 2$ Give the exact value of R and the value of  $\alpha$  in radians to 3 decimal places.





Figure 6 shows the cross-section of a water wheel.

The wheel is free to rotate about a fixed axis through the point *C*.

The point *P* is at the end of one of the paddles of the wheel, as shown in Figure 6.

The water level is assumed to be horizontal and of constant height.

The vertical height, H metres, of P above the water level is modelled by the equation

 $H = 3 + 4 \cos(0.5t) - 2 \sin(0.5t)$ 

where *t* is the time in seconds after the wheel starts rotating.

Using the model, find

(b) (i) the maximum height of *P* above the water level,

(ii) the value of t when this maximum height first occurs, giving your answer to one decimal place.



In a single revolution of the wheel, *P* is below the water level for a total of *T* seconds.

According to the model,

(c) find the value of T giving your answer to 3 significant figures.

(Solutions based entirely on calculator technology are not acceptable.)

In reality, the water level may not be of constant height.

(4)

(d) Explain how the equation of the model should be refined to take this into account.

(1)

(Total for question = 11 marks)

www.onlinemathsteaching.co.uk

# Online Maths Teaching

### Stats and Mechanics

## Q1.

The Venn diagram shows three events, A, B and C, and their associated probabilities.



Events *B* and *C* are mutually exclusive. Events *A* and *C* are independent.

Showing your working, find the value of *x*, the value of *y* and the value of *z*.

(Total for question = 5 marks)

www.onlinemathsteaching.co.uk



Q2.

A health centre claims that the time a doctor spends with a patient can be modelled by a normal distribution with a mean of 10 minutes and a standard deviation of 4 minutes.

(a) Using this model, find the probability that the time spent with a randomly selected patient is more than 15 minutes.

(1)

Some patients complain that the mean time the doctor spends with a patient is more than 10 minutes.

The receptionist takes a random sample of 20 patients and finds that the mean time the doctor spends with a patient is 11.5 minutes.

(b) Stating your hypotheses clearly and using a 5% significance level, test whether or not there is evidence to support the patients' complaint.



The health centre also claims that the time a dentist spends with a patient during a routine appointment,

T minutes, can be modelled by the normal distribution where  $T \sim N(5, 3.5^2)$ 

(c) Using this model,

(ii) find P (T < 2 | T > 0)

(i) find the probability that a routine appointment with the dentist takes less than 2 minutes

(iii) hence explain why this normal distribution may not be a good model for *T*.

(1)

(3)

The dentist believes that she cannot complete a routine appointment in less than 2 minutes.

She suggests that the health centre should use a refined model only including values of T > 2

(d) Find the median time for a routine appointment using this new model, giving your answer correct to one decimal place.

(Total for question = 15 marks) www.onlinemathsteaching.co.uk





A small ball, *P*, of mass 0.8 kg, is held at rest on a smooth horizontal table and is attached to one end of a thin rope.

The rope passes over a pulley that is fixed at the edge of the table.

The other end of the rope is attached to another small ball, *Q*, of mass 0.6 kg, that hangs freely below the pulley.

Ball P is released from rest, with the rope taut, with P at a distance of 1.5 m from the pulley and with Q at a height of 0.4 m above the horizontal floor, as shown in Figure 1.

Ball Q descends, hits the floor and does not rebound.

The balls are modelled as particles, the rope as a light and inextensible string and the pulley as small and smooth.

Using this model,

(a) show that the acceleration of Q, as it falls, is  $4.2 \text{ m s}^{-2}$ 

(5)



(b) find the time taken by *P* to hit the pulley from the instant when *P* is released.

(6)

(c) State one limitation of the model that will affect the accuracy of your answer to part (a).

(1)

(Total for question = 12 marks)







A ladder AB has mass M and length 6a.

The end A of the ladder is on rough horizontal ground.

The ladder rests against a fixed smooth horizontal rail at the point C.

The point *C* is at a vertical height 4*a* above the ground.

The vertical plane containing AB is perpendicular to the rail.

The ladder is inclined to the horizontal at an angle  $\alpha$ , where sin $\alpha = 5$ , as shown in Figure 1.

The coefficient of friction between the ladder and the ground is  $\mu$ .

The ladder rests in limiting equilibrium.

The ladder is modelled as a uniform rod.

Using the model,

9Mg

4

(a) show that the magnitude of the force exerted on the ladder by the rail at C is 25

(b) Hence, or otherwise, find the value of  $\mu$ .



(7)

(Total for question = 10 marks)

www.onlinemathsteaching.co.uk