BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 8B

Skills 1

Find the stationary points of the following functions. Justify whether they are maxima or minima

(a) $y = x^3 - x^2 - x + 1$

(b) $y = x + \frac{1}{x}$

(c) $y = x^2 + \frac{54}{x}$

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Skills 2

(Hint: a sketch helps in these questions)

(a) Find the set of values of x for which the curve with equation $y = x^2$ is below the line $y = x + 2$

(b) Find the set of values of x for which the curve with equation $y = \frac{8}{x}, x \neq 0$, is below the line $y = 1$

(c) Find the set of values of x for which the curve with equation $y = \frac{4}{x-1}, x \neq 1$, is below the line $y = 8$

(d) Find the set of values of x for which the curve with equation $y = \frac{6}{x+2}, x \neq -2$, is above the line $y = 8$

TAP FOR ANSWERS

Skills 1 - Answers

(a) (1, 0) min, $(-\frac{1}{3}, \frac{32}{27})$ max

(b) (1, 2) min, (–1, –2) max

(c) (3, 27) min

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Skills 2 – Answers

(a) $-1 < x < 2$

(b) $x < 0 \; or \; x > 8$

(c) $x < 1 \; or \; x > \frac{3}{2}$

(d) $-2 < x < -1.25$

TAP TO RETURN

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1

(a) Calculate the discriminant of the quadratic polynomial $2x^2 + 6x + 7$

(b) State the number of real roots of the equation $2x^2 + 6x + 7 = 0$ and hence explain why $2x^2 + 6x + 7$ is always positive

(c) The quadratic equation $kx^2 + (4k + 1)x = -3k - 1$ has a repeated root. Find the value of the constant k.

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2

The curve and the line given by the equations

$kx^2 - xy + (k+1)x = 1$
$-\frac{k}{2}x + y = 1$

where k is a non-zero constant, intersect at a single point.

(a) Find the value of k.

(b) Give the coordinates of the point of intersection of the line and the curve

TAP FOR ANSWERS

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NEW TECHNIQUES!

The modulus of a number a (written as $|a|$) is its positive numerical value. So $|2| = 2$ and $|-2| = 2$.

Sketch the following modulus graphs, writing down the co-ordinates of any points at which the graph meets the coordinate axes.

(a) $y = |2x + 3|$

(b) b) $y = |2x^2 + 5x - 12|$

(c) y= $|2^x - 2|$

(d) $y = |\sin 2x|$

TAP FOR ANSWERS

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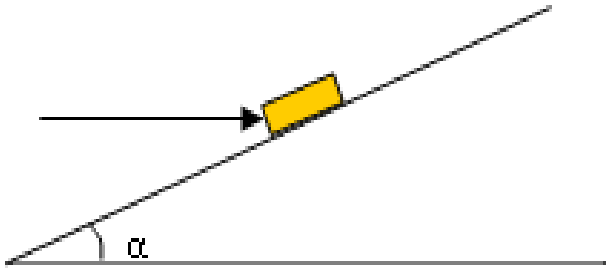
4

The diagram shows a box of mass 2kg being pushed up a smooth plane by a horizontal force of magnitude 20N. The plane is inclined to the horizontal at an angle α, where $\tan\alpha = \frac{3}{4}$.

Find:-

(a) the normal reaction between the box and the plane,

(b) the acceleration of the box up the plane.



TAP FOR ANSWERS

5

A particle of weight 12N is suspended by a light inextensible string from a fixed point O. A horizontal force of 8N is applied to the particle and the particle remains in equilibrium with the string at an angle θ to the vertical.

Find:-

(a) the angle θ

(b) the tension in the string.

TAP FOR ANSWERS

6

A van of mass 1800 kg is being towed along a horizontal road with constant acceleration 0.5 m s^{-2} by a breakdown vehicle. The connecting tow bar is inclined at an angle of 40° to the horizontal, **upwards** from the van. Given that the tension in the tow bar is 1500 N,

(a) calculate the magnitude of the force ***F*** resisting the motion of the car.

(b) calculate the normal contact force of the van on the road.

Draw a diagram showing **all** the forces acting on the **van**, and explain in which direction you are resolving the forces.

TAP FOR ANSWERS

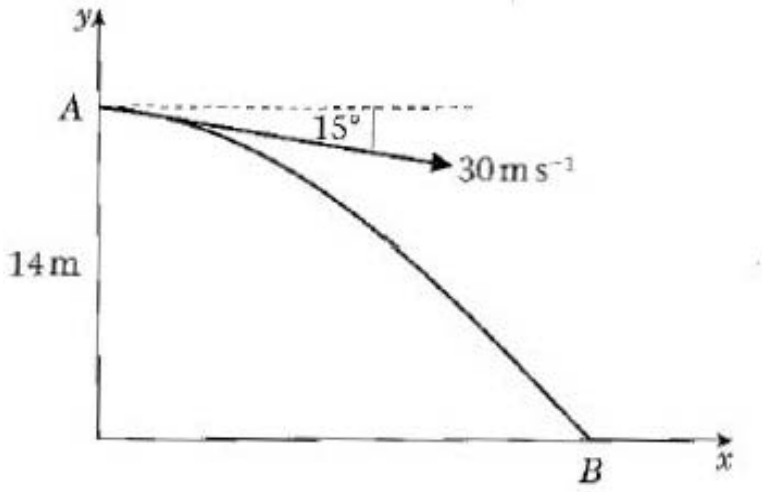
BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 8B

7

A stone is thrown from a point A with speed 30 m s^{-1} at an angle of 15° below the horizontal. The point A is 14m above horizontal ground. The stone strikes the ground at the point B, as shown in the figure above. Find

a) the time the stone takes to travel from A to B.

b) the distance AB



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BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 8B

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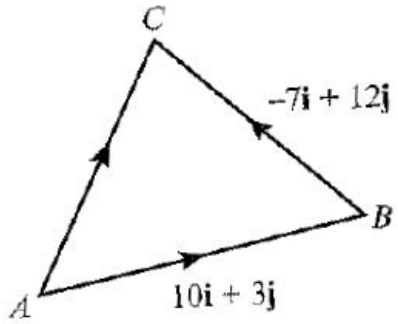
NEW TECHNIQUES!

A **VECTOR** quantity has both magnitude and direction, e.g. force, velocity, displacement.

A **SCALAR** quantity has only magnitude, e.g. time, speed

A girl cycles from A to B and then from B to C.
The displacement from A to B is $10\mathbf{i} + 3\mathbf{j}$ km.
The displacement from B to C is $-7\mathbf{i} + 12\mathbf{j}$ km.



(a) Find the magnitude of the displacement from A to C.

(b) Find the total distance the girl has cycled in getting from A to C.

(c) Work out the angle $\overrightarrow{AC}$ makes with the unit vector $\mathbf{i}$.

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The points A, B and C have position vectors $\begin{pmatrix} 8 \\ -7 \\ 4 \end{pmatrix}$, $\begin{pmatrix} 8 \\ -3 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 12 \\ -6 \\ 3 \end{pmatrix}$ respectively.

(a) Find the vectors $\overrightarrow{AB}$, $\overrightarrow{AC}$ and $\overrightarrow{BC}$.

(b) Find $\left|\overrightarrow{AB}\right|$, $\left|\overrightarrow{AC}\right|$ and $\left|\overrightarrow{BC}\right|$ giving your answers in exact form.

(c) Describe triangle ABC.

TAP FOR ANSWERS

10

$y = 4x^2 - x$

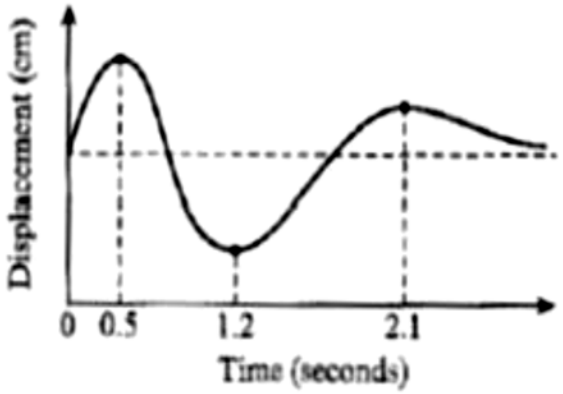
Use differentiation from first principles to show that $\frac{dy}{dx} = 8x - 1$

TAP FOR ANSWERS

11

The motion of a damped spring is modelled using this graph.

On a separate graph, sketch the gradient function for this mode. Choose suitable labels and units for each axis, and indicate the coordinates of any points where the gradient function crosses the horizontal axis.



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BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 8B

NEW TECHNIQUES!

Functions; Composites, domain, range, inverses

The **domain** of a function is the possible inputs (x values), the **range** of a function is the possible outputs (y or f(x) values).

State the range for the given domain for the function $f(x) = 2x - 3$

Domain $x = \{-2, -1, 0, 1, 2, 3\}$

Domain $-2 < x \leq 6$

Domain $x \in R$ (x is a member of the set of all real numbers)

TAP FOR ANSWERS

1 - Answers

(a) -20

(b) no roots as $b^2 - 4ac < 0$ so the graph of $y = x^2 + 6x + 7$ does not cut the x axis and therefore $2x^2 + 6x + 7$ is always positive.

(c) $k = \frac{-1}{2}$

TAP TO RETURN

2 - Answers

(a) $k = -2$

(b) $(-1, 2)$

TAP TO RETURN

3 - Answers

Use desmos to check.

TAP TO RETURN

4 - Answers

(a) 27.7N (3sf)

(b) 2.12 ms^{-2}

TAP TO RETURN

5 - Answers

(a) 33.7^{o}

(b) 14.4N

TAP TO RETURN

6 - Answers

(a) F=249N

(b) R=16700N

TAP TO RETURN

7 - Answers

(a) 1.1 s (2 s.f.)

(b) 34 m (2 s.f.)

TAP TO RETURN

8 - Answers

(a) 15.3 m

(b) 24.3 m

(c) 78.7°

TAP TO RETURN

9 - Answers

(a) $\overrightarrow{AB} = 4\mathbf{j} - \mathbf{k}, \overrightarrow{AC} = 4\mathbf{i} + \mathbf{j} - \mathbf{k}, \overrightarrow{BC} = 4\mathbf{i} - 3\mathbf{j}$

(b) $\left|\overrightarrow{AB}\right| = \sqrt{17}, \left|\overrightarrow{AC}\right| = 3\sqrt{2}, \left|\overrightarrow{BC}\right| = 5$

(c) scalene

TAP TO RETURN

10 - Answers

Proof

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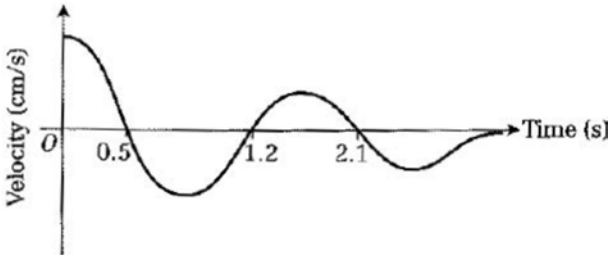
11 - Answers



TAP TO RETURN

12 - Answers

(a) Range $f(x) = \{-7, -5, -3, -1, 1, 3\}$

(b) Range $-7 < f(x) \leq 9$

(c) Range $f(x) \in R$ (x is a member of the set of all real numbers)

TAP TO RETURN