

BHASVIC Maths

Section A: Q1 - 6 90 mins

Section B: Q1 - 6 90 mins

Section C: Q1 - 6 90 mins

Notices:

- Remember teacher subject extension drop ins are every lunch time in room 24
- A2 Doubles students are available for drop in help almost every period, every day, in room 7

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1

1.

a) Express as a single fraction in its simplest form $\frac{x^2 - 8x + 15}{x^2 - 9} \times \frac{2x^2 + 6x}{(x-5)^2}$

Solve the equations

b) $\frac{7}{(x-4)(x+3)} - \frac{4}{(x+3)(x-1)} = \frac{-3}{2}$

c) $\frac{1}{x-1} = \frac{3}{x+1} - \frac{1}{4}$

2.

A teacher asks one of his students to solve the equation $2 \sin 3x = 1$ for $-360^\circ \leq x \leq 360^\circ$.

The attempt is shown below:

$$\begin{aligned} \sin 3x &= \frac{1}{2} \\ 3x &= 30^\circ \\ x &= 10^\circ \\ \text{Additional solution at } 180^\circ - 10^\circ &= 170^\circ \end{aligned}$$

a Identify two mistakes made by the student.

(2 marks)

b Solve the equation.

(2 marks)



3. (a) The following mappings f and g are defined on all the real numbers by

$$f(x) = \begin{cases} 4 - x, & x < 4 \\ x^2 + 9, & x \geq 4 \end{cases} \quad g(x) = \begin{cases} 4 - x, & x < 4 \\ x^2 + 9, & x > 4 \end{cases}$$

- a** Explain why $f(x)$ is a function and $g(x)$ is not. **b** Sketch $y = f(x)$.
c Find the values of: **i** $f(3)$ **ii** $f(10)$ **d** Find the solution of $f(a) = 90$.

4. (a)

A boy of mass 40 kg slides from rest down a straight slide of length 5 m. The slide is inclined to the horizontal at an angle of 20° . The coefficient of friction between the boy and the slide is 0.1. By modelling the boy as a particle, find:

- a** the acceleration of the boy
b the speed of the boy at the bottom of the slide.



5. The colours of the paws of 75 kittens are recorded. 26 kittens have all black paws and 14 kittens have all white paws. 15 have a combination of black and white paws. One kitten is chosen at random. Find the probability that the kitten has:
- a neither white nor black paws (1 mark)
 - b a combination of black and white paws given that they have some black paws. (2 marks)
- Two kittens are now chosen. Find the probability that:
- c both kittens have all black paws (2 marks)
 - d both kittens have some white paws. (2 marks)
- 6.
- a Factorise $\sec x \operatorname{cosec} x - 2 \sec x - \operatorname{cosec} x + 2$. (2 marks)
 - b Hence solve $\sec x \operatorname{cosec} x - 2 \sec x - \operatorname{cosec} x + 2 = 0$, in the interval $0 \leq x \leq 360^\circ$. (4 marks)



1.

$$\frac{x^3 + 2x^2 + 3x - 4}{x + 1} \equiv Ax^2 + Bx + C + \frac{D}{x + 1}$$

Find the values of the constants A , B , C and D .

(4 marks)

2.

A particle of mass 2 kg is in static equilibrium and is acted upon by three forces:

$$\mathbf{F}_1 = (i - j - 2k) \text{ N}$$

$$\mathbf{F}_2 = (-i + 3j + bk) \text{ N}$$

$$\mathbf{F}_3 = (aj - 2k) \text{ N}$$

a Find the values of the constants a and b .

\mathbf{F}_2 is removed. Work out:

b the resultant force \mathbf{R}

c the acceleration of the particle, giving your answer in the form $(pi + qj + rk) \text{ m s}^{-2}$

d the magnitude of this acceleration

e the angle the acceleration vector makes with the unit vector \mathbf{j} .



3 Prove that the equation $\frac{4x+3}{2x-1} + \frac{6x+1}{2x+3} = 3$ has no real roots

4. A particle is moving in a straight line with constant acceleration. The points A , B and C lie on this line. The particle moves from A through B to C . The velocity of the particle at A is 2 m s^{-1} and the velocity of the particle at B is 7 m s^{-1} . The particle takes 20 s to move from A to B .

a Find the acceleration of the particle. **(2 marks)**

The velocity of the particle at C is 11 m s^{-1} . Find:

b the time taken for the particle to move from B to C **(2 marks)**

c the distance between A and C . **(3 marks)**



5.

From the large data set, data was gathered in September 1987 and in September 2015 for the mean daily temperature in Leuchars. Summary statistics are given in the table.

	Min	Max	Median	Σx	Σx^2
1987	7.0	17.0	11.85	356.1	4408.9
2015	10.1	14.1	12.0	364.1	4450.2

- a Calculate the mean of the mean daily temperatures in each of the two years. **(2 marks)**
- b In 2015, the standard deviation was 1.02. Compare the mean daily temperatures in the two years. **(2 marks)**

6. Solve the equation $\sec^2 x = 4 \tan x$ for $-\pi \leq x \leq \pi$, giving answers to 3dp.



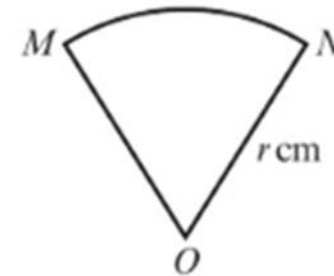
1. Prove that $\frac{5}{x+3} - \frac{10}{(x+3)^2} \equiv \frac{5(x+1)}{(x+3)^2}$

A sector of a circle has area 100 cm^2 .

2. a Show that the perimeter of this sector is given by the formula

$$P = 2r + \frac{200}{r}, r > \sqrt{\frac{100}{\pi}}$$

- b Find the minimum value for the perimeter.



3. $g(x) = \frac{x^4 + 3x^2 - 4}{x^2 + 1}$. Show that $g(x)$ can be written in the form $px^2 + qx + r + \frac{sx + t}{x^2 + 1}$

and find the values of p, q, r, s and t .

(4 marks)





4. It is claimed that 50% of women use Oriels powder. In a random survey of 20 women, 12 said they did not use Oriels powder.
Test, at the 5% significance level, whether or not there is evidence that the proportion of women using Oriels powder is 0.5. State your hypothesis carefully. **(6 marks)**
5. A block of mass 0.8 kg is pushed along a rough horizontal floor by a constant horizontal force of magnitude 7 N. The speed of the block increases from 2 m s^{-1} to 4 m s^{-1} in a distance of 4.8 m. Calculate:
- a the magnitude of the acceleration of the block **(3 marks)**
 - b the magnitude of the frictional force between the block and the floor. **(3 marks)**
6. A curve C has equation
$$y = 5 \sin 3x + 2 \cos 3x, -\pi \leq x \leq \pi$$
- a Show that the point $P(0, 2)$ lies on C . **(1 mark)**
 - b Find an equation of the normal to the curve C at P . **(5 marks)**

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Ans a) $\frac{2x}{x-5}$ b) $x=2, x=3$ c) $x=3, x=5$

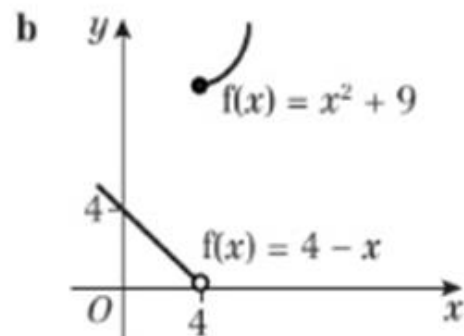
2.

a Found additional solutions after dividing by three rather than before. Not applied the full interval for solutions.

b $-350^\circ, -310^\circ, -230^\circ, -190^\circ, -110^\circ, -70^\circ, 10^\circ, 50^\circ, 130^\circ, 170^\circ, 250^\circ, 290^\circ$

3

a $g(x)$ is not a function because it is not defined for $x = 4$



c i 1 ii 109

d $a = -86$ or $a = 9$



4. $a = 2.43 \text{ ms}^{-2}$ (3 s.f.)
 $v = 4.93 \text{ ms}^{-1}$ (3 s.f.)

5. **a** $\frac{4}{15}$ **b** $\frac{15}{41}$
c 0.117 (3 s.f.) **d** 0.146 (3 s.f.)

6. **a** $(\sec x - 1)(\operatorname{cosec} x - 2)$ **b** $30^\circ, 150^\circ$



1. $A = 1, B = 1, C = 2, D = -6$

2. **a** $a = -2, b = 4$ **b** $(\mathbf{i} - 3\mathbf{j} - 4\mathbf{k}) \text{ N}$
c $(\frac{1}{2}\mathbf{i} - \frac{3}{2}\mathbf{j} - 2\mathbf{k}) \text{ ms}^{-2}$ **d** $\frac{1}{2}\sqrt{26} \text{ ms}^{-2}$
e 126°

3. Proof



BHASVIC Maths PS1

Answers: Section B

4. **a** 0.25 m s^{-2} **b** 16 s **c** 234 m

5 **a** 1987: $11.9 \text{ }^\circ\text{C}$, 2015: $12.1 \text{ }^\circ\text{C}$
b The mean temperature was slightly higher in 2015 than in 1987. The standard deviation of temperatures was higher in 1987 ($2.46 \text{ }^\circ\text{C}$) than in 2015 showing that the temperatures were more spread out.

6. $x = -2.880, -1.833, 0.262, 1.309$



BHASVIC Maths PS1 Answers: Section C

1.

proof

2.

b 40 cm²

3.

$p = 1, q = 0, r = 2, s = 0$ and $t = -6$



BHASVIC Maths PS1 Answers: Section C

4.

a 1.25 ms^{-2}

b 6 N

5.

$H_0: p = 0.5$, $H_1: p \neq 0.5$, $P(X \leq 8) = 0.252 > 0.025$ (two-tailed)

There is insufficient evidence to reject H_0 .

There is no evidence that the claim is wrong.

6.

a $5 \sin(3 \times 0) + 2 \cos(3 \times 0) = 0 + 2 = 2 = y$

When $x = 0$, $y = 2$, therefore $(0, 2)$ lies on C.

b $y = -\frac{1}{15}x + 2$

