Second Year Assignment 2

1. A person throws a ball in a Sports Hall. The height of the ball, h m, can be modelled in relation to the horizontal distance from the point it was thrown from by the quadratic equation

$h = -\frac{3}{10}x^2 + \frac{5}{2}x + \frac{3}{2}$

The Hall has a sloping ceiling. The height of the ceiling is $\frac{15}{2}$ m when $x = 0$ and $\frac{73}{10}$ when $x = 1$.

a) Show that the height of the ceiling is given by the expression $\frac{15}{2} - \frac{1}{5}x$

b) Determine whether the model predicts that the ball will hit the ceiling. Give a mathematical reason for your answer.

c) Is this a good model? Give reasons for your answer.

2. a) Find an equation of the straight line passing through the points with co-ordinates (-1,5) and (4,-2), giving your answer in the form $ax + by + c = 0$ where a, b and c are integers.

b) The line crosses the x-axis at the point A and the y-axis at the point B and O is the origin. Find the area of ΔAOB

3. Two cars A and B are moving in the same direction along a straight horizontal road. At time t=0, they are side by side, passing a point O on the road. Car A travels at a constant speed of $30\ ms^{-1}$. Car B passes O with a speed of $20\ ms^{-1}$, and has a constant acceleration of $4\ ms^{-1}$ Find

a) the speed of B when it has travelled 78 m from O

b) the distance from O of A when B is 78 m from O

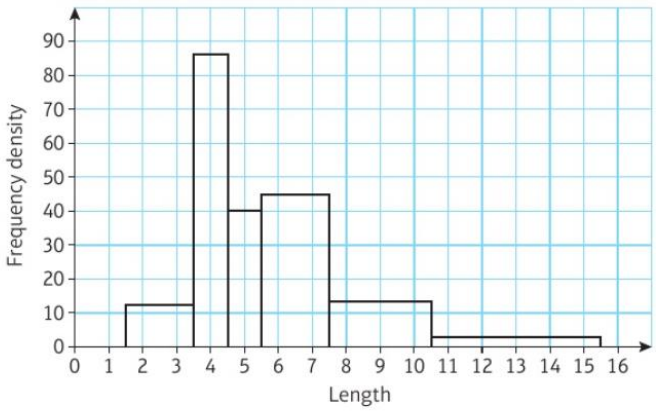
c) the time when B overtakes A

4. A motorcyclist M leaves a road junction at time $t = 0$ s. She accelerates from rest at a rate of $3\ ms^{-1}$ for 8 s and then maintains the velocity she has reached. A car C leaves the same road junction as M at time $t = 0$ s. The car accelerates from rest to $30\ ms^{-1}$. C passes M as they both pass a pedestrian.

a) On the same diagram, sketch velocity-time graphs to illustrate the motion of M and C

b) Find the distance of the pedestrian from the road junction.

5. A histogram looks like a bar chart but the frequency is NOT given by the height.
The frequency in a histogram is proportional to the AREA.
In this histogram the constant of proportionality is equal to 1 so the frequency = area.
BEWARE: This is not always the case. It's very unusual for the constant of proportionality to be equal to 1



Estimate the number of phone calls whose length was between 5½ and 7½ minutes.

6. A girl cycles from Appledore to Benfield and then from Benfield to Charlesville. The displacement from Appledore to Benfield is 10**i** + 3**j** km. The displacement from Benfield to Charlesville is -7**i** + 12**j** km

a) Find the magnitude of the displacement from Appledore to Charlesville.

b) Find the total distance the girl has cycled in getting from Appledore to Charlesville.

c) Work out the angle that the vector from Appledore to Charlesville makes with the unit vector **i**.

7. A sample of the daily maximum relative humidity is taken from the large data set for Leuchars and for Camborne during 2015. The data is given in the table.

Leuchars	100	98	100	100	100	100	100	100	94	100	91	100	100	89	100
Camborne	92	95	99	96	100	100	90	98	81	99	100	99	91	98	100

a) Find the median and quartiles for both samples

b) Compare the two samples

8. a) The table shows the daily mean temperature in Leuchars for the first week in May 2015

May 1st	May 2nd	May 3rd	May 4th	May 5th	May 6th	May 7th
3.8	4.6	9.3	11.0	7.5	9.4	6.8

Calculate i) the mean and ii) the standard deviation of the temperatures

b) The table shows the daily mean temperature in Leuchars for the first six days in May 1987

May 1st	May 2nd	May 3rd	May 4th	May 5th	May 6th
8.7	4.8	6.5	9.3	11.6	10.8

b) The standard deviation for the first week in May 2015 was equal (to 3 s.f.) to the first SEVEN days in May 1987. Find the mean temperature for May 7th 1987. Give your answer to the nearest $0.05℃$

9. Two particles P and Q are moving along the same straight horizontal line with constant acceleration $2\ ms^{-2}$ and $3.6\ ms^{-2}$ respectively. At time $t = 0$, P passes through a point A with speed $4ms^{-1}$. One second later Q passes through A with speed $3ms^{-1}$, moving in the same direction as P.

a) Write down expressions for the displacements of P and Q from A, in terms of t, where t seconds is the time after P has passed through A.

b) Find the value of t where the particles meet.

c) Find the distance of A from the point where the particles meet.

10. Given that $\frac{x^2+1}{x(x-2)} \equiv P + \frac{Q}{x} + \frac{R}{x-2}$, find the values of P,Q and R

11. Solve these equations

a) $|3x - 1| = 5$, b) $|\frac{x-5}{2}| = 1$, c) $|4x + 3| = -2$,

d) $|7x - 3| = 4$, e) $|\frac{4-5x}{3}| = 2$, f) $|\frac{x}{6} - 1| = 3$

12. For each function,

i) sketch the graph of $f(x)$

ii) State the range of $f(x)$

iii) State whether $f(x)$ is one-to-one or many-to-one

a) $f(x) = 2\sin x \ \ for\ the\ domain\ \{0 \ \leq x \leq 180\}$
b) $f(x) = e^x \ for\ the\ domain\ \{x \geq 0\}$
c) $f(x) = 7\log x \ \ for\ the\ domain\ \{x\ \epsilon\ R, x > 0\}$

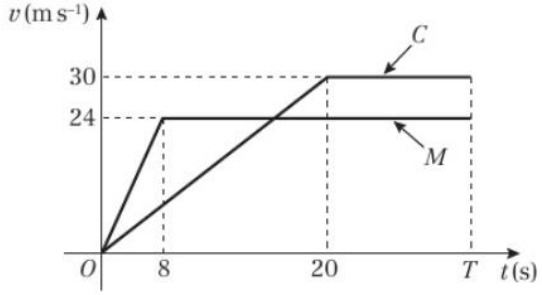
Answers

1 Yes.

2 a) 7x + 5y – 18 = 0 b) $\frac{162}{35}$

3. a) $32\ ms^{-1}$ $b)\ 90\ m$ c) $5\ s$

4. a)



b) 720 m

5. 90

6. a) 15.3 m b) 24.3 m c) 78.7°

7. a) Leuchars: median = 100, lower quartile = 98, upper quartile = 100

Camborne: median = 98, lower quartile = 92, upper quartile = 100

b) The median humidity in Leuchars is higher than the median humidity in Camborne. So Leuchars is, on average more humid than Camborne.

The spread of the humidities for Camborne is greater than the spread of humidities for Leuchars. So the humidity in Camborne is more variable than the humidity in Camborne.

8. a) i) $\frac{262}{35}$ ii) 2.44 b) 11.75

9. a) P: $4t + t^2$, Q:$3(t-1) + 1.8(t-1)^2$ b) 6 c) 60 m

10. $P = 1, Q = -\frac{1}{2}, R = \frac{5}{2}$

11. $a)\ 2, -\frac{4}{3}$ $b) 7, 3$ $c)\ No\ solution$ $d)\ 1, -\frac{1}{7}$ e) $-\frac{2}{5}, 2$ f) $24, -12$

12. a) $0 \leq f(x) \leq 2$, many-to-one

b) $f(x) \geq 1$, one-to-one

c) $f(x) \epsilon R$, one-to-one