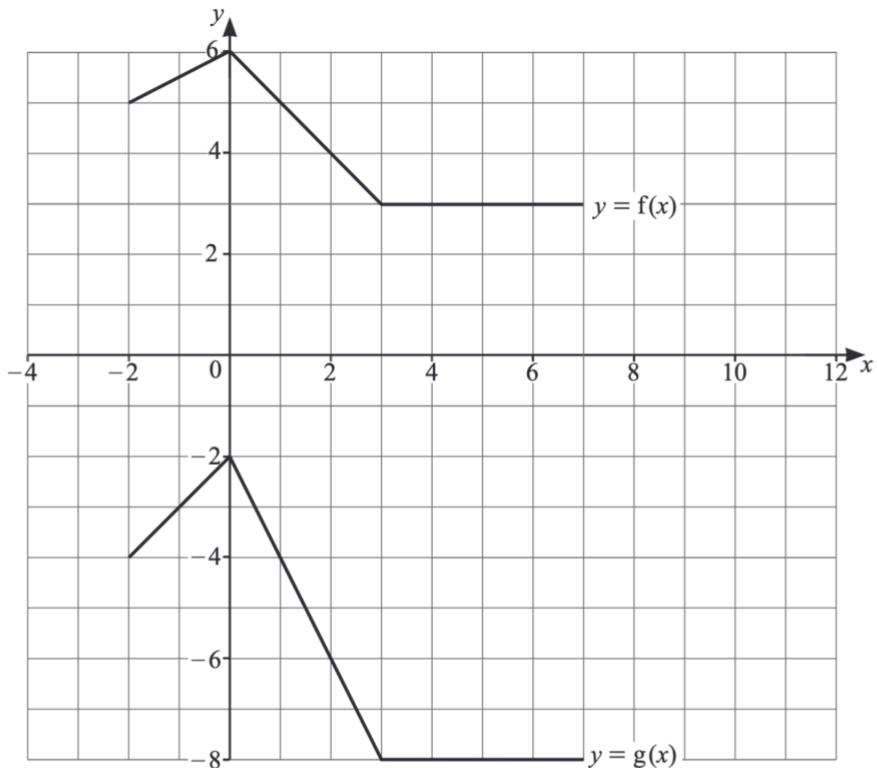


1



The diagram shows the graphs with equations $y = f(x)$ and $y = g(x)$.

Describe fully a sequence of two transformations which transforms the graph of $y = f(x)$ to the graph of $y = g(x)$. Make clear the order in which the transformations should be applied. [4]

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- 5 The equation of a curve is $y = 4 \cos 2x + 3$ for $0 \leq x \leq 2\pi$.

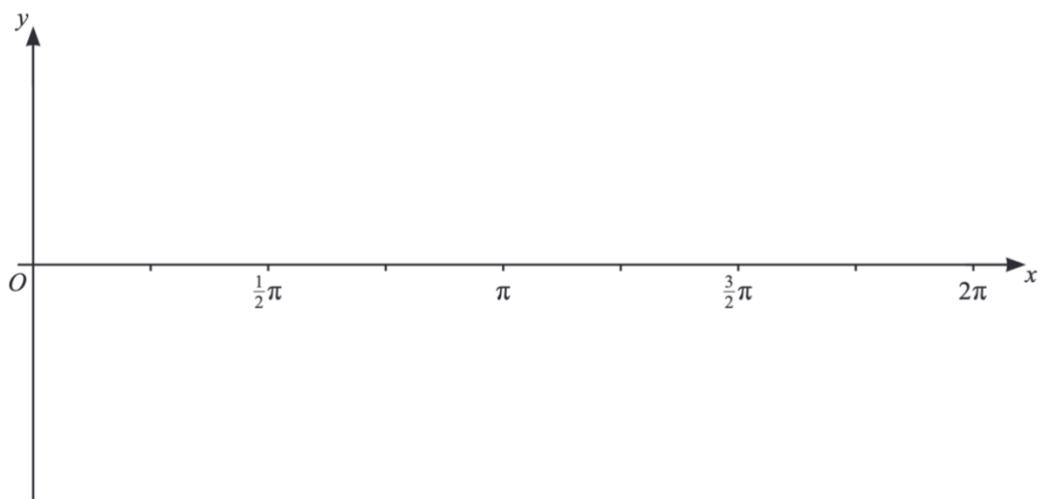
- (a) State the greatest and least possible values of y .

[2]

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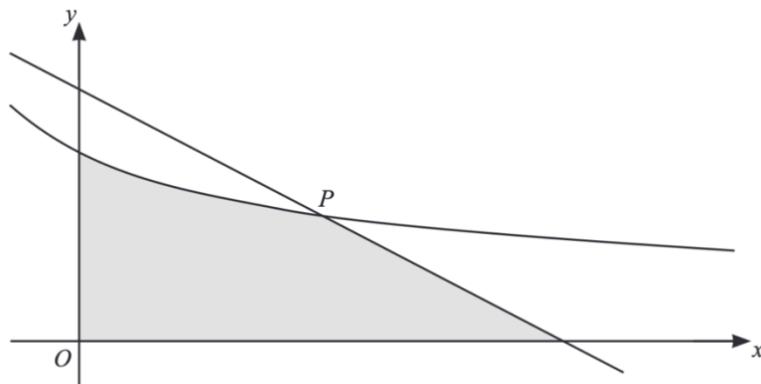
- (b) Sketch the curve.

[2]



- (c) Hence determine the number of solutions of the equation $4 \cos 2x + 3 = 2x - 1$ for $0 \leq x \leq 2\pi$. [1]

6



The diagram shows the curve with equation $y = \frac{9}{(5x+4)^{\frac{1}{2}}}$ and the line $y = 6 - 3x$. The line and the curve intersect at the point P which has y -coordinate 3.

- Find the area of the shaded region.

[6]

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- 10 (a)** The first, second and third terms of an arithmetic progression are $4k$, k^2 and $8k$ respectively, where k is a non-zero constant.

(i) Find the value of k .

[2]

- 10 (a)** The first, second and third terms of an arithmetic progression are $4k$, k^2 and $8k$ respectively, where k is a non-zero constant.

(i) Find the value of k .

[2]

(ii) Find the sum of the first 20 terms of the progression.

[3]

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- (b) The fourth and sixth terms of a geometric progression are 36 and 6 respectively. The common ratio of the progression is positive.

Find the sum to infinity of the progression. Give your answer in the form $\frac{a}{\sqrt{b}-c}$, where a , b and c are integers. [5]

- 11 (a) Express $x^2 + 4x + 2$ in the form $(x+a)^2 + b$, where a and b are integers. [2]

The functions f and g are defined as follows.

$$f(x) = x^2 + 4x + 2 \quad \text{for } x \leq -2$$

$$g(x) = -x - 4 \quad \text{for } x \geq -2$$

- (b) (i) Find an expression for $f^{-1}(x)$. [3]

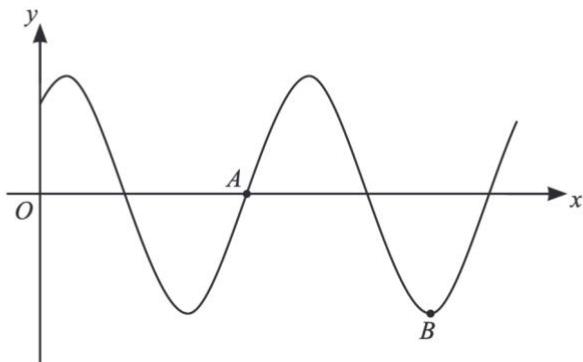
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(ii) Find an expression for $(gf)^{-1}(x)$.

(ii) Find an expression for $(gf)^{-1}(x)$.

[4]

2 (a)



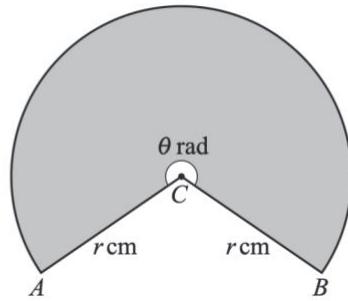
The diagram shows the curve $y = k \cos(x - \frac{1}{6}\pi)$ where k is a positive constant and x is measured in radians. The curve crosses the x -axis at point A and B is a minimum point.

Find the coordinates of A and B .

[3]

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The diagram shows a sector of a circle with centre C . The radii CA and CB each have length r cm and the size of the reflex angle ACB is θ radians. The sector, shaded in the diagram, has a perimeter of 65 cm and an area of 225 cm^2 .

(a) Find the values of r and θ .

[4]

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- 5 The equation of a curve is $y = 2x^2 - \frac{1}{2x} + 3$.

- (a) Find the coordinates of the stationary point.

[3]

- (b) Determine the nature of the stationary point.

[2]

- (c) For positive values of x , determine whether the curve shows a function that is increasing, decreasing or neither. Give a reason for your answer. [2]



- 7 The first term of an arithmetic progression is 1.5 and the sum of the first ten terms is 127.5.

(a) Find the common difference.

[2]

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- (b) Find the sum of all the terms of the arithmetic progression whose values are between 25 and 100.
[5]

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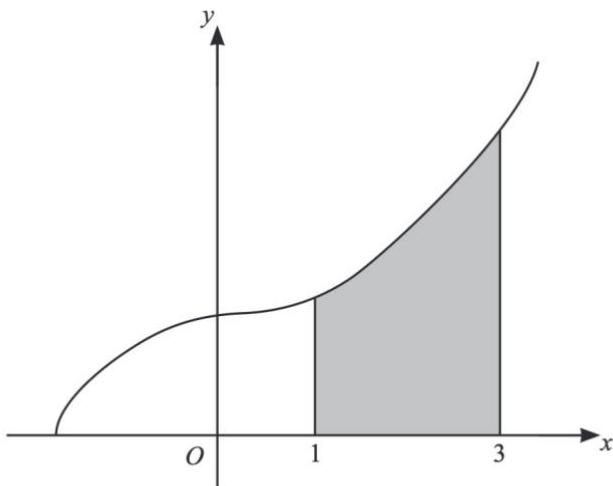
- 8 A circle with equation $x^2 + y^2 - 6x + 2y - 15 = 0$ meets the y -axis at the points A and B . The tangents to the circle at A and B meet at the point P .

Find the coordinates of P .

[8]

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9



The diagram shows the curve with equation $y = \sqrt{2x^3 + 10}$.

- (a) Find the equation of the tangent to the curve at the point where $x = 3$. Give your answer in the form $ax + by + c = 0$ where a , b and c are integers.
[5]

- (b) The region shaded in the diagram is enclosed by the curve and the straight lines $x = 1$, $x = 3$ and $y = 0$.

Find the volume of the solid obtained when the shaded region is rotated through 360° about the x-axis. [3]

- 10 The geometric progression a_1, a_2, a_3, \dots has first term 2 and common ratio r where $r > 0$. It is given that $\frac{9}{2}a_5 + 7a_3 = 8$.

- (a) Find the value of r .

[3]

- (b) Find the sum of the first 20 terms of the geometric progression. Give your answer correct to 4 significant figures. [2]

- 11 The function f is defined by $f(x) = 10 + 6x - x^2$ for $x \in \mathbb{R}$.

- (a) By completing the square, find the range of f .

[3]

The function g is defined by $g(x) = 4x + k$ for $x \in \mathbb{R}$ where k is a constant.

- (b) It is given that the graph of $y = g^{-1}f(x)$ meets the graph of $y = g(x)$ at a single point P .

Determine the coordinates of P .

[6]

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(Questions 4,5,6)

- 4 Vehicles approaching a certain road junction from Bromley must go either left, right or straight on. Over time, it is known that 30% turn left, 25% turn right and 45% go straight on. The driver of each vehicle chooses a direction independently of all other drivers.

- (a) Find the probability that the next three vehicles approaching this junction from Bromley all go in different directions. [2]

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- (b) Find the probability that, from the vehicles approaching this junction from Bromley today, the 1st vehicle to go left is before the 9th vehicle. [2]

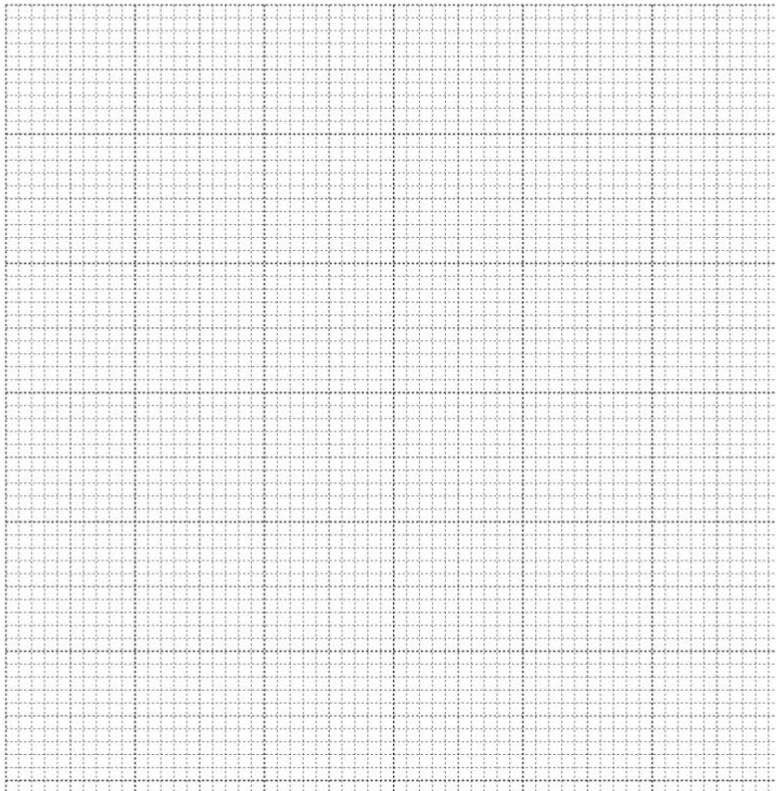
- (c) Find the probability that, from the vehicles approaching this junction from Bromley today, the 2nd vehicle to go left is the 7th vehicle. [2]

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- 5 The times taken, t minutes, by 300 students to travel to Hollowton College are recorded. The results are summarised in the table below.

Time (t minutes)	$t \leq 10$	$t \leq 20$	$t \leq 30$	$t \leq 40$	$t \leq 60$	$t \leq 90$
Cumulative frequency	34	86	142	208	265	300

- (a) On the grid, draw a cumulative frequency graph to illustrate this information. [2]



- (b) 120 students take more than k minutes to travel to college. Use your graph to estimate the value of k . [2]

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- (c) Calculate estimates of the mean and standard deviation of the times taken to travel to college by the 300 students. [6]

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- 6 (a) Find the number of different ways in which the 10 letters in the word AMALGAMATE can be arranged so that there is an M at the beginning, an M at the end and no As are together. [3]

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- (b) Find the number of different ways in which the 10 letters in the word AMALGAMATE can be arranged with exactly 3 letters between the two Ms. [3]

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Five letters are selected from the 10 letters in the word AMALGAMATE.

- (c) Find the number of different selections in which the five letters include at least one M and at least two As. [3]

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(Questions 1(a), 4(a), 5(c), 6(c), 6(d))

- 1 30% of the residents of Wimfield own an electric car. Three residents are chosen at random.

- (a) Find the probability that either all three own an electric car or none of them owns an electric car. [2]

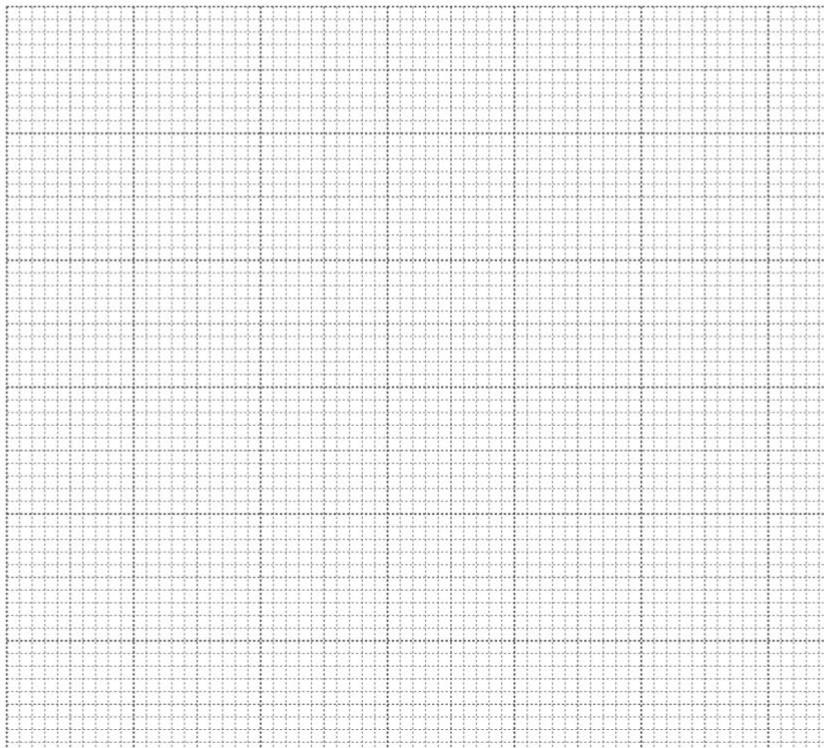
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- 4 On a certain day, the heights of 150 sunflower plants grown by children at a local school are measured, correct to the nearest cm. These heights are summarised in the following table.

Height (cm)	10–19	20–29	30–39	40–44	45–49	50–54	55–59
Frequency	10	18	32	42	28	14	6

- (a) Draw a cumulative frequency graph to illustrate the data.

[4]



- 5 A factory produces chocolates. 30% of the chocolates are wrapped in gold foil, 25% are wrapped in red foil and the remainder are unwrapped.

Indigo chooses 8 chocolates at random from the production line.

- (a) Find the probability that she obtains no more than 2 chocolates that are wrapped in red foil. [3]

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Jake chooses chocolates one at a time at random from the production line.

- (b) Find the probability that the first time he obtains a chocolate that is wrapped in red foil is before the 7th choice. [2]

Keifa chooses chocolates one at a time at random from the production line.

- (c) Find the probability that the second chocolate chosen is the first one wrapped in gold foil given that the fifth chocolate chosen is the first unwrapped chocolate. [5]

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- (c) Find the number of different arrangements of the 9 letters in the word HAPPINESS in which the two Ps are together and there are exactly two letters between the two Ss. [4]

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- (d) Find the probability that both Ps are in one group and both Ss are in the other group. [3]

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(Questions 1, 3, 4, 7)

- 1** Nicola throws an ordinary fair six-sided dice. The random variable X is the number of throws that she takes to obtain a 6.

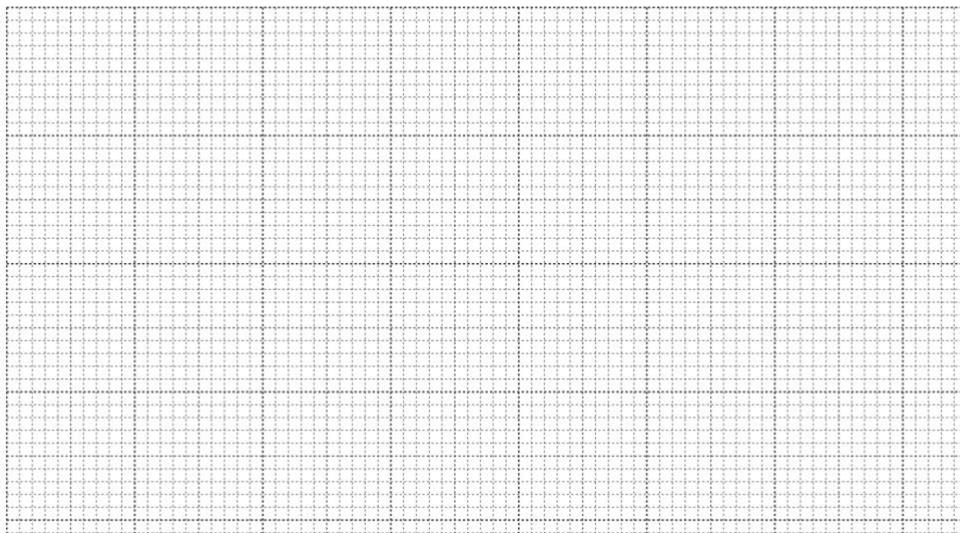
- (a) Find $P(X < 8)$. [2]

- (b) Find the probability that Nicola obtains a 6 for the second time on her 8th throw. [2]

- 3 The time taken, in minutes, to walk to school was recorded for 200 pupils at a certain school. These times are summarised in the following table.

Time taken (t minutes)	$t \leq 15$	$t \leq 25$	$t \leq 30$	$t \leq 40$	$t \leq 50$	$t \leq 70$
Cumulative frequency	18	46	88	140	176	200

- (a) Draw a cumulative frequency graph to illustrate the data. [2]



(b) Use your graph to estimate the median and the interquartile range of the data.

[3]

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(c) Calculate an estimate for the mean value of the times taken by the 200 pupils to walk to school.

[3]

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- 4 Rahul has two bags, X and Y . Bag X contains 4 red marbles and 2 blue marbles. Bag Y contains 3 red marbles and 4 blue marbles. Rahul also has a coin which is biased so that the probability of obtaining a head when it is thrown is $\frac{1}{4}$.

Rahul throws the coin.

- If he obtains a head, he chooses at random a marble from bag X . He notes the colour and replaces the marble in bag X . He then chooses at random a second marble from bag X .
- If he obtains a tail, he chooses at random a marble from bag Y . He notes the colour and discards the marble. He then chooses at random a second marble from bag Y .

(a) Find the probability that the two marbles that Rahul chooses are the same colour.

[3]

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- (b) Find the probability that the two marbles that Rahul chooses are both from bag Y given that both marbles are blue.

[3]

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- 7 (a) How many different arrangements are there of the 9 letters in the word INTELLECT in which the two Ts are together? [2]

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- (b) How many different arrangements are there of the 9 letters in the word INTELLECT in which there is a T at each end and the two Es are not next to each other? [3]

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(Questions 1 and 6)

- 1 The probability distribution table for a random variable X is shown below.

x	-2	-1	0.5	1	2
$P(X = x)$	0.12	p	q	0.16	0.3

Given that $E(X) = 0.28$, find the value of p and the value of q . [4]

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- 6 A Social Club has 15 members, of whom 8 are men and 7 are women. The committee of the club consists of 5 of its members.
- (a) Find the number of different ways in which the committee can be formed from the 15 members if it must include more men than women. [4]

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The 15 members are having their photograph taken. They stand in three rows, with 3 people in the front row, 5 people in the middle row and 7 people in the back row.

- (b) In how many different ways can the 15 members of the club be divided into a group of 3, a group of 5 and a group of 7? [3]

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In one photograph Abel, Betty, Cally, Doug, Eve, Freya and Gino are the 7 members in the back row.

- (c) In how many different ways can these 7 members be arranged so that Abel and Betty are next to each other and Freya and Gino are not next to each other? [3]

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(Question 7)

- 7 (a) Find the number of different arrangements of the 9 letters in the word ALLIGATOR in which the two As are together and the two Ls are together. [2]

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- (b) The 9 letters in the word ALLIGATOR are arranged in a random order.

Find the probability that the two Ls are together and there are exactly 6 letters between the two As. [5]

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- (c) Find the number of different selections of 5 letters from the 9 letters in the word ALLIGATOR which contain at least one A and at most one L. [3]

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(Questions 2, 7)

- 2 (a) Find the number of different arrangements of the 9 letters in the word ALGEBRAIC. [1]

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- (b) Find the number of different arrangements of the 9 letters in the word ALGEBRAIC in which there are no more than two letters between the two As. [3]

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- 7 In a game, players attempt to score a goal by kicking a ball into a net. The probability that Leno scores a goal is 0.4 on any attempt, independently of all other attempts. The random variable X denotes the number of attempts that it takes Leno to score a goal.

- (a) Find $P(X = 5)$. [1]

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- (b) Find $P(3 \leq X \leq 7)$. [2]

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- (c) Find the probability that Leno scores his second goal on or before his 5th attempt. [3]

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Leno has 75 attempts to score a goal.

- (d) Use a suitable approximation to find the probability that Leno scores more than 28 goals but fewer than 35 goals. [5]

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(Question 5)

- 5** A security code consists of 2 letters followed by a 4-digit number. The letters are chosen from {A, B, C, D, E} and the digits are chosen from {1, 2, 3, 4, 5, 6, 7}. No letter or digit may appear more than once. An example of a code is BE3216.

- (a) How many different codes can be formed? [2]

- (b) Find the number of different codes that include the letter A or the digit 5 or both. [3]

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A security code is formed at random.

- (c) Find the probability that the code is DE followed by a number between 4500 and 5000. [3]

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- 6 (a) How many different arrangements are there of the 11 letters in the word REQUIREMENT? [2]

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- (b) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which the two Rs are together and the three Es are together? [1]

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- (c) How many different arrangements are there of the 11 letters in the word REQUIREMENT in which there are exactly three letters between the two Rs? [3]

Five of the 11 letters in the word REQUIREMENT are selected.

- (d) How many possible selections contain at least two Es and at least one R? [4]

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(Question 5,6)

- 5 Salah decides to attempt the crossword puzzle in his newspaper each day. The probability that he will complete the puzzle on any given day is 0.65, independent of other days.

- (a) Find the probability that Salah completes the puzzle for the first time on the 5th day. [1]

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- (b) Find the probability that Salah completes the puzzle for the second time on the 5th day. [2]

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- (c) Find the probability that Salah completes the puzzle fewer than 5 times in a week (7 days). [3]

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- (d) Use a suitable approximation to find the probability that Salah completes the puzzle more than 50 times in a period of 84 days. [5]

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- 6 (a) How many different arrangements are there of the 9 letters in the word RECORDERS? [1]

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- (b) How many different arrangements are there of the 9 letters in the word RECORDERS in which there is an E at the beginning, an E at the end and the three Rs are not all together? [3]

The 9 letters of the word RECORDERS are divided at random into two groups: a group of 5 letters and a group of 4 letters.

- (c) Find the probability that the three Rs are in the same group. [4]

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(Questions 2, 4, 6)

- 2 There are 6 men and 8 women in a Book Club. The committee of the club consists of five of its members. Mr Lan and Mrs Lan are members of the club.

- (a) In how many different ways can the committee be selected if exactly one of Mr Lan and Mrs Lan must be on the committee? [2]

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- (b) In how many different ways can the committee be selected if Mrs Lan must be on the committee and there must be more women than men on the committee? [4]

- 4 Jacob has four coins. One of the coins is biased such that when it is thrown the probability of obtaining a head is $\frac{7}{10}$. The other three coins are fair. Jacob throws all four coins once. The number of heads that he obtains is denoted by the random variable X . The probability distribution table for X is as follows.

x	0	1	2	3	4
$P(X = x)$	$\frac{3}{80}$	a	b	c	$\frac{7}{80}$

- (a) Show that $a = \frac{1}{5}$ and find the values of b and c . [4]

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- (b) Find $E(X)$. [1]

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Jacob throws all four coins together 10 times.

- (c) Find the probability that he obtains exactly one head on fewer than 3 occasions. [3]

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- (d) Find the probability that Jacob obtains exactly one head for the first time on the 7th or 8th time that he throws the 4 coins. [2]

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- 6 Janice is playing a computer game. She has to complete level 1 and level 2 to finish the game. She is allowed at most two attempts at any level.

- For level 1, the probability that Janice completes it at the first attempt is 0.6. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.3.
- If Janice completes level 1, she immediately moves on to level 2.
- For level 2, the probability that Janice completes it at the first attempt is 0.4. If she fails at her first attempt, the probability that she completes it at the second attempt is 0.2.

- (a) Show that the probability that Janice moves on to level 2 is 0.72. [1]

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- (b) Find the probability that Janice finishes the game. [3]

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- (c) Find the probability that Janice fails exactly one attempt, given that she finishes the game. [4]

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