UNIVERSITY OF CAMBRIDGE

ECONOMICS ADMISSIONS ASSESSMENT **D563/11**

Thursday 2 November 2017 **80 minutes**

SECTION 1

INSTRUCTIONS TO CANDIDATES

Please read these instructions carefully, but do not open this question paper until you are told that you may do so. This paper is Section 1 of 2.

A separate answer sheet is provided for this paper. Please check you have one. You also require a soft pencil and an eraser.

Please complete the answer sheet with your candidate number, centre number, date of birth, and name.

At the end of 80 minutes, your supervisor will collect this question paper and answer sheet before giving out Section 2.

This paper contains two parts, **A** and **B**.

Part A	Problem Solving (20 questions)
Part B	Advanced Mathematics (16 questions)

You should attempt **both** parts and you are **strongly** advised to divide your time equally between the two parts: 40 minutes on **Part A** and 40 minutes on **Part B**.

This paper contains 36 multiple choice questions. There are no penalties for incorrect responses, only marks for correct answers, so you should attempt all 36 questions. Each question is worth one mark.

Questions ask you to show your choice between options. Choose the **one** option you consider correct and record your choice on the separate answer sheet. If you make a mistake, erase thoroughly and try again.

You **must** complete the answer sheet within the time limit.

You can use the question paper for rough working but **no extra paper** is allowed. Only your responses on the answer sheet will be marked.

Dictionaries and calculators may NOT be used.

Please wait to be told you may begin before turning this page.

This question paper consists of 27 printed pages and 1 blank page.

PV3

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PART A Problem Solving

1 A picture 40 cm high by 30 cm wide is to be framed. There will be a mount between the edge of the picture and the frame. This mount will be 6 cm wide at the top and sides, and 9 cm wide at the bottom. The width of the wood used for the frame is 2 cm.

What is the overall height of the framed picture?

A 46 cm

B 49 cm

C 56 cm

D 59 cm

E 62 cm

2 The following table summarises the results of all the matches played last season in a football league. (The home team's score is always given first.) Each team plays every other team in the league twice; once at home and once away.

		away team									
		Amazon	Danube	Ganges	Hudson	Nile	Orinoco	Rhine	Tigris	Volga	Yangtze
home team	Amazon		2–2	2–1	4–0	1–1	2–1	1–3	2–0	1–2	1–1
	Danube	1–3		1–4	2–1	2–3	0–1	2–1	0–0	2–5	0–1
	Ganges	2–2	3–1		2–0	1–2	2–3	1–3	1–2	3–1	2–0
	Hudson	1–2	0–1	2–1		0–1	1–3	2–1	1–0	1–4	0–0
	Nile	2–0	3–0	1–2	3–1		1–0	3–3	2–3	2–0	1–2
	Orinoco	4–1	0–0	3–1	2–0	3–2		2–2	3–1	1–2	2–0
	Rhine	2–3	2–1	1–1	3–0	1–2	2–0		3–0	2–2	3–1
	Tigris	1–1	2–2	1–3	1–0	2–0	0–2	0–3		2–4	1–0
	Volga	3–2	3–0	2–1	4–1	2–2	1–0	1–2	4–0		1–1
	Yangtze	0–2	1–2	2–0	2–1	3–1	0–3	0–2	2–0	1–3	

Which was the only team that scored at least one goal in every match they played last season?

A Amazon

B Ganges

C Nile

D Rhine

E Volga

3 Rosie needs to mow her lawn. She has just bought a new lawn mower, and believes she can mow at a rate of $2\,m^2$ a minute. With her old mower, she could only mow the lawn at a rate of $1\,m^2$ a minute. Her lawn is 10 m by 25 m. There is a patio in one corner which is 2 m by 3 m and which she does not need to mow.

How much time does she save with her new lawn mower?

A 122 minutes

B 125 minutes

C 128 minutes

D 244 minutes

E 250 minutes

4 Tasty Crisps are currently running a promotion in which there is one money-off coupon inside every packet. Some coupons are worth 19p, some are worth 12p and others are worth 7p.

My friend tells me that he has at least one of each value and his seven coupons have a total value of exactly £1.

How many of my friend's coupons are worth 19p?

A 1

B 2

C 3

D 4

E 5

5 The heptathlon is a seven-event athletics competition. In each event the time or distance recorded is converted into a points score. This is the scoring table that is used for the high jump:

performance	*points*	*performance*	*points*	*performance*	*points*	*performance*	*points*
2.19	1498	1.89	1093	1.59	724	1.29	399
2.18	1484	1.88	1080	1.58	712	1.28	389
2.17	1470	1.87	1067	1.57	701	1.27	379
2.16	1456	1.86	1054	1.56	689	1.26	369
2.15	1442	1.85	1041	1.55	678	1.25	359
2.14	1428	1.84	1029	1.54	666	1.24	350
2.13	1414	1.83	1016	1.53	655	1.23	340
2.12	1400	1.82	1003	1.52	644	1.22	331
2.11	1386	1.81	991	1.51	632	1.21	321
2.10	1373	1.80	978	1.50	621	1.20	312
2.09	1359	1.79	966	1.49	610	1.19	302
2.08	1345	1.78	953	1.48	599	1.18	293
2.07	1332	1.77	941	1.47	588	1.17	284
2.06	1318	1.76	928	1.46	577	1.16	275
2.05	1305	1.75	916	1.45	566	1.15	266
2.04	1291	1.74	903	1.44	555	1.14	257
2.03	1278	1.73	891	1.43	544	1.13	248
2.02	1264	1.72	879	1.42	534	1.12	239
2.01	1251	1.71	867	1.41	523	1.11	231
2.00	1237	1.70	855	1.40	512	1.10	222
1.99	1224	1.69	842	1.39	502	1.09	214
1.98	1211	1.68	830	1.38	491	1.08	205
1.97	1198	1.67	818	1.37	481	1.07	197
1.96	1184	1.66	806	1.36	470	1.06	188
1.95	1171	1.65	795	1.35	460	1.05	180
1.94	1158	1.64	783	1.34	449	1.04	172
1.93	1145	1.63	771	1.33	439	1.03	164
1.92	1132	1.62	759	1.32	429	1.02	156
1.91	1119	1.61	747	1.31	419	1.01	149
1.90	1106	1.60	736	1.30	409	1.00	141

Daphne is competing in a heptathlon competition and has just beaten her previous best high jump performance by 18 cm. This has increased her best points score in the high jump by 214.

What is Daphne's new personal-best high jump performance?

A 1.09 metres

B 1.44 metres

C 1.74 metres

D 1.89 metres

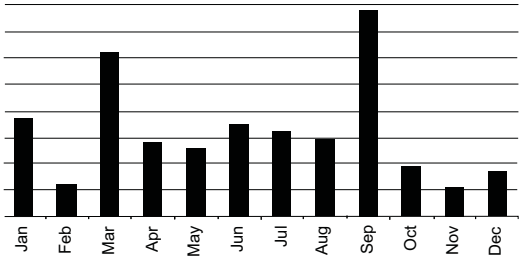
E 2.09 metres

6 After the financial crash there were fewer new car registrations in the UK in 2012 than there were in 2007. The monthly figures for new car registrations for both years are given in the table below.

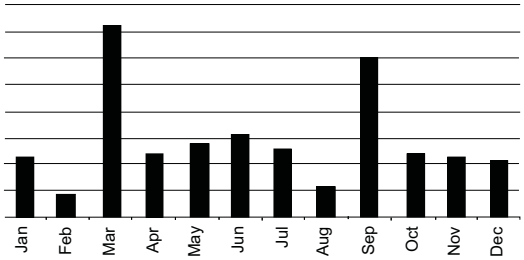
Jan 2012	124.1	Jan 2007	161.2
Feb 2012	61.4	Feb 2007	71.5
Mar 2012	367.9	Mar 2007	445.3
Apr 2012	138.0	Apr 2007	167.9
May 2012	159.0	May 2007	184.8
Jun 2012	185.5	Jun 2007	220.6
Jul 2012	141.7	Jul 2007	175.3
Aug 2012	57.5	Aug 2007	76.2
Sep 2012	359.0	Sep 2007	419.1
Oct 2012	149.7	Oct 2007	168.0
Nov 2012	150.3	Nov 2007	160.5
Dec 2012	123.1	Dec 2007	139.8

Which one of the following charts best represents the monthly differences between new car registrations for these two years?

A



B



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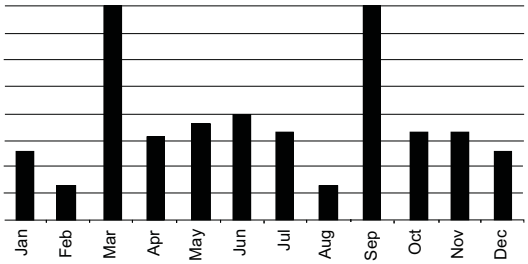
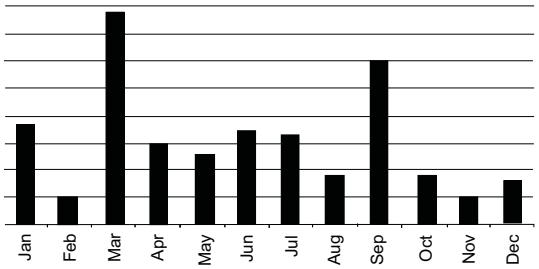
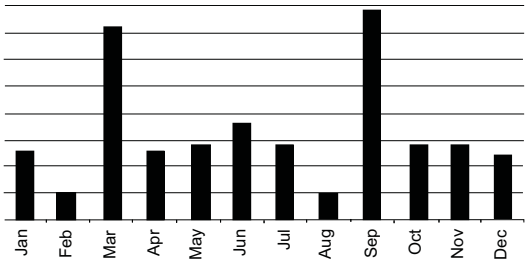


D



E



7 I am planning to repaint the walls and the ceiling of my dining room. The room has the shape of a rectangular box and is 8 m long, 4 m wide and 3 m high. I do not need to paint the door and the three windows, the combined surface area of which is 10 m^2. Paint is sold in 8-litre tins and 1 litre of paint is sufficient for a surface area of 12 m^2.

How many tins of paint do I need to buy?

A 1

B 2

C 6

D 8

E 17

8 Five friends wanted to go on holiday together, but they found it difficult to decide where to go. Jo and Mel both wanted to go to Portugal, with France as their second choice. Kim wanted to go to Majorca, while Lexy's first choice was Greece and Naz's was Tenerife. Naz and Kim both put France as their second choice, while Lexy gave it as her third choice, preferring Tenerife as her second choice. Kim and Mel put Tenerife as their third choice. Jo's third choice was Greece, and Naz's was Majorca.

They agreed to allocate three points for a 1st choice, two points for a 2nd choice and one point for a 3rd choice. The friends decided that they would not go anywhere which was not someone's first choice.

Where did they go on holiday?

A France

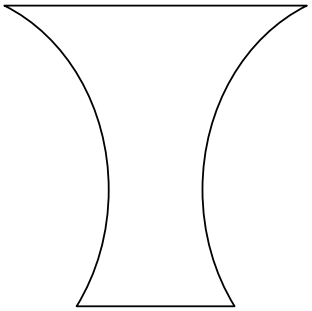
B Greece

C Majorca

D Portugal

E Tenerife

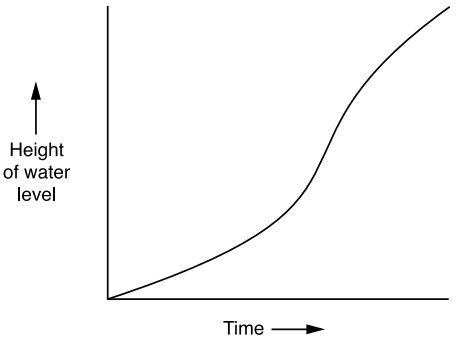
9 A circular flower vase is shown, in cross-section, below:



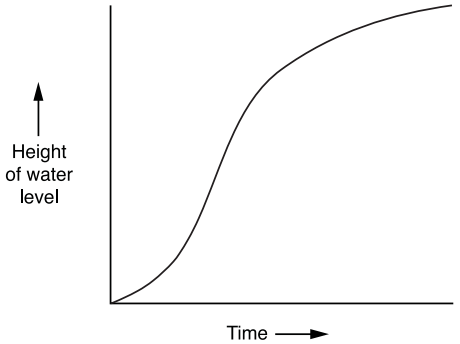
It is filled with water from a tap, flowing at a constant rate.

Which one of the following graphs could represent the height of the water level in the vase as it fills?

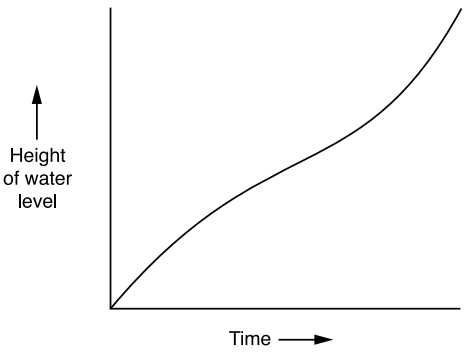
A



B



C



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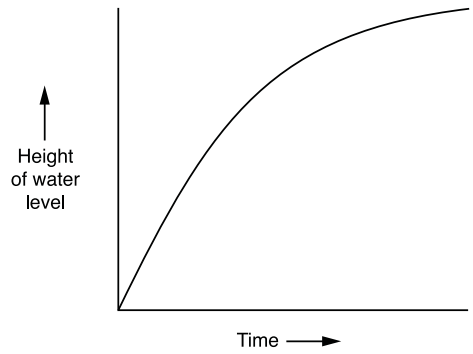
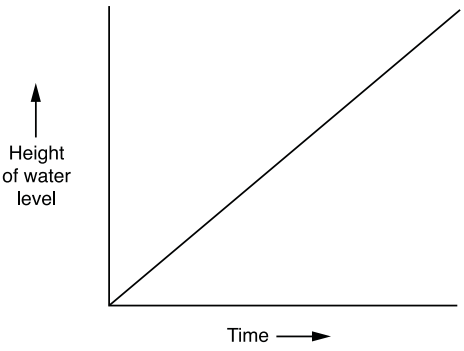


E



10 A laboratory technician has made up a stock mixture of two chemicals, X and Y, ready for use by all of the groups in Year 9 at a High School. He has mixed 6.0 kg which is $\frac{1}{4}$ of X and $\frac{3}{4}$ of Y. He realises that he has used the wrong mix and, rather than waste the chemicals he has used so far, he is going to add some more of chemical X so that the mix consists of 40% of X and 60% of Y.

What mass of chemical X must he add?

A 1.0 kg

B 1.5 kg

C 2.0 kg

D 2.5 kg

E 3.0 kg

11 The following ingredient and nutrition information (rounded to the nearest 0.1 g or 1 kcal) appears on a 300 g packet of oatcakes.

Each oatcake provides:

energy	53 kcal
fat	2.2 g
saturated fat	0.6 g
salt	0.2 g
sugars	0.3 g

Ingredients: oatmeal (77%), vegetable oils, wheat flour, sugar, salt, raising agent: sodium hydrogen carbonate.

Typical values per 100 g: energy 1792 kJ, 427 kcal; protein 10.7 g; carbohydrate 56.45 g of which sugars 2.4 g, starch 53.7 g; fat 17.6 g of which saturates 5.0 g, mono-unsaturates 7.9 g, polyunsaturates 4.5 g; fibre 8.9 g; salt 1.4 g of which sodium 0.6 g.

How many oatcakes are there in a packet?

A 7

B 8

C 21

D 24

E 27

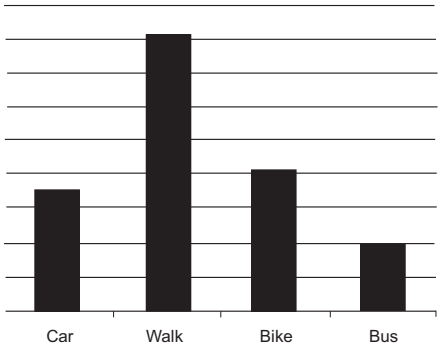
12 The students at the Bolandian Junior High School conducted a survey of methods of transport to school. Unfortunately, they did not record their data fully. Their results are shown below (x means no result was reported):

	car	*walk*	*bike*	*bus*	*total*
girls	x	x	80	50	460
boys	80	200	130	x	x
total	x	410	210	x	900

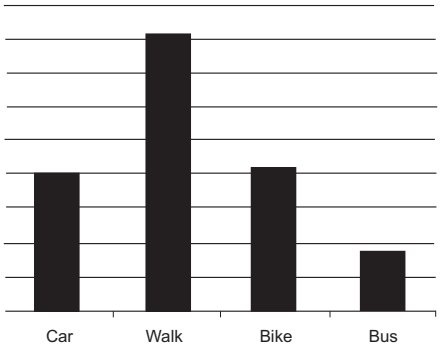
One of the students realised that there was enough information to calculate the totals using each mode of transport.

Which one of the bar charts below, if labelled appropriately, correctly shows the total number using each form of transport?

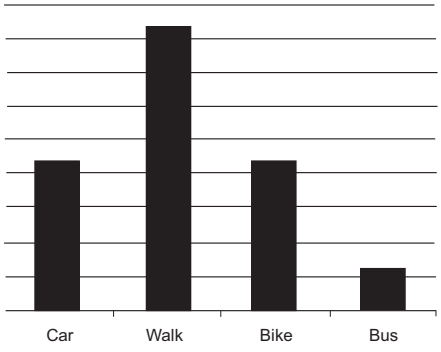
A



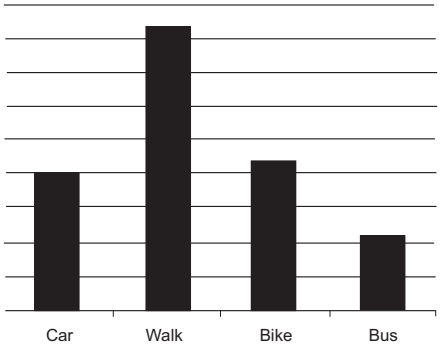
B



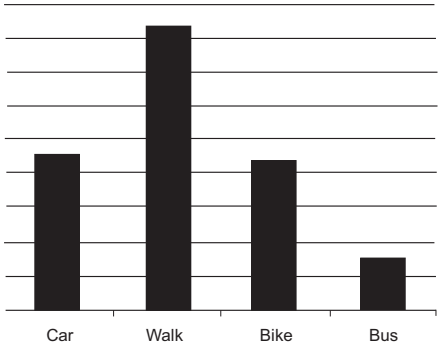
C



D



E



13 There are two ways of scoring points in a ball game: a ‘major’ scores 5 points and a ‘minor’ scores 3 points.

In a match played yesterday, the Reds beat the Blues 77–52 despite the fact that the Blues scored exactly twice as many majors as minors, whilst the Reds scored exactly half as many majors as minors.

How many majors were scored altogether in yesterday’s match?

A 9

B 12

C 15

D 18

E 21

14 Each word in a word game is scored by adding up the values of its letters. Each letter has the same value whenever it appears but different letters have different values. I know the word values for TEAR, RITE, TREE and RAT, but none of the letter values.

How many of the letter values can I now calculate?

A 0

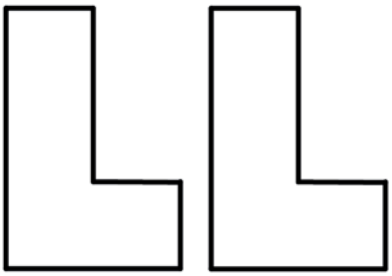
B 1

C 2

D 3

E 4

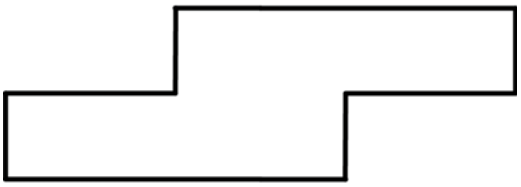
15 Marina purchased a pair of L-shaped tables thinking that they would add an unusual touch to her conference room.



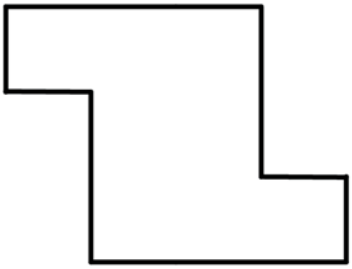
Which one of the following arrangements could **not** be made using the two L-shaped tables?

A

B



C



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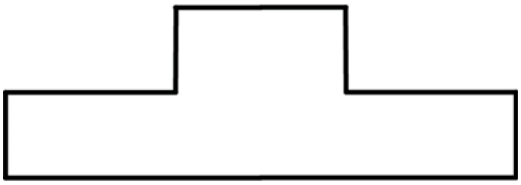
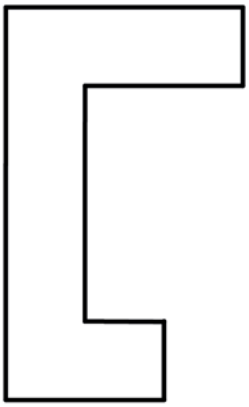


E



16 Fergus Castle is a tourist attraction on a small island off the coast of the mainland. A ferry service runs between the mainland and the island, and takes 40 minutes to make a single journey in either direction. There is a turnaround time of 5 minutes at the end of each single journey. Each day, ferries leave the mainland every 20 minutes, at 5, 25 and 45 minutes past each hour, starting at 09:05. Ferries leave the island at 15, 35 and 55 minutes past each hour, starting at 09:15.

What is the minimum number of boats needed?

A 3

B 4

C 5

D 6

E 7

17 A particular computer game involves the capturing of three types of mythical creatures: Arps, Orps and Urps.

Arps have 6 legs, 3 horns and a tail.
Orps have 4 legs and 2 horns, but no tail.
Urps have 3 legs and a tail, but no horns.

The last time Billy played this game he captured 45 creatures with a total of 222 legs, 99 horns and 33 tails.

How many of the 45 creatures that Billy captured were Urps?

A 8

B 12

C 15

D 20

E 25

18 I am in the habit of taking a daily dose of aloe vera juice. I buy the juice in 600 ml bottles from a local health food shop. At present, however, the shop has sold out and although the proprietor has ordered a further supply, he is not sure how long it will take to come through. As a result, after opening my last bottle and taking my normal dose for 2 days, I have decided to reduce my daily intake to $\frac{3}{4}$ of my normal dose. This means that the bottle will last for 6 days longer than usual.

What is my normal daily dose of aloe vera juice?

A 22.5 ml

B 25.0 ml

C 30.0 ml

D 37.5 ml

E 60.0 ml

19 Joan has a cat called Tibber.

Every day Tibber is fed 2 sachets of wet food and 25 grams of dry food.

For some time, Joan has bought the cat food from the local pet shop where one box of 12 sachets costs £12.00 and one 400 gram packet of dry food costs £4.00.

Joan has now decided to buy all of the cat food from an online distributor.

Four boxes, each of 24 sachets of wet food, will cost £62.40, and one 2 kilogram packet of dry food will cost £16.00.

How much money will Joan save each day on cat food when she buys it from the online distributor rather than the local pet shop?

A 40p

B 75p

C 93p

D £1.50

E £2.25

20 Nathan lives in London. His older brother Mark lives in San Diego, his younger brother Ben lives in Barcelona and his sister Isabel lives in Nairobi. Nathan is trying to arrange an online call between all four siblings. Each of the siblings has agreed to be available between 08:00 and 20:00 local time.

San Diego is 8 hours behind London time.
Barcelona is 1 hour ahead of London time.
Nairobi is 2 hours ahead of London time.

For how many hours during a 24-hour period are at least three of the four siblings able to be online at the same time?

A 8

B 9

C 10

D 11

E 12

PART B Advanced Mathematics

21 On Monday a shirt is reduced in price by 30% of its original price.

On Tuesday the shirt is further reduced in price by 20% of its Monday reduced price.

What is the overall price reduction of the shirt as a percentage of its original price?

A 6%

B 10%

C 25%

D 44%

E 50%

F 60%

22 Find $\int_1^2 \left(3x + \frac{1}{x}\right)^2 \mathrm{d}x$

A 13.5

B 14.75

C 21.5

D 26.5

E 27.5

F 28.75

23 Find the complete set of values of x for which $x - \frac{3}{2} > \frac{1}{x}$

A $x < -\frac{1}{2},\ x > 2$

B $x < -\frac{1}{2},\ 0 < x < 2$

C $x < -2,\ 0 < x < \frac{1}{2}$

D $x < -2,\ x > \frac{1}{2}$

E $-\frac{1}{2} < x < 0,\ x > 2$

F $-2 < x < 0,\ x > \frac{1}{2}$

24 75 pupils in a year group study German or French, or both, or neither.

10 pupils study both languages.

The ratio of those who study both to those that study neither is 5 : 3 respectively.

42 pupils study German.

2 pupils are chosen and each pupil is equally likely to be chosen.

What is the probability that one pupil studies French, and the other pupil studies **only** German?

A $\frac{16}{75}$

B $\frac{128}{555}$

C $\frac{7}{25}$

D $\frac{32}{75}$

E $\frac{256}{555}$

F $\frac{14}{25}$

25 The equation gives y in terms of x:

$$y = 3 + 2\left(\frac{x}{4} - 1\right)^2$$

Which one of the following is a rearrangement for x in terms of y?

A $x = 4\left(1 \pm \sqrt{\frac{y-3}{2}}\right)$

B $x = 4\left(1 \pm \sqrt{\frac{y+3}{2}}\right)$

C $x = 4\left(-1 \pm \sqrt{\frac{y-3}{2}}\right)$

D $x = 4\left(-1 \pm \sqrt{\frac{y+3}{2}}\right)$

E $x = 2\left(1 \pm \sqrt{\frac{y-3}{2}}\right)$

F $x = 2\left(-1 \pm \sqrt{\frac{y-3}{2}}\right)$

26 The function f is given by

$$f(x) = 2x^3 + px^2 + qx + 6$$

where p and q are real constants.

When $f(x)$ is divided by $(x+1)$, the remainder is 12

When $f(x)$ is divided by $(x-1)$, the remainder is -6

Find the remainder when $f(x)$ is divided by $(2x-1)$

A 0

B 4.5

C 9

D 10.5

E 11

27 A bag contains only n red balls and $2n$ green balls.

One ball is picked and its colour recorded. It is then put back in the bag, and an additional ball of the same colour is added to the bag.

A second ball is then picked.

What is the probability that the two balls picked are **not** the same colour?

A $\dfrac{2n}{3(3n-1)}$

B $\dfrac{4n}{3(3n-1)}$

C $\dfrac{5n}{3(3n-1)}$

D $\dfrac{5n-3}{3(3n-1)}$

E $\dfrac{2n}{3(3n+1)}$

F $\dfrac{4n}{3(3n+1)}$

G $\dfrac{5n}{3(3n+1)}$

H $\dfrac{5n+3}{3(3n+1)}$

28 The curve *C* has equation $y = x^3 - 7x - 6$

Find the equation of the tangent to *C* at the point where *C* cuts the positive x-axis.

A $y = 4 - 4x$

B $y = 2x - 6$

C $y = 5x - 10$

D $y = 9x - 27$

E $y = 20x - 60$

29 The simultaneous equations

$$3x^2 - xy = 4$$

$$2x - y = p$$

where p is a real constant, have two distinct real solutions for x.

What is the complete set of values that p can take?

A p can take any value

B $p < -4,\ p > 4$

C $-4 < p < 4$

D there are no possible values of p

30 A company employs a total of 180 people:

94 Category P employees

86 Category Q employees

All the employees were asked how they travelled to work each morning.

Responses have not yet been received from all of the employees.

Those responses that have been received so far are shown in the table.

	walk/cycle	*car*	*other*
category P	34	12	29
category Q	30	21	27

When all the responses have been received an employee will be chosen at random from those who come by car.

The probability that this chosen employee is in Category Q will then be calculated.

What is the smallest value that this probability could take?

A $\frac{7}{20}$

B $\frac{21}{52}$

C $\frac{29}{60}$

D $\frac{29}{41}$

E $\frac{4}{5}$

31 *S* and *T* are geometric progressions. For each, the second term is 6 and the sum to infinity is 25.

The first term of *S* is greater than the first term of *T*.

What is the fourth term of *S*?

A $\frac{8}{125}$

B $\frac{4}{25}$

C $\frac{24}{25}$

D $\frac{162}{125}$

E $\frac{54}{25}$

32 An arithmetic series has first term a, common difference d and n terms. The sum of the series is *S*.

A second arithmetic series also has common difference d and n terms. The first term of this series is $a+5$.

What is the sum of the second arithmetic series?

A $S+5$

B $S+5(n-1)$

C $S+5n$

D $S+(a+5)$

E $S+(a+5)(n-1)$

F $S+(a+5)n$

33 The real solution of the equation

$$5^{2x+1} + 5^x - 4 = 0$$

can be written as

A $\dfrac{2}{\log_2 5} - 1$

B $2\log_2 \dfrac{2}{5}$

C 0

D $\dfrac{2}{\log_2 5}$

E $\dfrac{1}{\log_2 5}$

34 Which one of the following is the area enclosed by the curves $y = -x^2 + 5x - 4$ and $y = x^2 - x$?

A $\dfrac{1}{3}$

B $\dfrac{5}{3}$

C 2

D $\dfrac{8}{3}$

E 5

35 The graph of $y = f(x)$ intersects the x-axis at exactly two distinct points.

Consider the graphs of the following:

$y = f(x) + 2$

$y = f(x + 2)$

$y = 2f(x)$

$y = 2 - f(x)$

$y = f(-2x)$

How many of these graphs **necessarily** intersect the x-axis at exactly two distinct points?

A 0

B 1

C 2

D 3

E 4

F 5

36 I make the following statements:

Statement P: **if** a pig has horns, **then** it can breathe fire.

Statement Q: **if** a pig can breathe fire, **then** it has wings.

Statement R: **if** a pig has wings, **then** it has horns.

Each statement is either true or false, but I don't know which.

I then see a pig with wings breathing fire. It has no horns.

Which statements, if any, can I now conclude are definitely true or definitely false?

A none of them

B P only

C Q only

D R only

E P and Q only

F P and R only

G Q and R only

H P, Q, and R

END OF TEST

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