ECONOMICS ADMISSIONS ASSESSMENT

SPECIMEN PAPER 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. 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 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.

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.

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 paper consists of 28 printed pages and 4 blank page

PV1

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PART A Problem Solving

1 Two neighbours work for the same company and share the journey to work, driving alternately in strict rotation. They work Monday to Friday each week and every other Saturday. They always work the same Saturdays as each other.

What is the maximum number of days either of them has to drive in a calendar month?

A 11

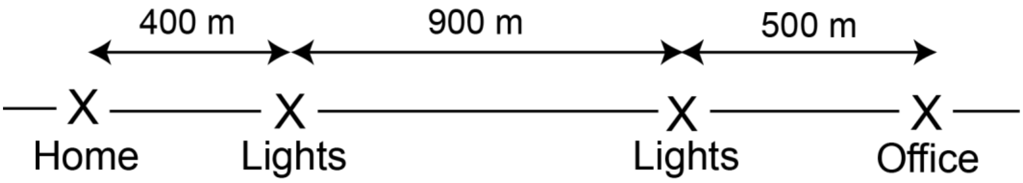
B 12

C 13

D 14

E 15

2 Central Avenue is a long straight road, several kilometres long. Both my home and my office are on Central Avenue, and the diagram below shows their positions, together with two sets of traffic lights that lie in between.



Both sets of lights turn to green for Central Avenue traffic simultaneously, showing green for exactly two minutes, turning green again exactly two minutes later.

I cycle to work every morning at a steady speed of 5 metres per second (except, of course, whilst waiting at traffic lights).

What is the **longest** time I can expect my journey to work to take?

A 6 minutes

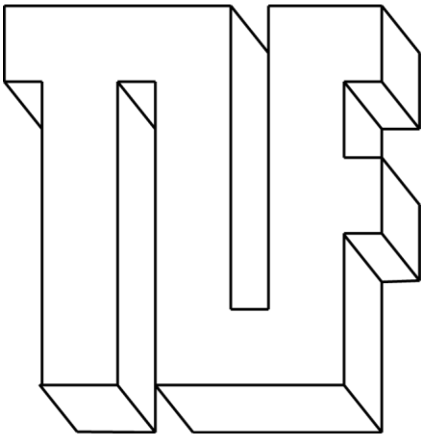
B 7 minutes

C 8 minutes

D 9 minutes

E 10 minutes

3 Below is Thomas Leslie Fuller's brass paperweight, which shows his initials.



Which one of the following is not a side view of the paperweight when it is placed flat on a table (either side up)?

A 

B 

C 

D 

E 

4 The table below shows the energy values for the main foods used by volunteer wardens at a wild bird reserve to prepare a variety of feed mixes.

Food	*Energy per 100 g (calories)*
mealworms	150
peanuts	560
apples	350
oats	370
niger seed	480
cheese	400
sunflower seeds	500
raisins	300
sunflower hearts	600
suet	800

A trainee volunteer has been asked to prepare a sample of a special mix to provide exactly 5 000 calories. He has weighed out the first four ingredients but cannot read the required mass of the final ingredient because of an ink blot. This is what has been weighed out so far:

mealworms 150 g, apples 150 g, raisins 250 g, suet 125 g

What mass of sunflower seeds must be used to complete the task successfully?

A 500 g

B 520 g

C 540 g

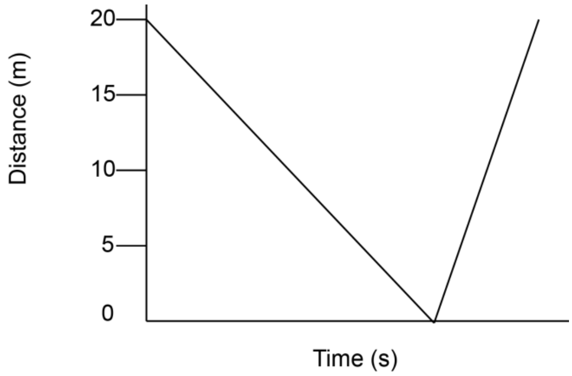
D 560 g

E 680 g

5 Sue takes her dog Freya to the park. She throws a stick for Freya to fetch. Freya runs to collect the stick and bring it back to Sue. While Freya is collecting the stick, Sue walks slowly towards Freya.

Which one of the following graphs could correctly show the distance between Sue and Freya?

A



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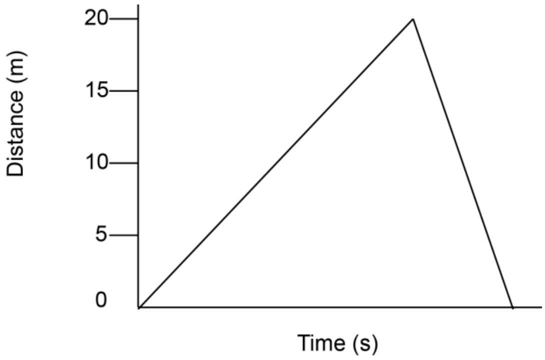

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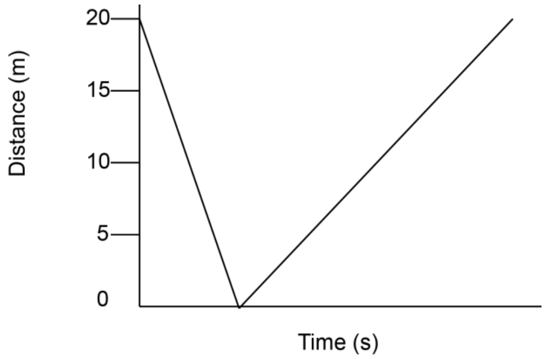

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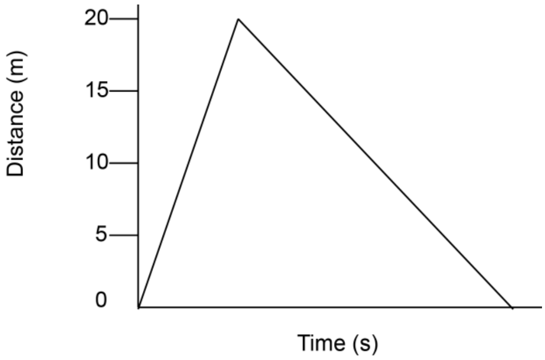

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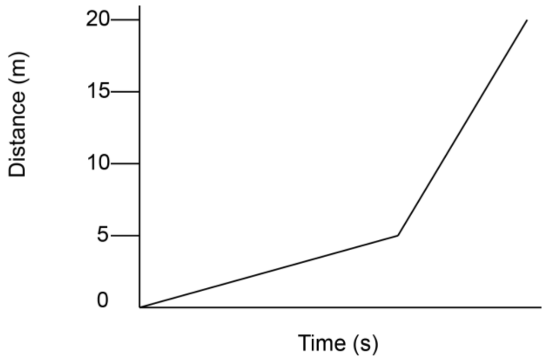
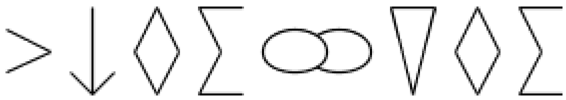


6 Whenever my friend Alistair writes to me he does so entirely in code. He always uses symbols for letters but changes the code each time, so any particular symbol does not necessarily stand for the same letter of the alphabet on the next occasion he writes.

I always start to crack the code by looking at how he has written his name at the end of his email. For instance, last time he was:

In my last email to him I asked him when he intends to visit me next. Today I have received a reply consisting of just one word as follows:



When can I assume that he intends to appear?

A TOMORROW

B THURSDAY

C SATURDAY

D NOVEMBER

E SOMETIME

7 David has a new on-board bicycle computer but has not learned all the functions yet, so can only read the total mileage and average speed of all of the journeys since he fitted it. On his first journey using it he covered 15 km at an average speed of 30 km/h. He can work out from this that the journey took him 15/30 hours or exactly 30 minutes. After the second journey, his total mileage was 24 km and overall average speed 32 km/h.

What was his average speed on the second journey?

A 18 km/h

B 31 km/h

C 34 km/h

D 36 km/h

E 45 km/h

8 My current membership of the squash club is about to expire and so I wish to renew it. The options available to me are given in the table below and have not changed since I joined as a new member six months ago (a change in membership type counts as a renewal, not a new member).

Membership type	*Length*	*Extras*	*New member (£)*	*Renewal price (£)*
Bronze	1 year	none	10	8
Silver	6 months	free locker	25	18
	1 year	free locker	45	28
Gold	6 months	free locker free competition entry	40	32
	1 year	free locker free competition entry	75	52

I am currently a Gold member, but I do not want to enter competitions any more as I play only once a month. I do need a locker when I visit and the normal cost to hire a locker is £2 per visit. I want to choose a membership that will give me the smallest possible total cost for a full year.

What will be the difference between the amount that I will pay now and the amount I paid six months ago?

A I will pay £32 less.

B I will pay £30 less.

C I will pay £12 less.

D I will pay £8 less.

E I will pay £5 more.

9 The table shows the number of children in the town of Lancester aged 11 and 16 who play various sports after school.

Sport	*11-year-olds*	*16-year-olds*
Football	120	181
Cricket	120	133
Hockey	55	66
Swimming	104	150
Tennis	123	149
Squash	51	97

In which sport was the proportion of 11-year-old to 16-year-old children nearest to that for swimming?

A Football

B Cricket

C Hockey

D Tennis

E Squash

10 The table below shows the mean maximum daily temperature for Oxford for each year from 1905 to 1920 along with a 5-year moving average (the value shown beside 1920 is the average from 1916 to 1920 inclusive). Three values are missing from the table.

Year	*Mean maximum daily temperature*	*5-year moving average*
1905	13.4	13.40
1906	14.4	13.56
1907	13.4	13.60
1908	13.7	13.66
1909	x	y
1910	13.3	z
1911	14.9	13.66
1912	13.7	13.72
1913	14.2	13.82
1914	14.7	14.16
1915	13.6	14.22
1916	13.3	13.90
1917	12.8	13.72
1918	13.8	13.64
1919	13.0	13.30
1920	13.8	13.34

What value should be in the position marked 'y'?

A 13.30

B 13.58

C 13.64

D 13.66

E 13.72

11 The West Water Canoe School offers tuition in basic canoeing skills. There are 18 canoes for students to use. The school offers a minimum instructor to student ratio of 1:6 and a minimum of two instructors for any group.

Instructors are hired by the centre on a casual basis and are paid only for the time they actually work. Instructors are paid £6 per hour and are expected to use their own canoes.

The cost for students depends on the numbers in the group and the length of the session. Costs are set out in the table below.

Number in group	*Cost per student for first hour*	*Cost per student for subsequent hours*
1 to 2	£12	£10
3 to 6	£10	£8
7 to 10	£8	£6
more than 10	£7	£5

What is the maximum profit the centre can make from a group after paying the instructors for a two-hour session?

A £108

B £180

C £198

D £216

E £360

12 A teacher is going to award a prize to her most deserving pupil in the current school year. She has narrowed it down to five students and must make her final judgements. She won't give the prize to anyone who has been late to her lessons more than twice. She won't give it to anyone who has failed to complete more than two pieces of homework by the deadline set. After these criteria have been met, the prize will be awarded to the student with the fewest non-A-grade pieces of work.

Pupil	*Year group*	*No. of lessons missed*	*No. of times late for lesson*	*No. of homeworks set*	*Homeworks completed by deadline*	*Homeworks with grade A*
Andrew	8	4	1	60	56	58
Carole	11	2	2	56	56	53
Edward	9	6	2	59	56	58
Grace	10	6	3	58	57	56
Ian	11	10	2	54	53	52

Which student will be awarded the prize?

A Andrew

B Carole

C Edward

D Grace

E Ian

13 A market research company conducted a survey into the relative popularity of two soft drinks with the following results (all figures are percentages):

	Age 5–15	*Age 15–25*	*Age 25–35*	*Age over 35*
Prefer Drink A	28	38	32	24
Prefer Drink B	20	31	33	19
No preference	33	12	22	34
Liked neither	19	19	13	23

The same number of people were surveyed in each age group.

Which one of the following conclusions can be justifiably drawn from the results?

A Drink A is consistently more popular than Drink B.

B There were more people with a preference for Drink B than with no preference.

C More people in the age group 5–15 expressed a preference than did not.

D Fewer people had a preference than those who did not.

E More than 20% of people did not know which they preferred.

14 My monthly electricity bill is calculated as a standing charge plus an amount per unit used. At the beginning of one month my electricity company decided to change the tariff by reducing the standing charge and increasing the cost per unit. This was intended to help customers who use less electricity.

The table below shows my consumption and monthly charges for the whole year.

Month	*Units used*	*Charge (£)*	*Month*	*Units used*	*Charge (£)*
Jan	125	42.50	Jul	60	36.00
Feb	150	45.00	Aug	70	37.00
Mar	130	43.00	Sep	80	36.00
Apr	110	41.00	Oct	100	40.00
May	95	39.50	Nov	110	42.00
June	75	37.50	Dec	130	46.00

At the beginning of which month was the tariff changed?

A February

B April

C August

D September

E December

15 There are 420 candidates sitting a public exam in a college. The sports hall can accommodate 210 students; once this has been filled there are other rooms available that are much smaller. The following is a list of the number of single desks that have been set up in each room:

26, 20, 24, 28, 24, 20, 24, 16, 20, 18, 26.

The rooms have sufficient space for all the candidates who are not in the sports hall. The exams officer wants to leave the same number of empty desks in each of these rooms.

What procedure should the exams officer adopt to work out how many students to have in each room?

A Divide the total number of candidates by the total number of workspaces in each room and take that number away from the capacity of each of the rooms.

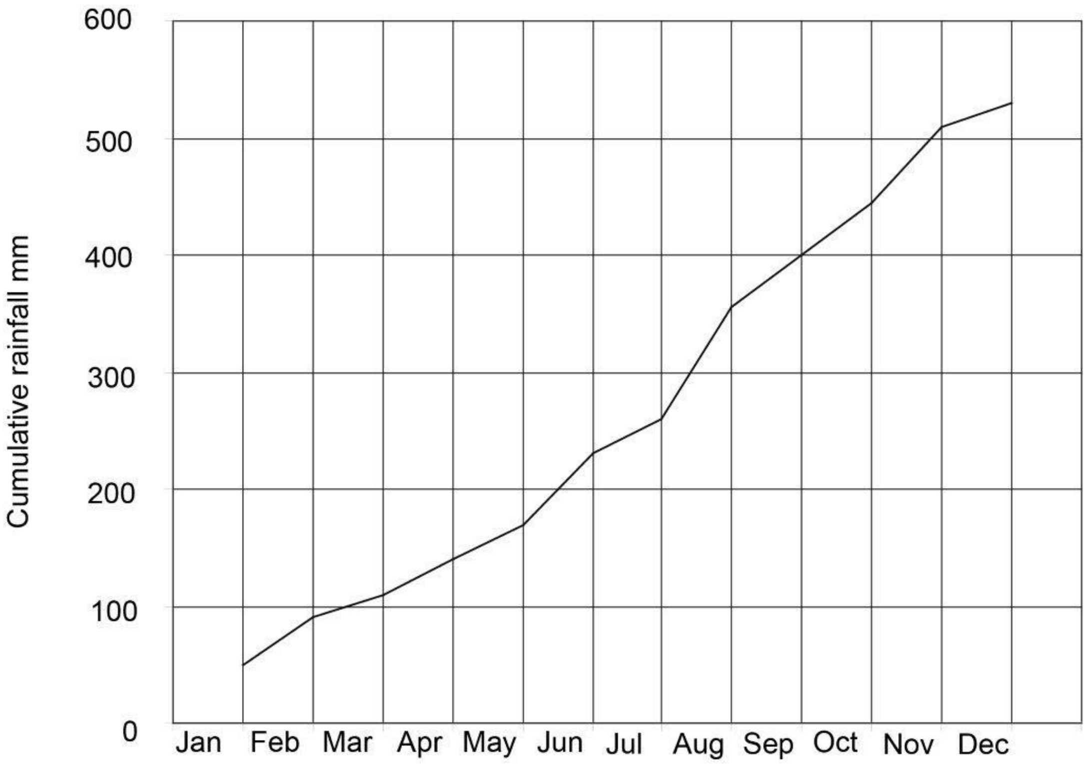
B Add up the total capacity of the rooms, subtract that number from the total number of candidates, divide the result by the total number of rooms and then subtract that number from the capacity of each room.

C Add up the total capacity of the rooms, subtract the total number of candidates from that figure, divide the result by the total number of rooms and subtract that number from the capacity of each room.

D Divide the total capacity by the number of students and then take that number away from the capacity of each room.

E Add up the total capacity of the rooms and divide by the total number of candidates. Multiply the result by the total number of rooms, which gives the number of students to place in each room.

16 The graph below shows the cumulative rainfall for Malvern Wells in the UK for 2010.



What, approximately, was the average monthly rainfall from the **beginning** of June to the **end** of September?

A 30 mm/month

B 40 mm/month

C 48 mm/month

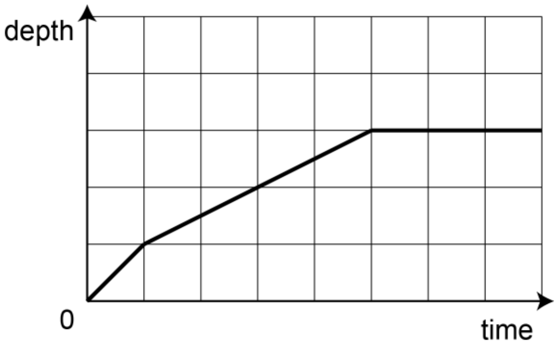
D 57 mm/month

E 100 mm/month

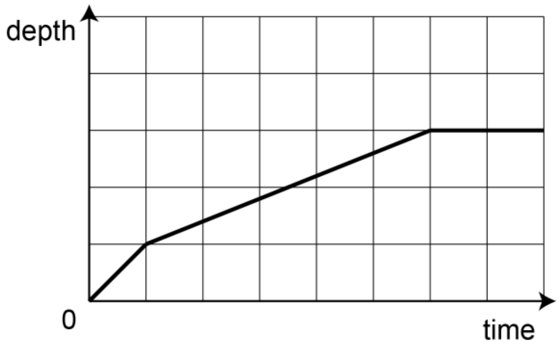
17 Duncan's bath has a flat base and vertical sides. It can be filled completely from the hot tap in 15 minutes or from the cold tap in 10 minutes. Its capacity is 360 litres. When preparing a bath, Duncan's habit is to run both taps together for 1½ minutes, before turning off the cold tap. He turns the hot tap off when the bath is ¾ full, then leaves the water for a while to cool down to a suitable temperature before he climbs in.

Which graph would show how the depth of water increases as Duncan prepares his bath?

A



B



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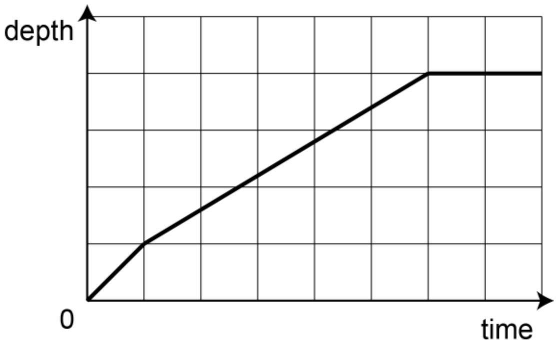

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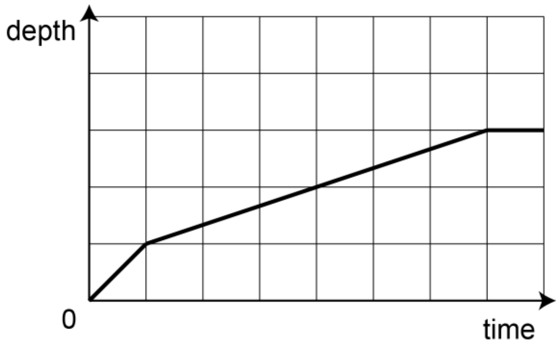
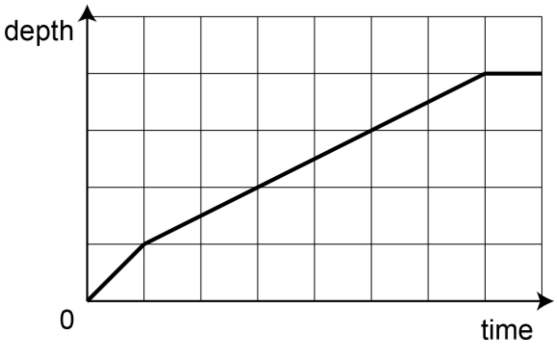
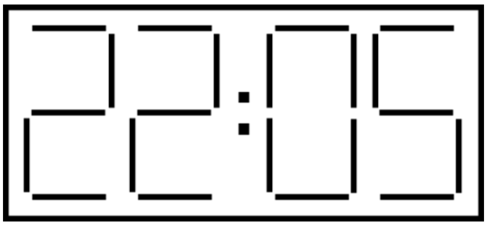


E



18 I stayed in a hotel last night. My room was at the front of the building. At one point I looked out of the window and saw:

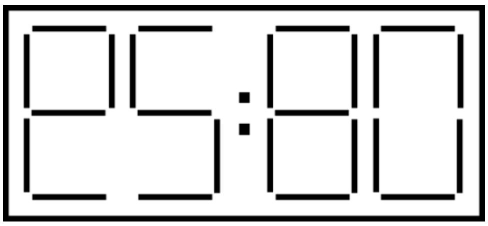


on an illuminated digital clock on the other side of the road. I took the opportunity to reset my watch, which had stopped sometime earlier.

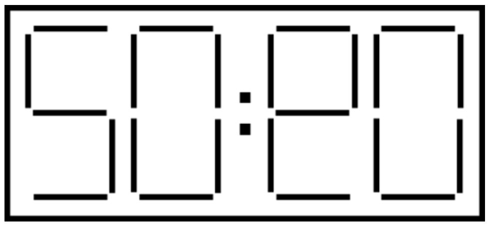
This morning, when I looked out, I realised that what I could see across the road was a reflection in the building opposite of a clock outside the hotel. According to my watch (which I now knew I had reset incorrectly last night) the time was supposedly nine minutes past ten.

What did I see across the road when I looked out this morning?

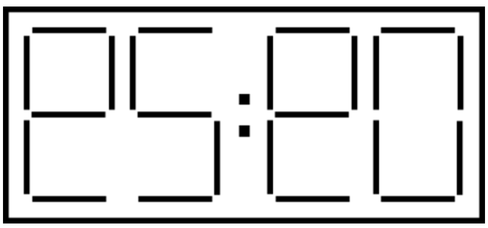
A



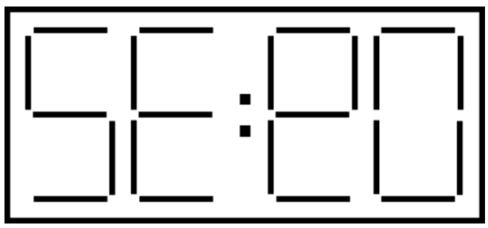
B



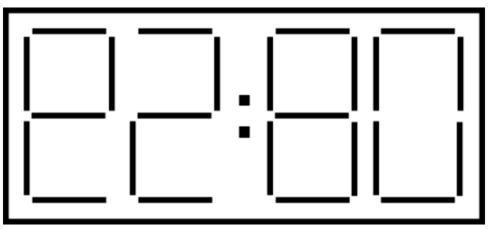
C



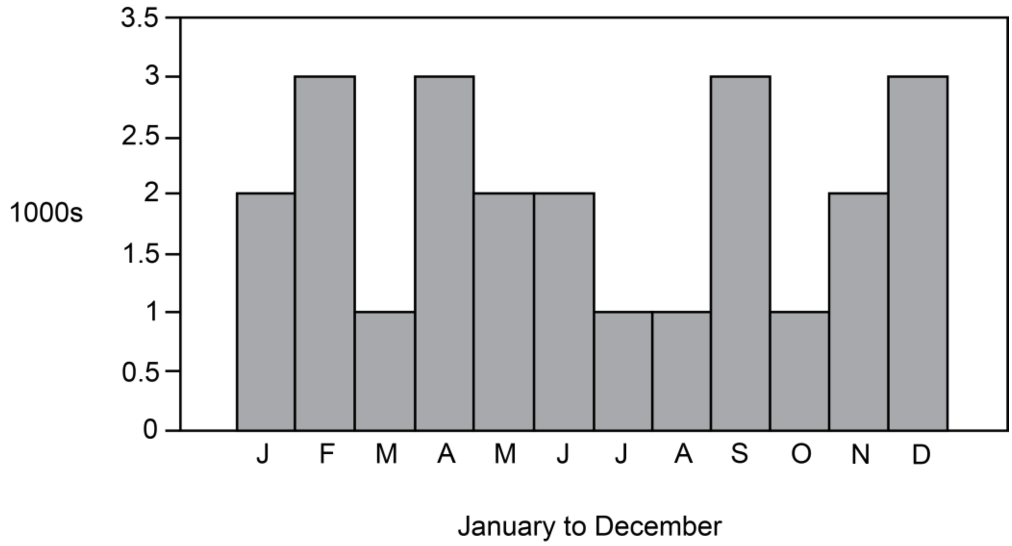
D



E



19 Deliveries of containers for a fast-food takeaway are made only four times per year, at the beginning of January, April, July and October. Last year the takeaway over-ordered containers and currently has 2,000 left. The number of containers used per month varies, but is no more than 3,000 and no fewer than 1,000. The maximum number that can be delivered at one time is 6,000. The usage for last year is illustrated below.



Assuming the same usage this year, how many containers need to be delivered (in January, April, July and October) in order for over-ordering to be minimised each quarter?

A 5,000 in January, 6,000 in April, 5,000 in July, 6,000 in October

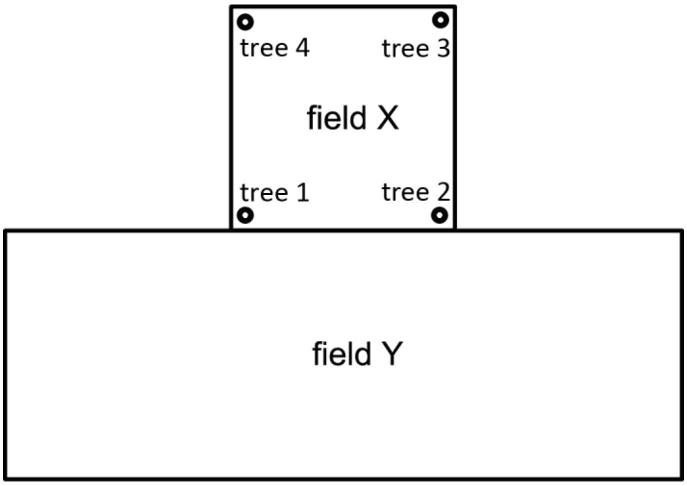
B 6,000 in January, 7,000 in April, 5,000 in July, 6,000 in October

C 4,000 in January, 7,000 in April, 5,000 in July, 6,000 in October

D 6,000 in January, 6,000 in April, 6,000 in July, 6,000 in October

E 4,000 in January, 6,000 in April, 6,000 in July, 6,000 in October

20 Four trees stand at the corners of square field X. They are photographed from field Y, from every possible direction, close up and from a distance, but never so that one tree stands in front of another.



In how many different orders, left to right, can the trees appear in the photographs?

A 1

B 2

C 3

D 4

E 5

PART B Mathematics

21 The gradient of the curve $y = \frac{(3x-2)^2}{x\sqrt{x}}$ at the point where $x = 2$ is

A $\frac{3}{2}\sqrt{2}$

B $3\sqrt{2}$

C $4\sqrt{2}$

D $\frac{9}{2}\sqrt{2}$

E $6\sqrt{2}$

22 Consider the statement about Fred:

(*) *Every day next week, Fred will do at least one maths problem.*

If statement (*) is **not** true, which one of the following is **certainly** true?

A Every day next week, Fred will do more than one maths problem.

B Some day next week, Fred will do more than one maths problem.

C On no day next week will Fred do more than one maths problem.

D Every day next week, Fred will do no maths problems.

E Some day next week, Fred will do no maths problems.

F On no day next week will Fred do no maths problems.

23 Given that $a^x b^{2x} c^{3x} = 2$, where $a, b,$ and c are positive real numbers, then $x =$

A $\log_{10}\left(\dfrac{2}{a+2b+3c}\right)$

B $\dfrac{\log_{10} 2}{\log_{10}(a+2b+3c)}$

C $\dfrac{2}{\log_{10}(a+2b+3c)}$

D $\dfrac{2}{a+2b+3c}$

E $\log_{10}\left(\dfrac{2}{ab^2c^3}\right)$

F $\dfrac{\log_{10} 2}{\log_{10}(ab^2c^3)}$

G $\dfrac{2}{\log_{10}(ab^2c^3)}$

H $\dfrac{2}{ab^2c^3}$

24 The roots of the equation $2x^2 - 11x + c = 0$ differ by 2. The value of c is

A $\dfrac{105}{8}$

B $\dfrac{113}{8}$

C $\dfrac{117}{8}$

D $\dfrac{119}{8}$

25 Five runners competed in a race: Fred, George, Hermione, Lavender, and Ron.

Fred beat George.

Hermione beat Lavender.

Lavender beat George.

Ron beat George.

Assuming there were no ties, how many possible finishing orders could there have been, given only this information?

A 1

B 6

C 12

D 18

E 24

F 120

26 The sum of the roots of the equation $2^{2x} - 8 \times 2^{x} + 15 = 0$ is

A 3

B 8

C $2\log_{10} 2$

D $\log_{10}\left(\frac{15}{4}\right)$

E $\frac{\log_{10} 15}{\log_{10} 2}$

27 The graph of the polynomial function

$$y = ax^5 + bx^4 + cx^3 + dx^2 + ex + f$$

is sketched, where a, b, c, d, e and f are real constants with $a \neq 0$.

Which one of the following is **not** possible?

A The graph has two local minima and two local maxima.

B The graph has one local minimum and two local maxima.

C The graph has one local minimum and one local maximum.

D The graph has no local minima or local maxima.

28 For any real numbers a, b, and c where $a \geq b$, consider these three statements:

1 $-b \geq -a$

2 $a^2 + b^2 \geq 2ab$

3 $ac \geq bc$

Which of the above statements must be true?

A none of them

B 1 only

C 2 only

D 3 only

E 1 and 2 only

F 1 and 3 only

G 2 and 3 only

H 1, 2 and 3

29 How many real roots does the equation $x^4 - 4x^3 + 4x^2 - 10 = 0$ have?

A 0

B 1

C 2

D 3

E 4

30 The variables x and y and the constants a and b are real and positive. The variables x and y are related.

A graph of $\log y$ against $\log x$ is drawn.

For which one of the following relationships will this graph be a straight line?

A $y^6 = a^x$

B $y = ab^x$

C $y^2 = a + x^b$

D $y = ax^b$

E $y^x = a^b$

31 The smallest possible value of $\int_0^1 (x-a)^2 \, dx$ as a varies is

A $\frac{1}{12}$

B $\frac{1}{3}$

C $\frac{1}{2}$

D $\frac{7}{12}$

E 2

32 A group of five numbers are such that:

- their mean is 0
- their range is 20

What is the largest possible median of the five numbers?

A 0

B 4

C $4\frac{1}{2}$

D $6\frac{1}{2}$

E 8

F 20

33 For what values of the non-zero real number a does the quadratic equation

$$ax^2 + (a - 2)x = 2$$

have distinct real roots?

A all values of a

B $a = -2$

C $a > -2$

D $a \neq -2$

E no values of a

34 Two variables are connected by the relation: $P \propto \frac{1}{Q^2}$

Q is increased by 40%.

To the nearest percent, describe the change in P in percentage terms.

A 29% decrease

B 44% decrease

C 49% decrease

D 51% decrease

E 80% decrease

F 96% decrease

35 A bag contains only x red balls, y blue balls and z yellow balls.

One ball is taken out at random; this ball is then placed back in the bag. Then once again, a ball is taken out at random from the bag.

If the balls are identical in all respects except colour and are well mixed, what is the probability that the first ball was red and the second blue?

A $\frac{(x+y)}{(x+y+z)}$

B $\frac{(x+y)}{(x+y+z)^2}$

C $\frac{xy}{(y+z)(x+z)}$

D $\frac{xy}{(x+y+z)(x+z)}$

E $\frac{xy}{(x+y+z)^2}$

36 A geometric series has first term 4 and common ratio r, where $0 < r < 1$.

The first, second, and fourth terms of this geometric series form three successive terms of an arithmetic series.

The sum to infinity of the geometric series is

A $\frac{1}{2}\left(\sqrt{5}-1\right)$

B $2\left(3-\sqrt{5}\right)$

C $2\left(1+\sqrt{5}\right)$

D $2\left(3+\sqrt{5}\right)$

END OF TEST

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