Write your name here

Surname	Other names

Pearson Edexcel Level 3 Certificate

Centre Number | | | | | |

Candidate Number | | | | |

Mathematics in Context

Paper 1: Comprehension

Wednesday 17 May 2017 – Morning
Time: 1 hour 40 minutes

Paper Reference
7MC0/01

You must have: Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser, calculator.
Source booklet.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- **Calculators may be used.**

Information

- The total mark for this paper is 60
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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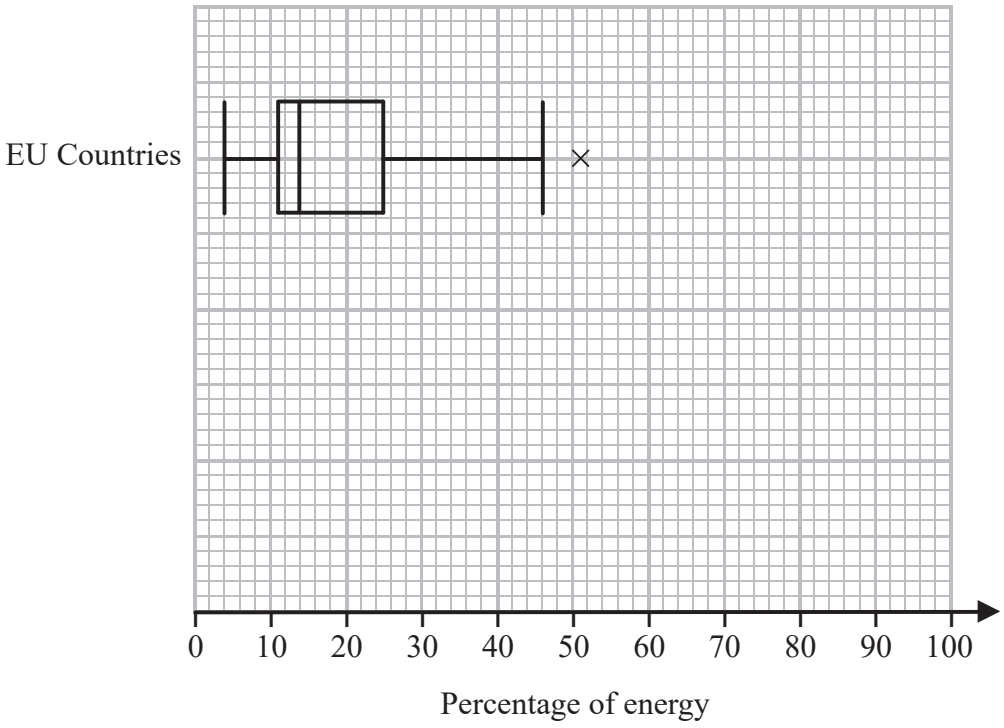
SECTION A

Answer ALL questions. Write your answers in the spaces provided.

ENERGY

Refer to **data source A** in the source booklet.

1 The data for the percentage of energy produced from renewable sources, from Table 1 in the source booklet, is shown in the box plot below.



The table below gives the information from Table 2 in the source booklet, ordered by the percentage of energy produced from renewable sources.

Sub-Saharan African Country	Percentage of energy produced from renewable sources	Total energy consumption (petajoules)
South Africa	16.9	2777
Ghana	49.5	284
Benin	50.6	145
Guinea	74.1	139
Cote d'Ivoire	74.4	291
Cameroon	78.1	256
Kenya	78.5	556
Burkina Faso	79.1	137
Nigeria	86.5	4829
Tanzania	88.2	800
Zambia	88.2	292
Mozambique	88.4	312
Uganda	90.0	403
Ethiopia	93.5	1547
Democratic Republic of Congo	96.0	825

An outlier is defined as any value that is

either greater than the upper quartile + (1.5 × interquartile range)

or less than the lower quartile – (1.5 × interquartile range)

(a) On the grid opposite, draw a box plot to show the information for the percentage of energy produced from renewable sources for the 15 countries given in the table above.

You must show any outliers on your box plot, along with calculations to identify these outliers.

(6)

(b) For the given data, compare the percentage of energy produced from renewable sources for the EU countries and the Sub-Saharan African countries.

(2)

Assume that all the energy produced from renewable sources is consumed.

For 2012 the percentage of the total energy consumed in the world that was produced from renewable sources is x%.

(c) Using the information in Table 3 in the source booklet, calculate the value of x.

(3)

(Total for Question 1 is 11 marks)

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2 The table below shows some of the 5-point moving averages for the cost per barrel of oil between 2004 and 2014.

Year	Cost per barrel ($)	5-point moving average
2004	47.96	
2005	66.09	
2006	76.50	76.03
2007	82.65	80.05
2008	106.94	84.09
2009	68.05	92.21
2010	86.31	98.71
2011	117.09	99.40
2012	115.14	.....
2013	110.42	
2014	98.95	

(a) Calculate the missing 5-point moving average.

(2)

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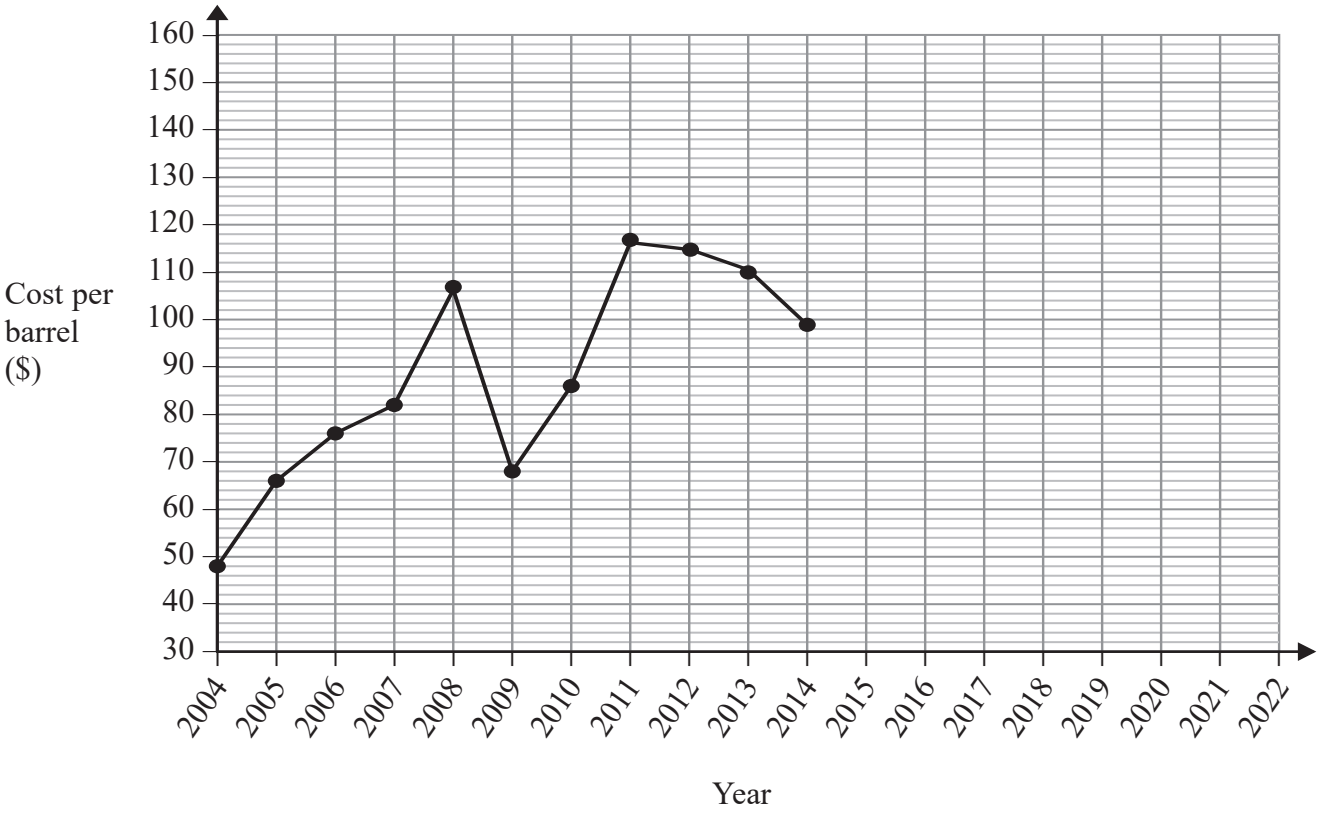
The costs of a barrel of oil for 2004 to 2014 are shown on the grid below.



(b) On the same grid, plot the moving averages.

(2)

(c) Predict the year in which the price of a barrel of oil will first reach \$150
Make your method clear.

(2)

(d) Comment on the reliability of your prediction in part (c).

(1)

(Total for Question 2 is 7 marks)

Refer to **data source B** in the source booklet.

Assume that, after 2014, oil consumption continues at the same rate as for 2014.

3 (a) During which year will the total proven reserves of oil known in 2014 run out?

(5)

Sahel wants to make a more accurate prediction for oil consumption after 2014.
He sets up a spreadsheet to do this.

	A	B	C
1	**Year**	**Oil consumption (1000 barrels per day)**	**Percentage change from previous year**
2	2004	83 107	
3	2005	84 411	1.57
4	2006	85 328	1.09
5	2007	86 741	1.66
6	2008	86 115	–0.72
7	2009	85 066	–1.22
8	2010	87 867	3.29
9	2011	88 974	1.26
10	2012	89 846	0.98
11	2013	91 243	1.56
12	2014	92 086	0.92

Sahel uses a formula to calculate the percentage changes from year to year.
Here are four formulas that he considered to go in cell C3.

- = (B3 – B2)/B2/100
- = (B3 – B2)/B2*100
- = (B3 – B2)/B3/100
- = (B3 – B2)/B3*100

(b) Write down the correct formula to go in cell C3.

(1)

Sahel thinks that the yearly consumption of oil can be modelled using a geometric progression of the form

$$C_n = 3.36 \times 10^{10} \times r^n$$

where

n is the number of years after 2014
C_n is the oil consumption in barrels per year in year n
r is a constant.

He decides to use the mean percentage change for the years 2005–2014 to find a value for r.

He uses the formula below to calculate a value for r.

$$r = \frac{100 + \text{mean percentage change for the years 2005–2014}}{100}$$

(c) Show that $r = 1.01$, correct to 3 significant figures.

(3)

(d) Using the model

$$C_n = 3.36 \times 10^{10} \times 1.01^n$$

where

n is the number of years after 2014
C_n is the oil consumption in barrels per year in year n

calculate the **total** oil consumption for the years 2014 to 2023 inclusive.

(3)

(Total for Question 3 is 12 marks)

TOTAL FOR SECTION A IS 30 MARKS

SECTION B

Answer ALL questions. Write your answers in the spaces provided.

COMPUTERS

Refer to **data source C** in the source booklet.

4 (a) Calculate the number of megabytes in 2 terabytes.

(2)

The cost per GB of memory for a 3 TB hard disk drive before the floods in Thailand in 2011 can be modelled using the formula

$$C = 0.68 \times 0.638^t$$

where

C is the cost per GB, in dollars, of memory for a 3 TB hard disk drive
t is the number of years after the start of 2005.

(b) (i) Use this formula to predict what the cost of a 3 TB hard disk drive would have been at the start of 2015 if the floods in Thailand had not happened.

(3)

(ii) Compare the cost of memory for a 3 TB hard disk drive predicted by the formula with the actual cost for 2015.

(2)

(Total for Question 4 is 7 marks)

Refer to **data source D** in the source booklet.

5 (a) By using the information in Table 6 and Table 7 in the source booklet, calculate how many PCs Dell sold in 2005.

(3)

In 2005, the average price of a PC was $805
In 2014, the average price of a PC was $317

(b) Calculate an estimate for the change in income for Dell from sales of PCs between the years 2005 and 2014.

State whether the change is an increase or decrease.

(4)

(Total for Question 5 is 7 marks)

Refer to **data source E** in the source booklet.

6 Jim thinks that if he spends more money on a CPU he will get a better performance.

He tests his hypothesis by calculating two types of correlation coefficient for each set of CPUs for

i Clockspeed versus Price
ii Passmark.com rating versus Price.

Some of his results are summarised below.

INTEL Processors	Product moment correlation coefficient	Spearman's rank correlation coefficient
Clockspeed v Price		0.701
Passmark.com rating v Price	0.829	0.832

AMD Processors	Product moment correlation coefficient	Spearman's rank correlation coefficient
Clockspeed v Price	0.487	0.465
Passmark.com rating v Price	0.608	

(a) Calculate the product moment correlation coefficient for Clockspeed versus Price for the INTEL processors.

You may use $S_{xx} = 7768$, $S_{yy} = 2.82$ and $S_{xy} = 104.74$
where £x is the price of the processor and y GHz is the clockspeed.

(2)

(b) Calculate Spearman's rank correlation coefficient for Passmark.com rating versus Price for the AMD processors.

(6)

CPU	Price (£)	Passmark.com rating		
AMD Sempron LE-1300	16.66	622		
AMD A8-3500M APU	22.00	2035		
AMD Turion II P540 Dual-Core	26.63	1492		
AMD Phenom 9850 Quad-Core	33.33	2937		
AMD Phenom II N660 Dual-Core	59.33	1865		
AMD A10-5800K APU	66.66	4639		
AMD A6-3650 APU	75.07	3211		
AMD FX-6200 Six-Core	80.59	6115		
AMD Athlon II X4 600e	86.82	2447		
AMD Athlon 64 X2 Dual Core 4800+	93.30	1282		
AMD FX-8320E Eight-Core	93.33	7500		
AMD FX-8100 Eight-Core	94.67	6071		

(c) Is Jim's hypothesis correct?

Justify your answer.

(2)

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(Total for Question 6 is 10 marks)

7 A small software company has developed a new app.

The company has two options

- market and launch the app itself
- go into partnership with a larger software company who will market and launch the app.

If the company chooses to go into partnership it will pay a commission of 40% of the expected income from sales to the larger software company.

The income that can be expected depends on the level of sales and is shown below.

	Expected income (£)
High sales	500 000
Medium sales	200 000
Low sales	100 000

The table below shows the probabilities of each level of sales.

	Probability		
	High sales	**Medium sales**	**Low sales**
Market and launch the app itself	0.1	0.2	0.7
Go into partnership	0.5	0.3	0.2

Which option gives the higher expected income?
Justify your answer.

(6)

(Total for Question 7 is 6 marks)

TOTAL FOR SECTION B IS 30 MARKS

TOTAL FOR PAPER IS 60 MARKS

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Wednesday 17 May 2017 – Morning
Source booklet

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Do not return this source booklet with the question paper.

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Formulae sheet

There will be no credit for anything you write on this formulae sheet.

Mean of a frequency distribution $= \dfrac{\sum fx}{\sum f}$

Mean of a grouped frequency distribution $= \dfrac{\sum fx}{\sum f}$, where x is the mid-interval value

Variance $= \dfrac{\sum (x - \bar{x})^2}{n}$

Standard deviation (set of numbers) $\sqrt{\left[\dfrac{\sum x^2}{n} - \left(\dfrac{\sum x}{n}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum (x - \bar{x})^2}{n}\right]}$

where $\bar{x}$ is the mean of the set of values

Standard deviation
(discrete frequency distribution) $\sqrt{\left[\dfrac{\sum fx^2}{\sum f} - \left(\dfrac{\sum fx}{\sum f}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum f(x - \bar{x})^2}{\sum f}\right]}$

Spearman's rank correlation coefficient $1 - \dfrac{6\sum d^2}{n(n^2 - 1)}$

The product moment correlation coefficient is

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \frac{\sum x_i y_i - \frac{\left(\sum x_i\right)\left(\sum y_i\right)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{\left(\sum x_i\right)^2}{n}\right)\left(\sum y_i^2 - \frac{\left(\sum y_i\right)^2}{n}\right)}}$$

The regression coefficient of y on x is $b = \frac{S_{xy}}{S_{xx}}$

Least squares regression line of y on x is $y = a + bx$ where $a = \bar{y} - b\bar{x}$

Arithmetic series

$$u_n = a + (n - 1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n[2a + (n - 1)d]$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r}$$

$$S_\infty = \frac{a}{1 - r} \quad \text{for} \quad |r| < 1$$

There will be no credit for anything you write in this source booklet.

SECTION A: ENERGY

Data source A

Renewable electricity output has increased in total world electricity output for the fourth year in a row. Its share has risen by two percentage points since 2007, which has taken it across the symbolic 20% mark. This growth is no quirk of fate, but is the result of an ambitious and concerted policy pursued by a number of nations that have worked for over a decade on developing production capacities and renewable energy technologies. In the electricity-generating sector, almost half the world's newly installed capacity in 2011 was for renewable energy facilities. Already more than a hundred countries have committed to renewable electricity production targets. This fact alone demonstrates the growing worldwide interest in these technologies.

The realignment of the global electricity mix is not over. In its publication "Renewable energy, medium term market report 2013", the International Energy Agency (IEA), reckons the renewable share could reach 25% in 2018. It forecasts that non-hydro renewable energies, driven by wind and solar power investments, could generate 8% of gross electricity output in 2018. The IEA predicts that gross renewable electricity output will continue to pick up speed in the medium term to 2018, rising by approximately 40% and forecasts installed renewable capacity increasing from 1580GW in 2012 to 2350GW in 2018.

Table 1: Percentage of energy produced from renewable sources and total energy consumption for the 15 EU countries with the highest total energy consumption in 2012

EU Country	Percentage of energy produced from renewable sources	Total energy consumption (petajoules)
Austria	32.1	1066
Belgium	7.4	1436
Czech Republic	11.4	963
Finland	34.5	1009
France	13.6	5987
Germany	12.1	8339
Greece	13.4	685
Italy	15.4	4805
Netherlands	4.5	1942
Poland	10.9	2596
Portugal	25.0	636
Romania	22.8	933
Spain	14.3	3293
Sweden	51.1	1303
United Kingdom	4.2	5053

Table 2: Percentage of energy produced from renewable sources and total energy consumption for the 15 Sub-Saharan African countries with the highest total energy consumption in 2012

Sub-Saharan African Country	Percentage of energy produced from renewable sources	Total energy consumption (petajoules)
Benin	50.6	145
Burkina Faso	79.1	137
Cameroon	78.1	256
Cote d'Ivoire	74.4	291
Democratic Republic of Congo	96.0	825
Ethiopia	93.5	1547
Ghana	49.5	284
Guinea	74.1	139
Kenya	78.5	556
Mozambique	88.4	312
Nigeria	86.5	4829
South Africa	16.9	2777
Tanzania	88.2	800
Uganda	90.0	403
Zambia	88.2	292

Table 3: Percentage of energy produced from renewable sources and total energy consumption by all the regions of the world in 2012

Region	Percentage of energy produced from renewable sources	Total energy consumption (petajoules)
Northern America	9.4	63 200
Europe	11.5	65 000
Asia	19.1	149 000
Oceania	13.1	3 780
Latin America and Caribbean	27.7	23 300
Africa	55.9	19 800
World Total		**324 080**

Data source B

The price of oil, or the oil price, generally refers to the spot price of a barrel of benchmark crude oil. Oil reserves are the amount of technically and economically recoverable oil. Proven reserves are those reserves claimed to have a reasonable certainty (normally at least 90% confidence) of being recoverable under existing economic and political conditions, with existing technology.

Table 4: Cost per barrel of oil and total proven oil reserves 2004–2014*

Year	Cost per barrel ($)	Oil consumption (1000 barrels per day)	Total proven reserves of oil (1000 million barrels)
2004	47.96	83 107	1366.2
2005	66.09	84 411	1374.4
2006	76.50	85 328	1383.7
2007	82.65	86 741	1419.0
2008	106.94	86 115	1490.0
2009	68.05	85 066	1529.5
2010	86.31	87 867	1636.6
2011	117.09	88 974	1675.3
2012	115.14	89 846	1697.9
2013	110.42	91 243	1701.0
2014	98.95	92 086	1700.1

* Cost per barrel for each year is given as relative to the 2014 price to take into account the effects of inflation.

SECTION B: COMPUTERS

Data source C

A hard disk drive (HDD) is a data storage device used for storing and retrieving digital information. The two most common modern HDDs are 3.5-inch, for desktop computers, and 2.5-inch, primarily for laptops. Capacity is specified in unit prefixes corresponding to powers of 1000: a 1-terabyte (TB) drive has a capacity of 1000 gigabytes (GB) where 1 GB = 1000 megabytes. The cost of hard disk drives has decreased dramatically over the past decade. China is the largest producer of hard disk drives followed by Thailand.

In 2011 Thailand suffered severe flooding with 20% of the country being underwater. The effect was a decrease in hard disk drive production of around 30%. The result of this was that prices of hard disk drives doubled at the start of 2012.

Table 5: Cost per GB of memory for a 3TB hard disk drive 2005–2015

Year	Cost per GB (cents)
2005	87.60
2006	40.63
2007	28.00
2008	20.00
2009	9.33
2010	7.33
2011	4.00
2012	7.86
2013	5.50
2014	4.00
2015	3.33

Data source D

You may have noticed that a majority of your non-gamer friends own tablets and smartphones, and you might occasionally remember a day when the desktop PC ruled the market. Especially if you live in a trendy city like New York, everyone seems to have a tablet that performs the majority of their computing needs nowadays. A new report by market intelligence firm IDC says that the reason why you've been noticing more tablets and smartphones is because PC sales are in decline. Since 2010, when tablet sales started to take off, sales of PCs have levelled off and then started to decline.

Table 6: Sales of personal computers (desktops and laptops) 2005–2014

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Sales of PCs (millions)	218.5	239.4	271.2	302.2	305.9	351.0	352.8	352.7	316.0	315.9

Table 7: Global PC market share by percentage of total sales (2005–2014)

Rank	2005		2006		2007		2008		2009	
1	Dell	16.8	Dell	15.9	HP	18.1	HP	18.2	HP	19.1
2	HP	14.6	HP	15.9	Dell	14.2	Dell	14.1	Acer	12.9
3	Lenovo	6.9	Acer	7.6	Acer	9.7	Acer	10.6	Dell	12.1
4	Acer	4.6	Lenovo	7.0	Lenovo	7.4	Lenovo	7.5	Lenovo	8.0
5	Toshiba	3.3	Toshiba	3.8	Toshiba	4.0	Toshiba	4.6	Toshiba	5.0
	Others	53.8	Others	49.8	Others	46.5	Others	44.9	Others	42.8

Rank	2010		2011		2012		2013		2014	
1	HP	17.9	HP	16.6	HP	16.1	Lenovo	16.9	Lenovo	18.8
2	Acer	13.9	Lenovo	12.5	Lenovo	14.9	HP	16.2	HP	17.5
3	Dell	12.0	Dell	11.7	Dell	10.7	Dell	11.6	Dell	12.8
4	Lenovo	10.9	Acer	10.8	Acer	10.2	Acer	8.0	Acer	7.9
5	Asus	5.4	Asus	5.7	Asus	6.9	Asus	6.6	Asus	7.2
	Others	40.0	Others	42.8	Others	41.2	Others	40.7	Others	35.7

Data source E

The central processing unit (CPU) is the primary component of a computer that processes instructions. It handles all the instructions you give your computer, and the faster it does this, the better.

One way to measure CPU performance is to consider its clockspeed, usually measured in Gigahertz (GHz). CPUs with a higher clockspeed can carry out tasks more quickly. However this is not the only factor when considering potential CPU performance. Passmark.com have developed a number of additional benchmark tests in order to better assess CPU performance.

A rating is then calculated based on the CPU's performance in these tests with a higher score indicating better performance.

The data for 12 Intel and 12 AMD CPUs is shown below.

Table 8: Price, clockspeed and Passmark.com rating for 12 Intel CPUs

CPU	Price (£)	Clockspeed (GHz)	Passmark.com rating
Intel Celeron 430	21.33	1.80	486
Intel Pentium P6200	24.66	2.13	1342
Intel Core2 Duo T9400	33.33	2.53	1753
Intel Celeron E3200	34.66	2.40	1391
Intel Pentium G645	39.33	2.90	2605
Intel Pentium G3450	57.99	3.40	3789
Intel Pentium G850	65.59	2.90	2685
Intel Pentium E6800	68.95	3.33	2089
Intel Core2 Duo E7600	69.99	3.06	1993
Intel Core i3-4130T	86.66	2.90	4150
Intel Core i3-2120T	88.11	2.60	3207
Intel Core i3-3245	99.99	3.40	4354

Table 9: Price, clockspeed and Passmark.com rating for 12 AMD CPUs

CPU	Price (£)	Clockspeed (GHz)	Passmark.com rating
AMD Sempron LE-1300	16.66	2.30	622
AMD A8-3500M APU	22.00	1.50	2035
AMD Turion II P540 Dual-Core	26.63	2.40	1492
AMD Phenom 9850 Quad-Core	33.33	2.50	2937
AMD Phenom II N660 Dual-Core	59.33	3.00	1865
AMD A10-5800K APU	66.66	3.80	4639
AMD A6-3650 APU	75.07	2.60	3211
AMD FX-6200 Six-Core	80.59	3.80	6115
AMD Athlon II X4 600e	86.82	2.20	2447
AMD Athlon 64 X2 Dual Core 4800+	93.30	2.50	1282
AMD FX-8320E Eight-Core	93.33	3.20	7500
AMD FX-8100 Eight-Core	94.67	2.80	6071

Source information

Data source A adapted from:
http://trackingenergy4all.worldbank.org/reports Global Tracking Framework 2015

http://www.energies-renouvelables.org

Data source B adapted from:
http://www.bp.com/statisticalreview BP Statistical Review of World Energy June 2015

Data source C adapted from:
http://www.jcmit.com/memoryprice.htm

Data source D adapted from:
http://www.gartner.com/technology/home.jsp
(https://en.wikipedia.org/wiki/Market_share_of_personal_computer_vendors#cite_note-2002_PC-5)

Data source E adapted from:
http://www.passmark.com (retrieved 24/01/2015)

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