

# OCR

Oxford Cambridge and RSA

**Wednesday 6 June 2018 – Morning**

**AS GCE/Level 3 Certificate**

**QUANTITATIVE METHODS (MEI)**

**G244/01 Introduction to Quantitative Methods (IQM)**

**Insert**

**Duration:** 1 hour 30 minutes



## **INFORMATION FOR CANDIDATES**

- This Insert contains a copy of the pre-release material for use with the Question Paper.
- This document consists of **8** pages. Any blank pages are indicated.

## **INSTRUCTION TO EXAMS OFFICER/INVIGILATOR**

- Do not send this Insert for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

## 1 Exoplanet discovery: seven Earth-sized planets spotted orbiting nearby star

*This is an extract from an article published by the Guardian on 23/02/2017. The article was written by Ian Sample, Science editor.*

A huddle of seven worlds, all close in size to Earth, and perhaps warm enough for water and the life it can sustain, has been spotted around a small, faint star in the constellation of Aquarius.

The discovery, which has thrilled astronomers, has raised hopes that the hunt for alien life beyond the solar system could start much sooner than previously thought, with the next generation of telescopes that are due to switch on in the next decade.

It is the first time that so many Earth-sized planets have been found in orbit around the same star, an unexpected haul that suggests the Milky Way may be teeming with worlds that, in size and firmness underfoot at least, resemble our own rocky home.

The planets closely circle a dwarf star named Trappist-1, which at 39 light years away makes the system a prime candidate to search for signs of life. Only marginally larger than Jupiter, the star shines with a feeble light about 2000 times fainter than our sun.

“The star is so small and cold that the seven planets are temperate, which means that they could have some liquid water and maybe life, by extension, on the surface,” said Michaël Gillon, an astrophysicist at the University of Liège in Belgium.

While the planets have Earth-like dimensions, their sizes ranging from 25% smaller to 10% larger, they could not be more different in other features. Most striking is how compact the planet’s orbits are. Mercury, the innermost planet in the solar system, is six times farther from the sun than the outermost seventh planet is from Trappist-1.

Any life that gained a foothold and the capacity to look up would have a remarkable view from a Trappist-1 world. From the fifth planet, considered the most habitable, the salmon-pink star would loom 10 times larger than the sun in our sky. The other planets would soar overhead as their orbits required, appearing up to twice the size of the moon as seen from Earth. “It would be a beautiful show,” said Amaury Triaud at the Institute of Astronomy at Cambridge University.

The researchers hope to know whether there is life on the planets “within a decade,” Amaury added. “I think we’ve made a crucial step in finding out if there’s life out there,” he said. “If life managed to thrive and releases gases in a similar way as on Earth, we will know.”

The planets are on such tight orbits that it takes between 1.5 and 20 days for them to whip around the star. At such proximity, most, if not all, will be “tidally locked”, meaning they show only one face to Trappist-1, just as one side of the moon always faces Earth. Some of the planets are thought to be the right temperature to host oceans of water, depending on the makeup of their atmospheres, but on others any hospitable regions may be confined to the bands that separate the light and dark sides of the planets.

Ignas Snellen, an astrophysicist at the Leiden Observatory in the Netherlands who was not involved in the study, said the findings show that Earth-like planets must be extremely common. “This is really something new,” he said. “When they started this search several years ago, I really thought it was a waste of time. I was very, very wrong.”

Note A light year is the distance that light travels in one year.

## 2 Crime figures for a Devon town

*This is an extract from an article in the Totnes Times on 1/2/2017.*

### Recorded crime drops in Town by 16%

Crime fell by almost 16 per cent in Totnes Town last year – in direct contrast to the rest of Devon where the crime rate rose by almost 6 per cent.

Violence, sexual offences, burglary, shoplifting, general theft, criminal damage and public order offences were all down in 2016 compared to the previous year, the latest crime figures have revealed.

The trend for Totnes town area was also in contrast to two rural and urban areas around the town which saw the level of recorded crime shoot up by more than 20 percent and by almost 15%.

The policing area for Totnes is divided into three areas – Totnes Town and two huge swathes of rural South Hams called Totnes East and Totnes West.

Crime Group	Totnes East			Totnes West			Totnes Town		
	Recorded Crime			Recorded Crime			Recorded Crime		
	2015	2016	Difference	2015	2016	Difference	2015	2016	Difference
Violence with injury	20	18	-10.0%	25	25	0.0%	49	45	-8.2%
Violence without injury	28	34	21.4%	24	29	20.8%	48	38	-20.8%
Rape	4	2	-50.0%	4	7	75.0%	5	6	20.0%
Other Sexual Offences	8	5	-37.5%	3	11	266.7%	7	6	-14.3%
Robbery	-	-	-	0	2	-	2	2	0.0%
Burglary Dwelling	10	13	30.0%	6	8	33.3%	20	4	-80.0%
Burglary Non-Dwelling	16	18	12.5%	27	24	-11.1%	12	21	75.0%
Vehicle Offences	21	27	28.6%	14	7	-50.0%	16	17	6.3%
Shoplifting	2	3	50.0%	5	9	80.0%	36	34	-5.6%
Other Theft	27	47	74.1%	41	52	26.8%	83	59	-28.9%
Criminal Damage	27	46	70.4%	47	46	-2.1%	62	52	-16.1%
Public Order Offences	20	10	-50.0%	9	11	22.2%	28	21	-25.0%
Possession of Weapons	0	1	-	-	-	-	3	1	-66.7%
Trafficking of Drugs	1	4	300.0%	0	4	-	3	3	0.0%
Possession of Drugs	10	7	-30.0%	7	8	14.3%	17	21	23.5%
Other Offences	2	2	0.0%	6	7	16.7%	5	3	-40.0%
<b>Total</b>	<b>196</b>	<b>237</b>	<b>20.9%</b>	<b>218</b>	<b>250</b>	<b>14.7%</b>	<b>396</b>	<b>333</b>	<b>-15.9%</b>

### 3 Lightning strike

*The information and data for this article were provided by Professor D.M. Elsom of Oxford Brookes University and Tornado and Storm Research Organisation (TORRO).*

Thunderstorms occur throughout the world. Usually there are electrical discharges between clouds and the earth (cloud to ground lightning) or between clouds (cloud to cloud lightning). We hear the sound made by the discharges as thunder. The term *lightning strike* is widely used to describe a discharge between the atmosphere and an object on the ground. Cloud to ground lightning may also hit an aircraft before going on to strike the ground.

Lightning strikes present a danger to animals and humans; in 2016 a storm killed 323 wild reindeer in central Norway. Estimates of human fatalities around the world vary from 6000 to 24 000 people per year; many more are injured.

In contrast to many parts of the world, historical records of cause of death in the UK allow the number of people dying from lightning strike to be known reasonably accurately and these are summarised in Table 1. The final column shows that a very high percentage of the victims were male.

Location	Period	Average fatalities/year	% male
England & Wales	1852 – 1899	19	82
England & Wales	1900 – 1949	13	89
England & Wales	1950 – 1999	5	84
UK	1988 – 2012	2	83

**Table 1**

The format of the information in the final row of Table 1 is different from that in the other rows. The reason for this is that it is taken from a particular study covering 453 known incidents of lightning strike in the UK, involving 722 people over a 25 year period<sup>1, 2</sup>. (Some incidents involved more than one person experiencing an electrical shock.) The number of deaths was 47. This study forms the basis for the figures in the remainder of this article.

Table 1 covers deaths from lightning strike but it is only a minority of those suffering from lightning strike who die. Most recover although some have serious and long-term injuries. The immediate effects are summarised in Table 2. The figures refer to the most serious medical effect of any incident.

Medical effects	Outdoors	Indoors
Death	21%	0%
Recovery after resuscitation	7%	0%
Serious burns	16%	2%
Lesser injuries	56%	98%
	100%	100%

**Table 2**

Table 2 distinguishes between incidents occurring outdoors and indoors. In the study 52% of incidents were outdoors, 47% indoors and 1% inside a car or an aircraft. Of those involved in outdoor incidents, 73% were male; for indoor incidents the figure was 49%.

Tables 3 and 4 give more detailed information about the percentages of incidents at different categories of location, outdoor and indoor.

<b>Outdoors</b>	
<b>Category</b>	<b>%</b>
Near or under a tree	16
Mountain, hill, moor, cliff top	11
Low lying farmland or country	5
Golf course	13
Other sports or recreation ground	20
Urban setting	20
Near, in or on water	11
Other (eg airfield)	4
	100

**Table 3**

<b>Indoors</b>	
<b>Category (near or touching)</b>	<b>%</b>
Corded telephone	26
Computer equipment	5
Other electrical equipment	13
Window or external door	15
Large object with metal pipes	15
Other (eg in bed) or unknown	25
	100

**Table 4**

Most incidents of lightning strike occur during the summer months and this is shown in Table 5.

<b>Month</b>	<b>Incidents</b>	<b>Fatalities</b>
January	2%	0%
February	1%	0%
March	0%	0%
April	4%	11%
May	14%	21%
June	19%	17%
July	25%	15%
August	19%	26%
September	8%	8%
October	5%	2%
November	2%	0%
December	1%	0%
	100%	100%

**Table 5**

1. Professor D.M. Elsom, Oxford Brookes University and Tornado and Storm Research Organisation (TORRO)
2. J.D.C. Webb, TORRO.

**BLANK PAGE**

**BLANK PAGE**

**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website ([www.ocr.org.uk](http://www.ocr.org.uk)) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.