Level 3 International Foundation Diploma for Higher Education Studies
Ofqual Number: 600/0080/2   Quartz ID: 1125 / 1207

Component ID: 2367

Mathematics for University Study

SAMPLE EXAMINATION

This specimen assessment material is devised from previous past papers to reflect the single examination assessment approach now taken for this unit in the Level 3 International Foundation Diploma for Higher Education Studies.

Time allowed: 1 hour 30 minutes

Marking Scheme

This marking scheme has been prepared as a guide only to markers. This is not a set of model answers, or the exclusive answers to the questions, and there will frequently be alternative responses which will provide a valid answer. Markers are advised that, unless a question specifies that an answer be provided in a particular form, then an answer that is correct (factually or in practical terms) must be given the available marks.

If there is doubt as to the correctness of an answer, the relevant NCC Education materials should be the first authority.

Throughout marking, please credit any valid alternative point.

Candidate Name and ID number:		
Marker's comments:		
Moderator's comments:		
Mark:	**Moderated mark:**	**Final mark:**
Penalties applied for academic malpractice:		

Answer ALL questions

Marks

Question 1

a) A certain laptop in the UK costs £605. The same laptop in Spain costs €680 Euros. The exchange rate from £ to Euros is £1:1.15 Euros.

i) Determine in which country the laptop is more expensive. **2**

Mark scheme:
£605 is 1.15 x 605 = 695.75 Euros. (1 mark)
This is greater than 680 Euros.
So the laptop is more expensive in UK. (1 mark)

Also accept conversion to Pounds:
€1 is 1/1.15 = £0.87. So the Spanish laptop costs 680 x 0.87 = £591.30.

ii) In the US, the same laptop costs $810. The exchange rate from £ to dollars is £1:$1.35. Calculate the value of the US laptop in Pounds Sterling (£). **2**

Mark scheme:
Dollars to pounds sterling exchange rate is $1:1/1.35 pounds sterling, i.e., $1:£0.74.
(1 mark.)

So the US laptop costs 810 x 0.74 = £599.99. (1 mark)
(Accept £600)

iii) Ava is from the US. Say where you would recommend that she buys the laptop from – the US, Spain, or the UK? Provide a reason. **2**

Mark scheme:
Laptop costs are the following:

UK: £605 = 695.75 Euros = $816.75.
US: $810 = £599.99 = 689.99 Euros.
Spain: 680 Euros = £591.30
(1 mark for stating prices in at least TWO countries.)

Spain is the cheapest. (1 mark)
So buy it from Spain. (1 mark)

Also valid:
Spain is cheapest but US is only slightly more expensive. Including delivery costs, Spain may be more expensive. (1 mark)
So buy it from the US

Marks

b) Ravi's final year grade depends on three modules, totalling 100 credits. Module 1 is worth 30 credits, Module 2 is worth 30 credits, and Module 3 is worth 40 credits.

i) Express how much the THREE (3) modules contribute towards the final year grade as a ratio. **1**

Mark scheme:
3:3:4.
(1 mark for all correct numbers, order not important. 0 marks for 2 or fewer correct)

ii) Ravi is aiming to achieve a final year grade of 80%. If he has already achieved marks of 88% and 68% for Modules 1 and 2, what mark does Ravi require for Module 3 to achieve his aim? **4**

Mark scheme:
The Module 1 mark is equivalent to 0.3 x 88 = 26.4% of the final year grade.
The Module 2 mark is equivalent to 0.3 x 68 = 20.4% of the final year grade.
So, in total, Ravi has so far achieved 26.4+20.4 = 46.8%.
He therefore requires a further $80 - 46.8 = 33.2\%$ ***from Module 3.***

(1 mark for working that leads to 46.8% or $80 - 46.8$ ***or 33.2%.***
1 mark for stating 46.8% or $80 - 46.8$ ***or 33.2% or equivalent if error made)***

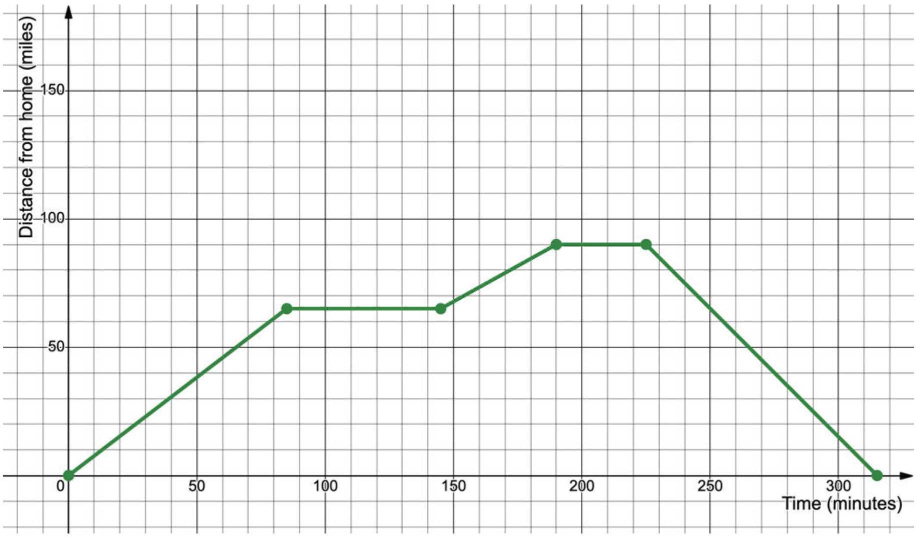
If the Module 3 mark is x***, then we solve*** $0.4x = 33.2$***,***
giving $x = \frac{33.2}{0.4} = 83\%$***. (1 mark for working, 1 mark for final year mark)***
Error carried forward should not be penalised.

Marks

c) Saira leaves home at 10:00. After 1 hour and 25 minutes of moving at a constant speed, she has travelled 65 miles. She then stops for some lunch. After stopping for 1 hour, she drives to another location a further 25 miles away at a constant speed. After driving 45 minutes, she stops at this location. After stopping here for 35 minutes, she drives towards home at a constant speed. It takes her 1.5 hours to get home.

i) Construct a distance-time graph using the graph paper provided, to show this information. **5**

Mark scheme:



Correct labels, including unit, on axes (1 mark for each axis). Allow x-axis unit to be hours instead of minutes, starting at 10:00 or 0 hours.

Correct coordinates of FOUR-FIVE points (1 mark).
Correct coordinates of ALL SIX points (2 marks).

Lines connected at FOUR points (1 mark).

ii) There are FIVE (5) parts to Saira's journey. Find her speed (in miles per hour) in each of the FIRST, THIRD, AND FIFTH parts. **3**

Mark scheme:
First part: Speed is $\frac{65}{85} = 0.76$ ***miles per minute.***
So 0.76x60 = 45.9 mph. (1 mark)
Third part: Speed is $\frac{25}{45} \times 60 = 33.3$ ***mph. (1 mark)***
Fifth part: Speed is $\frac{90}{1.5} = 60$ ***miles per hour. (1 mark.***
Accept -60 mph)

Deduct 1 mark if no conversion to mph done for any part.

Marks

d) A car is travelling at 15 metres per second (m/s). It slows down to 5 m/s in 10 seconds. **1**

Kit incorrectly says that the deceleration of the car was 10 m/s.

Give ONE (1) correction to this statement.

Mark scheme:
Unit should be m/s^2 (1 mark)
Alternatively:
Acceleration of the car was -1 m/s^2
Or
Deceleration of the car was 1 m/s^2

Total 20 Marks

Marks

Question 2

a) The population of the United States was 229.86 million in the year 1980, 281.48 million in the year 2000, and 339.44 million in the year 2020.

i) Calculate the percentage change in the United States population between 1980 and 2000. Give your answer correct to 1 decimal place. **2**

Mark scheme:

$$\frac{\mathbf{281.48 - 229.86}}{\mathbf{229.86}} \times \mathbf{100 = 22.5\%}$$

(1 mark for working, 1 mark for correct answer to 1 decimal place)

ii) Calculate the percentage change in the United States population between 2000 and 2020. Give your answer correct to 1 decimal place. **2**

Mark scheme:

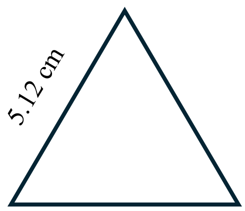
$$\frac{\mathbf{339.44 - 281.48}}{\mathbf{281.48}} \times \mathbf{100 = 20.6\%}$$

(1 mark for working, 1 mark for correct answer to 1 decimal place)

iii) State, with a reason, the period in which the United States population grew slower, in percentage terms: between 1980 and 2000 or between 2000 and 2020. **1**

Mark scheme:
Slower between 2000 and 2020 because percentage change (20.6) is smaller (than 22.5). (1 mark)
0 marks if no reason given.

b) The sides of an equilateral triangle are each 5.12 cm long, rounded to 2 decimal places, as shown below:



i) Find the upper and lower bounds of the side length. **2**

Mark scheme:
The error interval of the side length, l, is

$$\mathbf{5.115\ cm \leq l < 5.125\ cm}$$

(1 mark for correct lower bound, 1 mark for correct upper bound).

Marks

ii) Find the upper and lower bounds of the perimeter, P, of the triangle. Give your answer to 2 decimal places. **2**

Mark scheme:
The upper and lower bound of the perimeter is:

$$\mathbf{5.115 \times 3\ cm \leq P < 5.125 \times 3\ cm}$$
$$\mathbf{15.345\ cm \leq P < 15.375\ cm}$$

(1 mark for correct lower bound, 1 mark for correct upper bound).

iii) Emma says that the height of the triangle is 4.43 cm. Say if Emma is correct, showing your working. **2**

Mark scheme:
If Emma is correct, we can check using Pythagoras' rule:

$$\mathbf{4.43^2 + \left(\frac{5.12}{2}\right)^2 = 5.12^2}$$

This gives approximately:

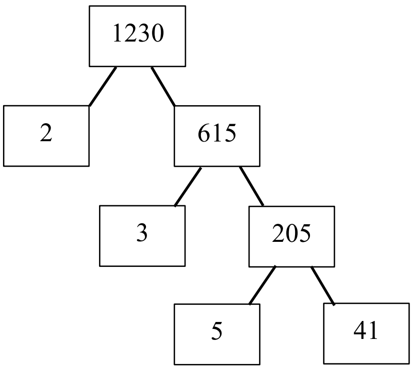
$$\mathbf{19.62 + 6.55 = 26.21}$$

Which is true. So Emma is correct.

1 mark for checking, 1 mark for correct conclusion (Emma is correct).

c) Write 1230 as a product of prime factors. **2**

Mark scheme:



1 mark for above diagram or numbers identified in a list.
1230 = 2 x 3 x 5 x 41. (1 mark)

Marks

d) Consider the following expression:

$$12 + 2x(x - 1) + 4(x - 3)$$

i) Factorise the given expression. **2**

Mark scheme:
$\mathbf{12 + 2x(x - 1) + 4(x - 3) = 12 + 2x^2 - 2x + 4x - 12}$ ***(1 mark)***
$\mathbf{= 2x(x + 1)}$ ***(1 mark)***

ii) Use your factorisation in (i) to solve the following equation: **3**

$$12 + 2x(x - 1) + 4(x - 3) = 4$$

Mark scheme:

$$\mathbf{2x(x + 1) = 4}$$
$$\mathbf{x(x + 1) = 2}$$
$$\mathbf{x^2 + x - 2 = 0}$$
$$\mathbf{(x + 2)(x - 1) = 0}$$
$$\mathbf{x = -2, 1}$$

1 mark for working, 1 mark for each solution.

e) Rearrange the following formula to make s the subject: **2**

$$6r - 4t = \frac{3}{s}$$

Mark scheme:
Multiply by s: $s(6r - 4t) = 3$. (1 mark)
Divide by $6r - 4t$: $s = \frac{3}{6r-4t}$. (1 mark)

Total 20 Marks

Marks

Question 3

a) Consider the points $P = (-2, 3)$ and $Q = (6, -3)$.

i) Find the gradient of the straight line joining the points P and Q. **2**

Mark scheme:

$$\boldsymbol{m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3-3}{6-(-2)} = -\frac{6}{8} = -\frac{3}{4}}$$

(1 mark for working, 1 mark for correct answer; simplification not required)

ii) Write the equation of the straight line joining points P and Q in the form $y = mx + c$. **2**

Mark scheme:
Line equation is $\boldsymbol{y - y_1 = m(x - x_1)}$.
So, $\boldsymbol{y - 3 = -\frac{3}{4}(x + 2)}$.
This can be simplified to $\boldsymbol{y = -\frac{3}{4}x + \frac{3}{2}}$
(1 mark: correct working, 1 mark: $\boldsymbol{\frac{3}{2}}$)

b) The line l_1 has equation $3y - 6x - 6 = 0$

The line l_2 has equation $y = mx + 12$

i) Given that l_1 and l_2 are perpendicular, find the value of m. **2**

Mark scheme:
Line $\boldsymbol{l_1}$ can be rewritten as: $y = 2x + 2$. ***The gradient is 2.***
Perpendicular lines have gradients that multiply to give -1. (1 mark)
Therefore, $\boldsymbol{2m = -1}$, so $\boldsymbol{m = -\frac{1}{2}}$. (1 mark)

Marks

ii) Find the point P where lines l_1 and l_2 intersect. **4**

Mark scheme:
We solve: $\boldsymbol{y = 2x + 2 = -\frac{1}{2}x + 12}$***. (1 mark)***
This gives: $\boldsymbol{\frac{5}{2}x = 10}$***. (1 mark)***
So $\boldsymbol{x = 4}$***. (1 mark)***
Substitute into any of the two equations: $\boldsymbol{y = 2(4) + 2 = 10}$***. (1 mark)***
Errors carried forward from previous section are not to be penalised.

c) Consider the TWO (2) functions:

$f(x) = 4x - 3$

And

$$g(x) = \frac{x}{2} + 8$$

i) Find $f(f(x))$. **2**

Mark scheme:
$\boldsymbol{f(f(x)) = 4(4x - 3) - 3}$ ***(1 mark)***
$\boldsymbol{= 16x - 12 - 3 = 16x - 15}$ ***(1 mark)***

ii) Find $g(f(3))$. **2**

Mark scheme:
$\boldsymbol{f(3) = 4(3) - 3 = 9}$***. (1 mark)***
So $\boldsymbol{g(f(3)) = \frac{9}{2} + 8 = 12.5}$***. (1 mark)***

iii) Find $f^{-1}(x)$. **2**

Mark scheme:
$\boldsymbol{f = 4x - 3}$***.***
$\boldsymbol{f + 3 = 4x}$***.***
$\boldsymbol{\frac{f+3}{4} = x}$***. (1 mark for working)***

So $\boldsymbol{f^{-1}(x) = \frac{x+3}{4}}$***. (1 mark)***

Marks

iv) Show that both $f(x)$ and $g(x)$ are neither odd nor even functions. **2**

Mark scheme:
$\boldsymbol{f(-x) = -4x - 3}$***, which is neither*** $\boldsymbol{-f(x) = -4x + 3}$ ***nor*** $\boldsymbol{f(x)}$. **(1 mark)**
Similarly, $\boldsymbol{g(-x) = \frac{-x}{2} + 8}$***, which is neither*** $\boldsymbol{-g(x) = \frac{-x}{4} - 8}$ ***nor*** $\boldsymbol{g(x)}$. ***(1 mark)***
Deduct a mark if only odd (or even) checked.

v) Consider the function: **2**

$$h(x) = \frac{1}{4}f(x)$$

Explain the effect of this transformation on the graph of function $f(x)$.

Mark scheme:
$\boldsymbol{f(x)}$ ***will be compressed (in the*** $\boldsymbol{y}$***-direction) (1 mark) by a factor of 4 (1 mark).***

Alternatively:
$\boldsymbol{f(x)}$ ***will be stretched (in the*** $\boldsymbol{y}$***-direction) (1 mark) by a factor of*** $\boldsymbol{\frac{1}{4}}$ ***(1 mark).***

Total 20 Marks

Marks

Question 4

a) Consider the function $y = x^3 - 6x^2 + 6x + 2$.

i) Calculate the value of y for the following SEVEN (7) x-values: **3**

$x = -1, 0, 1, 2, 3, 4, 5.$

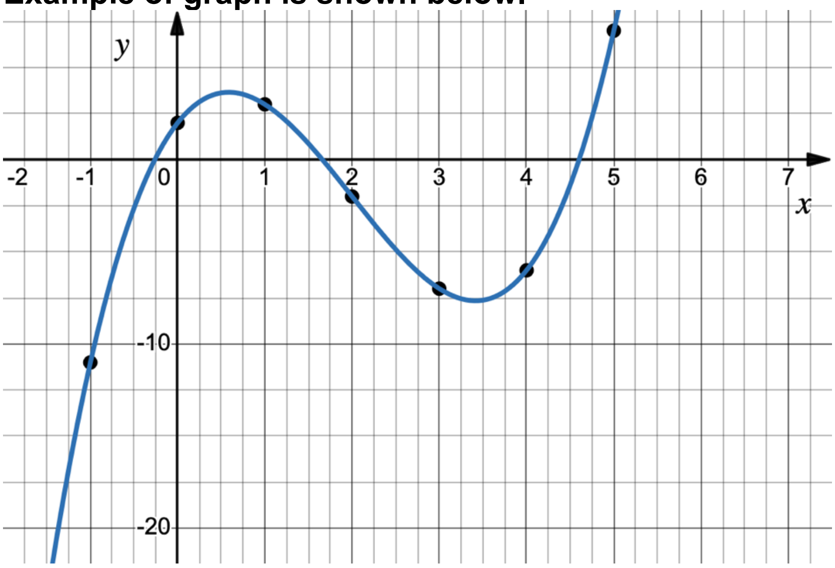
Mark scheme:

x	***-1***	***0***	***1***	***2***	***3***	***4***	***5***
$y = x^3 - 6x^2 + 6x + 2$	***-11***	***2***	***3***	***-2***	***-7***	***-6***	***7***

3-4 correct values: 1 mark.
5-6 correct values: 2 marks.
All seven correct values: 3 marks.

ii) Plot this function and clearly indicate the SEVEN (7) points calculated in (i). Use the graph paper provided. **4**

Mark scheme:
Example of graph is shown below.



Both axes drawn and labelled (1 mark)
Maximum of 2 marks for points correctly plotted: Award 1 mark for FOUR (4) or FIVE (5) points correctly plotted, 2 marks for all points plotted correctly.
Points joined with a smooth curve. (1 mark)

iii) State the name of this type of graph. **1**

Mark scheme:
Cubic. (1 mark).

Marks

iv) Use the graph to solve the following equation: **3**

$$y = x^3 - 6x^2 + 6x + 2 = 0$$

Mark scheme:
Accept $\boldsymbol{x = -0.25 \pm 0.1}$. (1 mark),
$\boldsymbol{x = 1.65 \pm 0.1}$. (1 mark),
$\boldsymbol{x = 4.6 \pm 0.1}$. (1 mark).

v) Comment on the nature of any turning points on the graph. **2**

Mark scheme:
There is a maximum at $\boldsymbol{x = 0.5 \pm 0.1}$. (1 mark),
There is a minimum at $\boldsymbol{x = 3.5 \pm 0.1}$. (1 mark).

b) Consider the following quadratic equation:

$$2x^2 + 6x - 3 = 0$$

i) Cody says that this equation will have THREE (3) solutions. Without solving, briefly say why Cody is wrong. **1**

Mark scheme:
This is a quadratic equation, which can only ever have TWO (2) solutions at most. (1 mark)

ii) Use the Quadratic Formula to solve the quadratic equation. Simplify your answer and leave it in surd form. **3**

Mark scheme:
$\boldsymbol{a = 2, b = 6, c = -3}$.
$\boldsymbol{x = \frac{-6 \pm \sqrt{6^2 - 4(2)(-3)}}{2(2)}}$,
This gives:
$\boldsymbol{x = \frac{-6 \pm \sqrt{60}}{4}}$, (1 mark for correct substitution and working)
which simplifies to:
$\boldsymbol{x = \frac{-3 \pm \sqrt{15}}{2}}$. (1 mark for each correctly simplified solution)
Error carried forward from working should not be penalised.

c) Solve the inequality $11 < 9x^2 - 5$ **3**

Mark scheme:
$\boldsymbol{16 < 9x^2}$, so $\boldsymbol{\frac{16}{9} < x^2}$. (1 mark for working)
$\boldsymbol{\frac{4}{3} < x}$ and $\boldsymbol{-\frac{4}{3} > x}$. (1 mark for each correct answer).

Total 20 Marks

Marks

Question 5

a) A local gym recorded the ages of its members who attended a special fitness class for the past month. The ages of FORTY ONE (41) attendees are listed below:

23, 31, 45, 38, 29, 52, 41, 35, 27, 48,
33, 25, 50, 39, 44, 30, 26, 47, 36, 28,
51, 42, 34, 29, 46, 32, 24, 49, 37, 28,
53, 40, 35, 27, 43, 31, 25, 50, 36, 32, 41.

i) Say whether the data is continuous or discrete. Briefly explain your answer. **2**

Mark scheme

Discrete. (1 mark)
The data as presented can only take certain values / is countable. (1 mark)

ii) Present the data as an ordered stem and leaf diagram. **4**

Mark scheme

2	***3 4 5 5 6 7 7 8 8 9 9***
3	***0 1 1 2 2 3 4 5 5 6 6 7 8 9***
4	***0 1 1 2 3 4 5 6 7 8 9***
5	***0 0 1 2 3***

N = 41, Key: 3 | 1 means 31.

(1 mark for correct layout (aligned values etc.),
1 mark for key,
2 marks for values in diagram correctly.
Deduct 1 mark per error up to a maximum of 2 marks).

ii) Find the median of the data. **2**

Mark scheme:
N=41, so median is the (41+1)/2 = 21st data point. (1 mark)
Median = 36 years. (1 mark)

Marks

b) A group of 10 students were asked to record the average number of hours they slept per night in the week leading up to a major exam, and their score on that exam (out of 100). The results are shown in the table below:

Average hours of sleep per night	Exam score (out of 100)
6.5	72
8	90
5	60
7.5	85
7	78
6.25	74
5.5	65
8	92
6.8	75
7.2	84

i) State whether the data collected is quantitative or qualitative. Briefly explain your answer. **2**

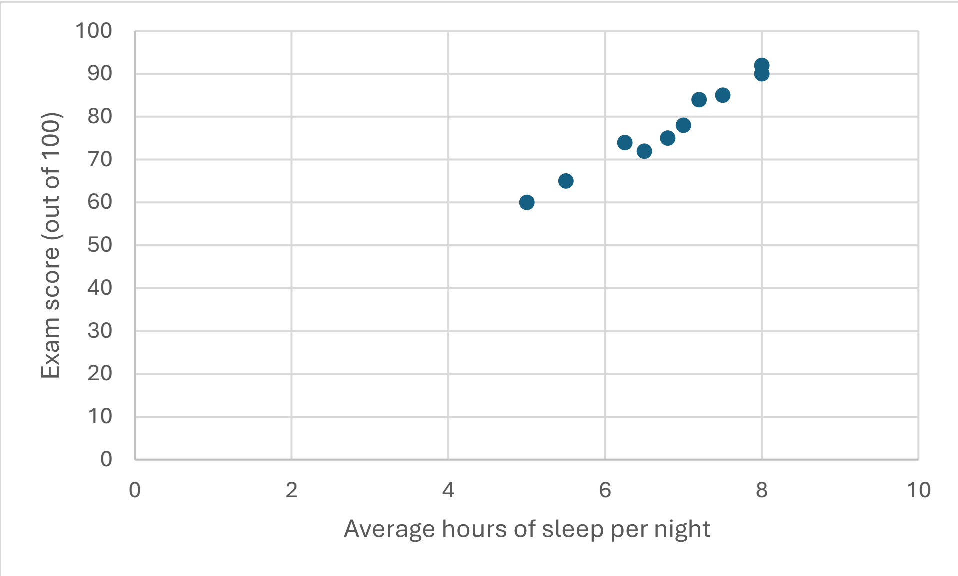
Mark scheme

Quantitative. (1 mark)
It is numeric. (1 mark)

Marks

ii) Construct a scatter graph to show this information. You should plot the average hours of sleep on the horizontal axis and the exam score on the vertical axis. Remember to label your axes appropriately. Use the graph paper provided. **5**

Mark scheme



1 mark for scatter graph.
1 mark for correct horizontal axis label.
1 mark for correct vertical axis label.
2 marks for accurate plotting of points. Deduct 1 mark per error.

Origin at (0,0) is not required.

iii) Describe the correlation shown in the scatter graph. Briefly say how this correlation relates sleep with exam score. **3**

Mark scheme

The scatter graph shows a strong (1 mark), positive (1 mark) correlation.
The more sleep a student gets, the better the exam result. (1 mark)

Marks

iv) Another student later says that they slept an average of 7 hours per night and received an exam score of 60. **2**

Say whether you think this is a relatively worse or better exam score than expected. Give ONE (1) reason for your answer.

Mark scheme
This is a relatively worse exam score than expected. (1 mark)

1 mark for a statement like one of the following:
This point lies BELOW and relatively FAR from the other points.
This point could be an OUTLIER, lying below the other points.
60 is already the lowest exam score in the sample of 10 students.

Total 20 Marks

End of paper

Mathematics for University Study
Formulae sheet

Table of Content

1. Transformations of Functions

Vertical shift	$g(x) = f(x) + k$ (up for $k > 0$)
Horizontal shift	$g(x) = f(x - h)$ (right for $h > 0$)
Vertical reflection	$g(x) = -f(x)$
Horizontal reflection	$g(x) = f(-x)$
Vertical stretch	$g(x) = af(x)$ ($a > 0$)
Vertical compression	$g(x) = af(x)(0 < a < 1)$
Horizontal stretch	$g(x) = f(bx)$ $(0 < b < 1)$
Horizontal compression	$g(x) = f(bx)$ ($b > 1$)

2. The Quadratic Formula and Discriminants

Written in standard form, $ax^2 + bx + c = 0$, any quadratic equation can be solved using the **quadratic formula**:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where a, b, and c are real numbers and $a \neq 0$

The discriminant is defined as $b^2 - 4ac$.

- If $b^2 - 4ac = 0$, there is one rational solution
- If $b^2 - 4ac > 0$ and a perfect square, there are two rational solutions
- If $b^2 - 4ac > 0$ and not a perfect square, there are two irrational solutions
- If $b^2 - 4ac < 0$, there are two complex solutions

3. Properties of Inequalities

Addition Property — If $a < b$, then $a + c < b + c$

Multiplication Property — If $a < b$ and $c > 0$, then $ac < bc$
If $a < b$ and $c < 0$, then $ac > bc$

These properties also apply to $a \leq b$, $a > b$, and $a \geq b$

4. Logarithms

The **product rule for logarithms** can be used to simplify a logarithm of a product by rewriting it as a sum of individual logarithms.
$\log_b(MN) = \log_b M + \log_b N$ for $b > 0$

The **quotient rule for logarithms** can be used to simplify a logarithm of a quotient by rewriting it as the difference of individual logarithms.
$$\log_b\left(\frac{M}{N}\right) = \log_b M - \log_b N$$

The **power rule for logarithms** can be used to simplify a logarithm of a power by rewriting it as the product of the exponent times the logarithm of the base.
$\log_b(M^n) = n\log_b M$

5. Sequences

The nth term of an arithmetic sequence is given by the explicit formula:
$a_n = a_1 + (n-1)d$

The nth term of a geometric sequence is given by the explicit formula:
$a_n = a_1 r^{n-1}$

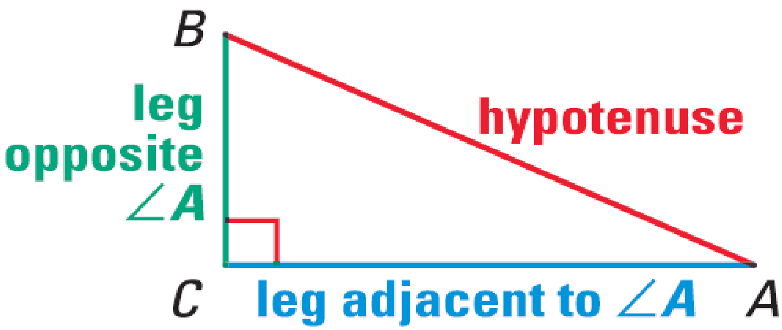
The formula for the **partial sum** of an arithmetic series is
$$S_n = \frac{n(a_1 + a_n)}{2}$$

The formula for the **partial sum** of a geometric series is
$S_n = \frac{a_1(1-r^n)}{1-r}$, $r \neq 1$

6. Geometry and Trigonometry

The sine and cosine ratios

- $\sin A = \frac{\text{opposite leg}}{\text{hypotenuse}}$
- $\cos A = \frac{\text{adjacent leg}}{\text{hypotenuse}}$
- $\tan A = \frac{\text{opposite leg}}{\text{adjacent leg}}$

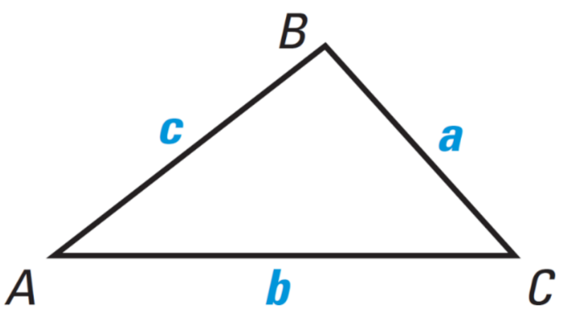


Law of Sines

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

Law of Cosines

$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$c^2 = a^2 + b^2 - 2ab\cos C$$



Equation of a Circle
$(x-a)^2+(y-b)^2=r^2$

where (a, b) is the center and r is the radius

Perimeters and Areas for Shapes

<u>Square</u>
Side s
P = $4s$
A = s^2

<u>Rectangle</u>
Length ℓ
Width w
P = $2\ell + 2w$
A = ℓw

<u>Triangle</u>
sides a, b, c
base b, height h
P = a + b + c
A = $\frac{1}{2} bh$

<u>Circle</u>
diameter d
radius r
C = $2\pi r$
A = πr^2

Area of a Trapezoid

$$A = \frac{1}{2}h(b_1 + b_2)$$

Where h is the height and b_1 and b_2 are the bases.

Area of a Rhombus

$$A = \frac{1}{2}d_1 d_2$$

Where d_1 and d_2 are the diagonals.

Area of a Kite

$$A = \frac{1}{2}d_1 d_2$$

Where d_1 and d_2 are the diagonals.

Area of a Regular Polygon

$$A = \frac{1}{2}Pa$$

Where P is the perimeter and a is the apothem

Surface Areas for Shapes

Surface Area of a Right Prism

$S = 2B + Ph$
Where S = surface area, B = base area,
P = perimeter of base, h = height of prism

Surface Area of a Right Cylinder

$S = 2\pi r^2 + 2\pi rh$
Where S = surface area, r = radius of base,
h = height of prism

Surface Area of a Regular Pyramid

$S = B + \frac{1}{2}P\ell$
Where B = base area, P = base perimeter, ℓ = slant height

Surface Area of a Right Cone

$S = \pi r^2 + \pi r\ell$
Where r = base radius, ℓ = slant height

Volumes for Shapes

Volume of a Prism

$V = Bh$
Where B = base area, h = height of prism

Volume of a Cylinder

$V = \pi r^2 h$
Where r = radius, h = height of cylinder

Volume of a Pyramid

$V = \frac{1}{3} Bh$
Where B = base area, h = height of pyramid

Volume of a Cone

$V = \frac{1}{3} \pi r^2 h$
Where r = radius, h = height of cone

Surface area of a Sphere

$S = 4\pi r^2$
Where r = radius

Volume of a Sphere

$V = \frac{4}{3} \pi r^3$
Where r = radius

Volume of the Frustum of a Pyramid

$$V = \frac{1}{3} h(A_B + A_b + \sqrt{A_B A_b})$$

where V = volume
h = height
A_B = area of the larger base
A_b = area of the smaller base

Volume of the Frustum of a Right Circular Cone

$V = \frac{1}{3}\pi h(R^2 + r^2 + Rr)$

where V = volume
h = height
R = radius of larger base
r = radius of smaller base

7. Statistics

Mean

Ungrouped data:

$\bar{x} = \frac{\sum x}{n}$

Ungrouped frequency table:

$\bar{x} = \frac{\sum fx}{n} = \frac{\sum fx}{\sum f}$

Grouped frequency table:

$\bar{x} = \frac{\sum fm}{n} = \frac{\sum fm}{\sum f}$

Mode

Grouped data

Estimated mode = $L + \frac{(F_m - F_b) \times c}{(2F_m - F_b) - F_n}$

Median

Grouped data

Estimated median = $L_{med} + W_{med} \times \frac{\frac{n}{2} - C_{med}}{F_{med}}$

Quartiles

Ungrouped data:

$LQ = \frac{1}{4}(n + 1)$

$UQ = \frac{3}{4}(n + 1)$

Grouped data

Quartile = $L + \frac{(Q-P)\times I}{F}$

Mean deviation

Ungrouped data
Mean deviation $= \frac{\sum|x-\bar{x}|}{n}$

Grouped data
Mean deviation $= \frac{\sum f|x-\bar{x}|}{\sum f}$

Variance

Ungrouped data:
$$s^2 = \frac{\sum(x - \bar{x})^2}{n} = \frac{\sum x^2}{n} - \bar{x}^2$$

Grouped data:
$$s^2 = \frac{\sum f(x - \bar{x})^2}{\Sigma f} = \frac{\sum f x^2}{\Sigma f} - \left[\frac{\sum f x}{\Sigma f}\right]^2$$

Standard deviation

Ungrouped data:
$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$

Grouped data:
$$s = \sqrt{\frac{\sum f x^2}{\Sigma f} - \left[\frac{\sum f x}{\Sigma f}\right]^2}$$

Coefficient of Variation
$$CV = \frac{s}{\bar{x}}$$

8. Kinematics
$$\boldsymbol{v = u + at}$$
$$\boldsymbol{v^2 = u^2 + 2as}$$
$$\boldsymbol{s = ut + \frac{1}{2}at^2}$$

Learning Outcomes matrix

Question	Learning Outcomes assessed	Marker can differentiate between varying levels of achievement
1	1, 2, 3, 4	Yes
2	1, 2, 3	Yes
3	1, 3, 4	Yes
4	1, 3, 4	Yes
5	3, 4, 5	Yes

Grade Descriptors

<table>
<tr><th>Learning Outcome</th><th>Pass
(40-59%)</th><th>Merit
(60-69%)</th><th>Distinction
(70-100%)</th></tr>
<tr><td>1. Be able to develop fundamental knowledge, skills and understanding of number and algebra and be able to perform and solve a range of algebraic calculations, equations and inequalities.</td><td rowspan="6">Demonstrates an adequate awareness and understanding of concepts, terminology, principles and processes with a reasonable application and use of mathematical principles, tools and techniques and satisfactory reference to theory through an adequate ability to perform calculations correctly using appropriate techniques and methods.</td><td rowspan="6">Demonstrates a consistent and accurate awareness and understanding of concepts, terminology, principles and processes with a detailed application and use of mathematical principles, tools and techniques and precise reference to theory through a robust ability to perform calculations consistently correctly using appropriate techniques and methods.</td><td rowspan="6">Demonstrates an outstanding awareness and understanding of concepts, terminology, principles and processes with a highly comprehensive and sophisticated application and use of mathematical principles, tools and techniques and critical and meticulous reference to theory through an excellent ability to perform calculations consistently correctly and to the highest standard using appropriate techniques and methods.</td></tr>
<tr><td>2. Acquire, select and apply mathematical techniques to solve sequence, ratio, proportion, rates of change and geometry problems.</td></tr>
<tr><td>3. Be able to mathematically, solve, reason, make deductions and inferences and draw conclusions within mathematics and other contexts.</td></tr>
<tr><td>4. Comprehend, interpret and communicate mathematical information in a variety of forms appropriate to the information and context.</td></tr>
<tr><td>5. Recognise and apply the fundamentals of statistics and be able to present data in graphical form.</td></tr>
<tr><td>6. Recognise and apply the fundamentals of probability.</td></tr>
</table>