IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper H

Difficulty Rating: 3.3533/0.7557

Time: 3 hours

Candidates may use any calculator allowed by the regulations of this examination.

Information for Candidates

This practice paper follows closely the Pearson Edexcel Syllabus, suitable for first assessment Summer 2018.

The standard booklet "Mathematical Formulae and Statistical Tables" may be used.
Full marks may be obtained for answers to ALL questions.
The marks for the parts of questions are shown in round brackets, e.g. **(2)**.
There are 16 questions in this question paper.
The total mark for this paper is 150.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.
You must show sufficient working to make your methods clear to the Examiner.
Answers without working may not gain full credit.
Non exact answers should be given to an appropriate degree of accuracy.
The examiner may refuse to mark any parts of questions if deemed not to be legible.

SECTION 1 - STATISTICS

Question 1

The table below shows the number of Maths teachers x, working in 8 different schools and the number of students y, in each of these 8 schools.

School	A	B	C	D	E	F	G	H
x	5	9	11	17	12	10	9	8
y	225	247	334	811	382	340	285	k

a) Use a statistical calculator to find the product moment correlation coefficient between the number of maths teachers and the number of students, for the schools A to G. **(1)**

b) Use linear regression to estimate the value of k, for school H.

Justify the reliability of the estimate. **(4)**

Question 2

Hooks produced in a factory are packed in boxes of sixty. It is thought that 5% of the hooks produced are defective.

The main production machine is replaced and the makers of the new machine claim that their machine will produce less defective hooks.

A box from the production of the new machine is inspected and is found to contain one defective hook. **(6)**

a) Test at the 10% level of significance the claim made by the makers of the new machine.

b) If the test was carried out at the 5% level of significance find the critical region for the test. **(3)**

Question 3

In a certain Crown Court 95% of the defendants being tried have actually committed the crime they are being tried for.

For those who committed the crime the probability of being found guilty is 90% and for those who did not commit the crime the probability of being found guilty is 5%.

a) Find the probability that a randomly chosen defendant will be found guilty. **(3)**

b) Given that a randomly chosen defendant was found guilty, find the probability that the defendant committed the crime. **(3)**

Question 4

The weekly mileages of a sales rep are thought to be Normally distributed with mean μ and standard deviation σ.

5% of his weekly mileages are less than 850 miles and 1% exceed 960 miles.

a) Find, correct to the nearest mile, the value of μ and the value of σ. **(7)**

The rep believes that the value of μ is much lower than the one found in part **(a)**, based on a random sample of 4 weeks whose mean mileage was 863.

b) Using the value of σ found in part **(a)**, conduct a hypothesis test at the 1% level of significance to investigate the rep's belief.

State your hypotheses clearly. **(6)**

Question 5

a) Give two reasons why stratified sampling might be a more suitable sampling method than simple random sampling. **(2)**

b) Give two reasons why stratified sampling might be a more suitable sampling method than quota sampling. **(2)**

Question 6

The distances rounded to the nearest mile, of 64 journeys covered by a taxi driver during a given week, is summarized in the table below.

Distance (nearest mile)	Frequency
3 – 5	12
6 – 7	14
8	19
9 – 11	13
12 – 17	6

a) Estimate the mean and the standard deviation of these weekly distances. **(4)**

No credit will be given unless appropriate formulae are used in this part.

b) Estimate, by linear interpolation, the median value. **(3)**

In a histogram drawn for the above data, the class 3 – 5 is represented by a rectangle of base length 1.2 cm and height 5 cm.

c) Find the base length and height of the rectangle representing the class 12 – 17 in the same histogram. **(3)**

It is further given that the lower and upper quartiles of these distances are 6.07 and 9.19, respectively.

d) Investigate the possibility of any outliers. **(3)**

e) By considering the skewness using the averages, discuss briefly whether the above set of data can be modelled by a normal distribution. **(3)**

Question 7

The events A and B are such so that

$$\mathrm{P}(A)=0.3, \qquad \mathrm{P}(A\cap B')=0.1, \qquad \mathrm{P}(A\cup B')=0.55.$$

a) Find $\mathrm{P}(B)$. **(4)**

b) Illustrate the above information in a fully completed Venn diagram. **(2)**

c) Determine …

i. … $\mathrm{P}(A|B)$. **(2)**

ii. … $\mathrm{P}(B'|A')$. **(2)**

Question 8

A box contains three blue discs and two red discs.

An experiment is conducted where three discs are selected at random from the box **without** replacement.

The variable X represents the number of blue discs selected.

a) Show that the probability distribution of X is given by

x	1	2	3
$\mathrm{P}(X=x)$	$\frac{3}{10}$	$\frac{6}{10}$	$\frac{1}{10}$

(6)

Four independent observations of X are recorded, labelled as X_1, X_2, X_3 and X_4.

b) Determine $\mathrm{P}(X_1+X_2+X_3+X_4\geq 10)$. **(6)**

SECTION 2 - MECHANICS

Question 9

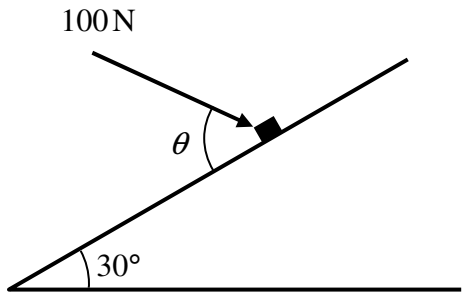
A uniform rod AB has length 6 m and weight 40 kg.

The rod rests in a horizontal position on two smooth supports at P and Q, where $AP = 1$ m and $AQ = d$ m.

The magnitude of the reaction force on the rod at Q is 3 times as large as that at P.

Calculate the value of d. **(5)**

Question 10



A particle of weight 120 N, rests on a **smooth** plane inclined at an angle of 30° to the horizontal.

The box is kept in **equilibrium** by a force of magnitude 100 N, **pushing** at an angle of θ $(\theta > 30°)$ to the direction of the greatest slope of the plane, as shown in the above figure.

Calculate the normal reaction between the particle and the plane. **(8)**

Question 11



Two forces, F_1 N and F_2 N, are acting on a particle at right angles to each other, as shown in the figure above. The resultant of the two forces has magnitude 41 N.

a) Given that the magnitude of F_1 is 9 N, find the magnitude of F_2. **(2)**

b) Determine the angle the resultant makes with F_2. **(2)**

A third force F_3 is added on the particle so that all three forces are in equilibrium.

c) State the magnitude of F_3. **(1)**

d) Calculate the angle F_3 makes with F_2. **(2)**

Question 12

A car is travelling along a straight horizontal road with constant acceleration a ms^{-2}.

The points A, B and C lie in that order on this road.

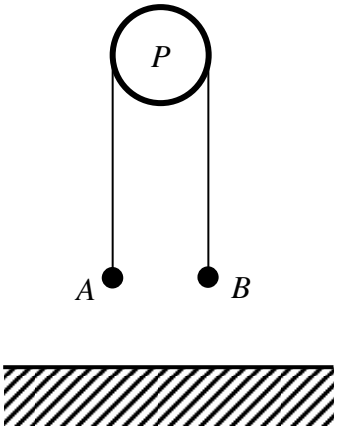
The car is passing through A with speed u ms^{-1} and 4 s later is passing through B.

The car finally passes through C, 2 s after passing through B.

The distance $AB = 68$ m and the distance $BC = 49$ m.

By modelling the car as a particle find in any order the value of a and the value of u. **(7)**

Question 13



Two particles A and B of respective masses 3 kg and m kg are each attached to the two ends of a light inextensible string which passes over a smooth pulley P. The two particles are held at rest, both at a height of 1.28 m above a horizontal floor with the portions of the strings not in contact with the pulley vertical.

The system of the two particles is then released from rest with B accelerating towards the floor at 1.96 ms^{-2}, while A never reaches P.

a) For the period before B reaches the floor, calculate the tension in the string. **(3)**

b) Determine the value of m. **(3)**

c) Calculate the speed with which B strikes the floor. **(2)**

When B reaches the floor it remains at rest.

d) Determine the greatest height above the floor reached by A. **(4)**

Question 14

A car is observed travelling along a straight horizontal road between two points on this road, A and B, where $AB = 1362$ m.

At time $t = 0$ s the car goes past A with speed $30\ \text{ms}^{-1}$.

The car maintains this speed for 17 s.

It then decelerates uniformly to a speed of $12\ \text{ms}^{-1}$.

The car finally maintains the speed of $12\ \text{ms}^{-1}$ until it goes past B.

a) Sketch a speed time graph to show the motion of the car from A to B. **(3)**

The car took 70 s to travel from A to B.

b) Calculate the deceleration of the car during the motion described above. **(6)**

Question 15

Relative to a fixed origin O, the horizontal unit vectors $\mathbf{i}$ and $\mathbf{j}$ are pointing due east and due north, respectively.

A ship P is sailing with constant velocity $(-7\mathbf{i} - 5\mathbf{j})\ \text{km h}^{-1}$.

a) Calculate the speed of P. **(2)**

b) Find the direction in which P is moving, giving the answer as a bearing. **(3)**

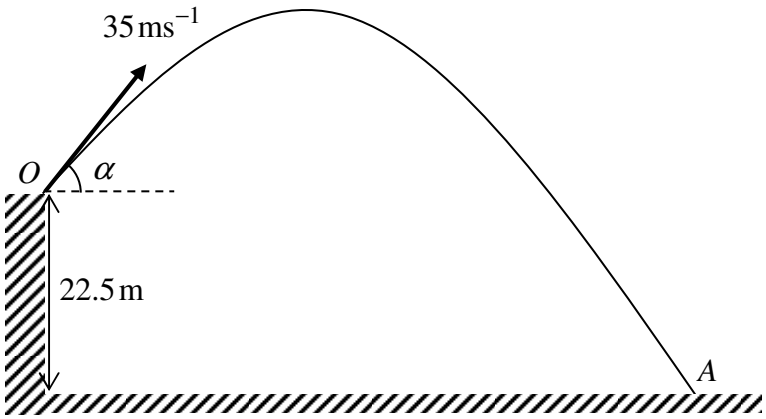
At 12.00 hours, P is observed passing through the point with position vector $(40\mathbf{i} + 28\mathbf{j})$ km.

A lighthouse L is located at the point with position vector $(-12\mathbf{i} + \mathbf{j})$ km.

c) Find the distance between P and L at 16.00 hours. **(5)**

d) Determine the time, using 24 hour clock notation, when P is east of L. **(3)**

Question 16



A particle is projected with a speed of 35 ms^{-1} at an angle of elevation α, where $\sin\alpha = \frac{4}{7}$ from a point O which is 22.5 m above level horizontal ground.

The particle is moving freely under gravity and first strikes the ground at a point A, as shown in the figure above.

a) Find the greatest height above ground, achieved by the particle. **(4)**

b) Show that the flight time of the particle from O to A is 5 s. **(4)**

You may NOT use a verification method in this part.

c) Determine the speed and direction of motion of the particle as it reaches A. **(6)**