IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper O

Difficulty Rating: 3.2600/0.6569

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 15 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.

Note that the actual exam papers are out of 100 marks (50 marks in each section) and typically contain 11 to 13 questions.

SECTION 1 - STATISTICS

Question 1

The percentage mock exam marks, of a random sample of 8 G.C.S.E. students, in Geography and History are recorded in the table below.

Student	A	B	C	D	E	F	G	H
Geography	80	29	56	56	58	45	67	72
History	78	49	65	50	75	50	60	47

Test, at the 10% level of significance, whether there is evidence of positive correlation between the percentage mock exam marks in Geography and History. **(6)**

Question 2

During the winter, Ned attends weekly business meetings in Newcastle and always travels to these meetings by car.

The probability of being dry, raining or snowing during his travel to these meetings is $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{6}$, respectively. The respective probabilities of Ned arriving on time when is dry, raining or snowing are $\frac{4}{5}$, $\frac{2}{5}$ and $\frac{1}{10}$.

a) Determine the probability that Ned will arrive late for his next winter business meeting. **(5)**

Ned arrived late for his meeting last week.

b) Find the probability that it was raining on that day. **(3)**

Question 3

A group of patients with a certain respiratory condition were asked to hold their breath for as long as they could.

The results are summarized in the table below.

Time t (in seconds)	Frequency
$0 < t \leq 10$	30
$10 < t \leq 15$	35
$15 < t \leq 18$	33
$18 < t \leq 20$	20
$20 < t \leq 30$	25
$30 < t \leq 50$	10

a) Draw an accurate histogram to represent this data. **(5)**

b) Use the histogram to estimate the number of patients that managed to hold their breath between 24 and 36 seconds. **(3)**

c) Calculate estimates for the mean and standard deviation of this data. **(5)**

Question 4

The masses, x kg, of 40 students were measured and the results were summarized using the notation below.

$$\sum_{n=1}^{40}(x_n - 50) = 140 \qquad \text{and} \qquad \sum_{n=1}^{40}(x_n - 50)^2 = 4490.$$

Calculate the mean and standard deviation of the masses of these 40 students. **(7)**

Question 5

Drawing pins are sold in boxes of 20 and it is thought that 10% of these drawing pins have flaws.

a) If a box of these drawing pins is examined at random, find the probability that it will contain ...

i. ... 3 drawing pins with flaws. **(3)**

ii. ... at least 2 drawing pins with flaws. **(2)**

b) If 3 boxes of these drawing pins are examined at random, determine the probability that at least one of these boxes will contain at least 2 drawing pins with flaws. **(2)**

A single box of these drawing pins is picked at random and found to contain exactly 5 drawing pins with flaws.

c) Test, at the 5% level of significance, whether this constitutes evidence that the proportion of drawing pins with flaws is higher than 10% . **(6)**

Question 6

Paul's training session times, in minutes, are modelled as a Normal variable, distributed with a standard deviation of 18 .

In 3 sessions out of 4 , Paul takes more than 80 minutes to complete his training.

a) Determine, to the nearest minute, Paul's mean training time. **(4)**

b) Find the probability that one of Paul's sessions will last more than 2 hours. **(3)**

One of Paul's training sessions lasted more than 2 hours.

c) Find the probability that this particular session did not exceed $2\frac{1}{4}$ hours. **(6)**

Question 7

Abel usually visits his hairdresser at most once a week. On any given week, there is a probability of 0.08 that Abel will not go to his hairdresser.

The probability that, on his weekly visit to his hairdresser, Abel has a haircut but not a shave is 0.72. On his weekly visit, if Abel has a haircut the probability he will also have a shave is 0.2.

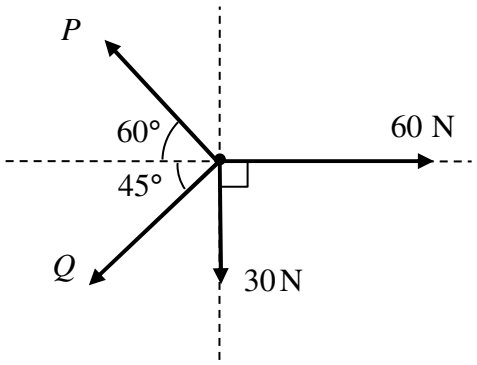
a) Find the probability that on a week picked at random Abel has a haircut and a shave at his hairdresser. **(6)**

b) Determine whether the events "having a haircut at his hairdresser" and "having a shave at his hairdresser" are statistically independent. **(3)**

SECTION 2 – MECHANICS

Question 8

The four coplanar forces, shown in the figure below, are in equilibrium.



Determine in exact surd form the value of P and the value of Q. **(7)**

Question 9

A particle is projected vertically upwards from level ground with a speed of $14\ \text{ms}^{-1}$.

a) Determine the speed of the particle and the distance of the particle from the ground, 0.5 s after projection. **(5)**

b) Calculate the total distance travelled by the particle during the first 2 s of its motion. **(7)**

Question 10

A particle is projected from a point A on level horizontal ground with speed of $39.2\ \text{ms}^{-1}$ at an angle θ to the horizontal.

The particle is travelling freely under gravity and after 3 s it reaches the point C, where C is at the greatest height of the particle above the ground.

a) Show that $\sin\theta = \frac{3}{4}$. **(3)**

b) Find the height of C, above the ground. **(3)**

The particle eventually lands on the ground at a point B.

c) Calculate the distance AB. **(3)**

d) State the least speed of the particle. **(3)**

Question 11

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

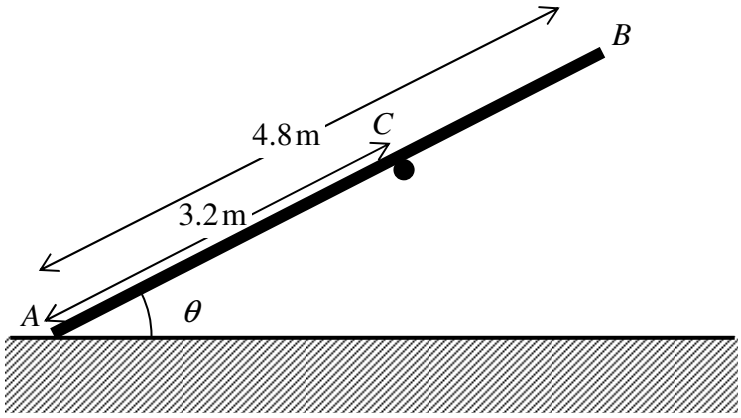
At time $t = 0$, particle A is at the point with position vector $(7\mathbf{i} - 2\mathbf{j})$ m, moving with velocity $(2\mathbf{i} + 3\mathbf{j})\ \text{ms}^{-1}$.

At time $t = 0$, particle B is moving with velocity $(3\mathbf{i} + 5\mathbf{j})\ \text{ms}^{-1}$.

The constant accelerations of the two particles, A and B, are $(0.1\mathbf{i} + 0.2\mathbf{j})\ \text{ms}^{-2}$ and $(-0.2\mathbf{i} + 0.3\mathbf{j})\ \text{ms}^{-2}$, respectively.

Determine the position vector of B when $t = 0$, given further that A and B collide when $t = 10$. **(8)**

Question 12



The figure above shows a plank AB resting on a smooth peg. The plank is modelled a uniform rod of weight W N and of length 4.8 metres, resting on the peg at the point C, where AC is 3.2 metres.

The end A of the plank rests in limiting equilibrium on rough ground, where the coefficient of friction between the plank and the ground is $\frac{9}{13}$.

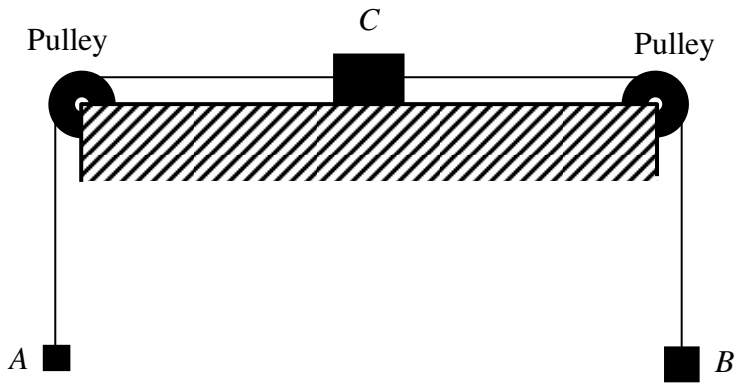
The plank is inclined at angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$. The points A, B and C lie in a vertical plane which is perpendicular to the ground.

Given that the magnitude of the normal reaction of the ground at A is $65\,\text{N}$, find in any order …

a) … the value of W. **(3)**

b) … the magnitude of the force between the plank and the peg. **(3)**

Question 13



A block C, of mass 4 kg, is placed on a rough horizontal table, where the coefficient of friction between the table and C is 0.65.

C is connected by two light inextensible strings to two more blocks, A and B, of respective masses 3 kg and 7 kg.

Each of the strings passes over two smooth pulleys, each of the pulleys located at the edge of the table, with A and B hanging freely at each of the two ends of the table, as shown in the figure above.

The system is released from rest with the strings taut.

By modelling the three blocks as particles, determine in any order the acceleration of the system and the tension in each of the two strings. **(11)**

Question 14

A particle P is moving on the x axis and its velocity v ms^{-1} in the positive x direction, t seconds after a given instant, is given by

$$v = t^2 - 2t - 24\,,\ t \geq 0\,.$$

When $t = 3$, P is observed passing through the origin.

a) Find the acceleration of P when $t = 3$. **(3)**

b) Determine the distance of P from O when it is instantaneously at rest. **(6)**

c) Find the time at which P is passing through O again. **(4)**

Question 15

A non uniform plank AB has length 12 m and mass M kg.

A smooth support is placed under the plank at the point C, where $|AC| = 3$ m. When a child of mass 30 kg stands at A, the plank rest horizontally in equilibrium.

The smooth support is next placed under the plank at the point D, where $|BD| = 5$ m. When the same child stands at B, the plank again rest horizontally in equilibrium.

The plank is modelled as a non uniform rod whose centre of mass is at the point G, and the child is modelled as a particle.

a) Determine the value of M. **(4)**

b) Calculate the distance AG. **(4)**

Two smooth supports are next placed under the plank at the points C and D, and when the same child stands at E, the plank rest horizontally in equilibrium with the reactions at the two supports being equal.

c) Find the distance AE. **(4)**
