# IYGB GCE

## Mathematics MMS

## Advanced Level

## Practice Paper N

Difficulty Rating: 3.5533/0.8174

## 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**

Bag $A$ contains 3 red balls and 4 green balls and bag $B$ contains 2 red balls and 3 green balls.

A fair dice numbered 1 to 6 is rolled.

- If the dice shows 6, a ball is drawn at random from bag $A$.
- If the dice does not show 6, a ball is drawn at random from bag $B$.

**a)** Find the probability that a red ball will be drawn. **(3)**

**b)** Given that a red ball was drawn, determine the probability that the dice had previously shown a six. **(3)**

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**Question 2**

An airline operates between Manchester and Madrid.

The flight time may be modelled by a Normal distribution with mean of 85 minutes and standard deviation 8.

In order to boost sales for the service, the airline decides to refund the fares if a flight time exceeds the mean flight time by $t$ minutes.

The airline does not want to refund more than 0.005 of the fares.

Find the value of $t$, correct to the nearest minute. **(6)**

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**Question 3**

A farmer keeps chicken and sells most of the eggs they lay.

The table below summarizes information about the number of eggs laid by his chickens every week, for a period of 47 weeks.

| Total number of eggs laid in a week | Number of weeks |
|---|---|
| 52 | 1 |
| 53 | 4 |
| 54 | 7 |
| 55 | 10 |
| 56 | 11 |
| 57 | 8 |
| 58 | 5 |
| 59 | 1 |

**a)** Calculate the mean and the standard deviation of the eggs laid per week. **(5)**

**b)** Determine the median and the quartiles for these data. **(3)**

**c)** If the farmer only sells 45 eggs per week and keeps the rest for his family, find the mean and the standard deviation of the eggs he keeps for his family. **(3)**

**d)** Use the median and mean to determine the skew of the above data, and hence determine whether this data can be modelled by a Normal distribution. **(3)**

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**Question 4**

In a histogram the weights of baby hamsters, correct to the nearest gram, are plotted on the $x$ axis.

In this histogram the class $24-30$ has a frequency of 63 and is represented by a rectangle of base 2.8 cm and height 6 cm.

In the same histogram the class $31-35$ has a frequency of 60.

Determine the measurements, in cm, of the rectangle that represents the class $31-35$.

**(3)**

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**Question 5**

Tim's tennis serve has a mean speed of 125 miles per hour.

Tim buys a new racket and wishes to know whether or not using this racket has changed the mean speed of his serve. He decides to measure the speed of a random sample of 10 serves with his new racket.

The speeds, in miles per hour, are shown below.

$$127.0,\ 124.6,\ 122.8,\ 127.2,\ 123.1,\ 124.8,\ 126.0,\ 123.5,\ 123.2,\ 121.8.$$

You may assume that this random sample comes from a Normal distribution with standard deviation 1.1.

Determine the $p$-value for these results and state the conclusion in context at the 5% level of significance. **(8)**

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**Question 6**

The records in a doctor's surgery show that 20% of the patients that make an appointment fail to turn up.

During a given weekday there are 20 appointments to see the doctor and the doctor has enough time to see all 20 patients.

**a)** Find the probability that all the patients **will** turn up. **(2)**

**b)** Find the probability that more than three patients **will not** turn up. **(2)**

In order to improve efficiency in the surgery, the doctor decides to make more than 20 appointments although he still has enough time to see only 20 patients.

One day the doctor has booked 21 appointments.

**c)** Find the probability he will be able to see all the patients that **will** turn up. **(3)**

Another day the doctor has booked 25 appointments.

**d)** Find the probability that the doctor **will not** be able to see one of the patients that will turn up. **(3)**

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**Question 7**

In a particular day, the following information is given about the 125 customers of a ladies leather goods store.

- 25 customers did not buy a pair of shoes, nor a handbag, nor a belt.
- No customer bought a pair of shoes and a belt.
- 60 customers bought pairs of shoes.
- 20 customers bought belts.
- 24 customers bought a pair of shoes and a handbag.
- 6 customers bought a belt and a handbag.

One of these 125 customers is selected at random.

**a)** Draw a Venn diagram to represent the above information and hence determine the probability that this customer bought ...

**i.** ... shoes. **(5)**

**ii.** ... belts. **(2)**

**iii.** ... two different leather items. **(2)**

**b)** If a customer bought a handbag, find the probability that she also bought shoes. **(2)**

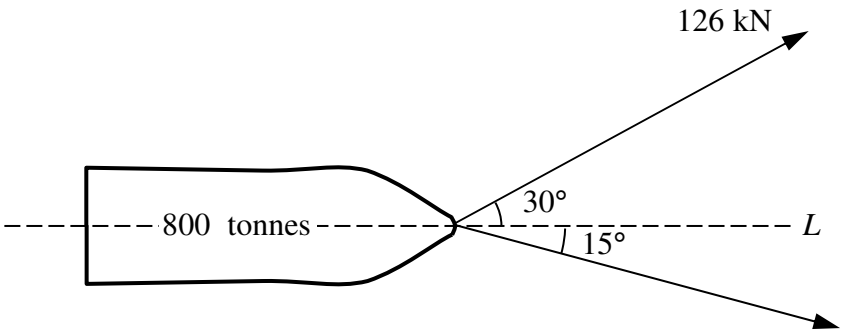
**c)** If a customer bought a handbag, find the probability that she also bought a belt. **(2)**

**d)** State, with justification, two types of leather purchases which are statistically independent. **(3)**

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## SECTION 2 – MECHANICS

**Question 8**




The figure above shows a ship, of mass 800 tonnes, being pulled by two tugs using horizontal cables, so that the ship is moving in a straight line $L$.

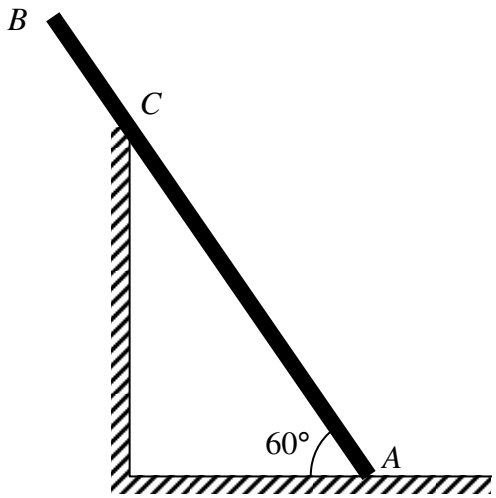
One tug exerts a force of 126 kN, at an angle of $30°$ to $L$.

The other tug exerts a force at an angle of $15°$ to $L$.

The ship is accelerating along $L$ at $0.05\ \text{ms}^{-2}$.

Determine the magnitude of the resistance opposing the motion of the ship. **(7)**

**Question 9**




A uniform ladder $AB$, of length 6 m and mass 20 kg, is placed with its end $A$ on rough horizontal ground and $B$ **over** a smooth vertical wall. The ladder rests on the wall at the point $C$, so that $|BC| = 1$ m.

The ladder is inclined at an angle of $60°$ to the horizontal and the coefficient of friction between the ladder and the ground is $\mu$.

When a man, of mass 80 kg, is standing at the point $P$ on the ladder, so that $|AP| = 4$ m, the ladder is in limiting equilibrium.

Determine the exact value of $\mu$. **(9)**

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**Question 10**

A particle is moving in a straight line in an electromagnetic field.

Its velocity, $v$ ms$^{-1}$, at time $t$ s, $t \geq 0$, is given by

$$v = t^2 + kt + 3.2,$$

where $k$ is a non zero constant.

**a)** Given that the particle achieves its minimum velocity when $t = 2.4$ s, show that $k = -4.8$. **(2)**

**b)** Determine the values of $t$ when the particle is instantaneously at rest. **(4)**

**c)** Calculate the total distance covered by the particle for $0 \leq t \leq 6$. **(8)**

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**Question 11**

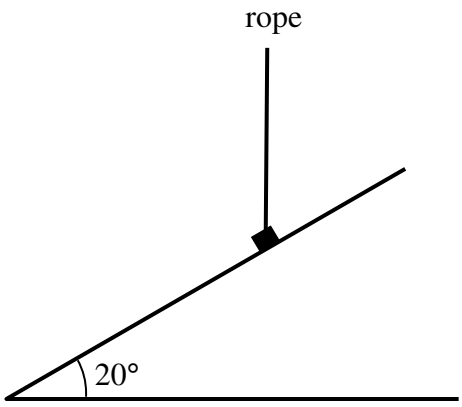
A boy kicks a football from a point $O$ on level horizontal ground. The football travels freely under gravity and $2\frac{1}{2}$ seconds later it just clears the top of a tree $P$.

The **horizontal** distance from $O$ to $P$ is 42 m and the tree is 3 m tall.

Find the speed and the direction of the football as it passes through $P$. **(10)**

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**Question 12**




A box of mass 40 kg is held by a rope on a fixed rough inclined plane. The plane is at an angle of 20° to the horizontal. The rope is vertical and lies in a vertical plane containing a line of greatest slope of the incline plane, as shown in the figure above.

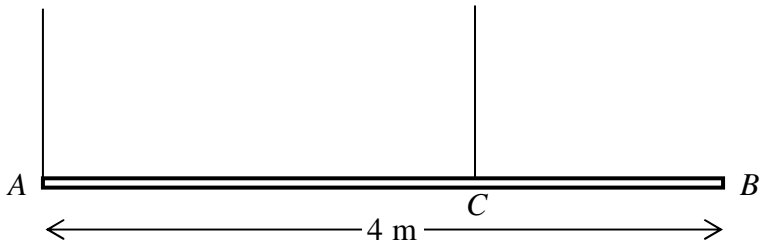
The rope is modelled as a light inextensible string and the box is modelled as a particle, at the point of slipping down the plane.

The coefficient of friction between the box and the plane is $\mu$.

Given that the ground friction has magnitude 70 N, determine the value of $\mu$. **(9)**

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**Question 13**




A rod $AB$ has mass $m$ kg and length $4$ m.

The rod is hanging in equilibrium in a horizontal position by two vertical strings attached to the rod. The rod is uniform and the strings are light and inextensible. One string is attached to $A$ and the other string is attached to the point $C$ on the rod as shown in the figure above.

The tension in the string attached at $C$ is twice as large as the tension in the string attached at $A$.

Then a particle of mass $\lambda m$ kg is attached to the rod at $B$.

The rod remains in equilibrium in a horizontal position. The tension in the string attached at $C$ is now four times as large as the tension in the string attached at $A$.

Determine the value of $\lambda$. **(10)**

**Question 14**

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

At noon a ship $A$ is at the point with position vector $(-2\mathbf{i}+\mathbf{j})$ km and travelling with constant velocity $(4\mathbf{i}-7\mathbf{j})\ \text{km h}^{-1}$.

**a)** Calculate the speed of $A$. **(2)**

At noon ship $B$ is at the point with position vector $(10\mathbf{i}-3\mathbf{j})$ km and travelling with constant velocity $(-2\mathbf{i}+5\mathbf{j})\ \text{km h}^{-1}$.

**b)** Determine the bearing at which $B$ is travelling. **(2)**

**c)** Find an expression for the position vector of $A$ relative to $B$. **(2)**

The distance between the two ships, $t$ hours after noon is $d$ km.

**d)** Show clearly that

$$d^2 = 180t^2 - 240t + 160,\ t \geq 0.$$ **(3)**

**e)** Calculate the times when the two ships are 10 km apart. **(4)**

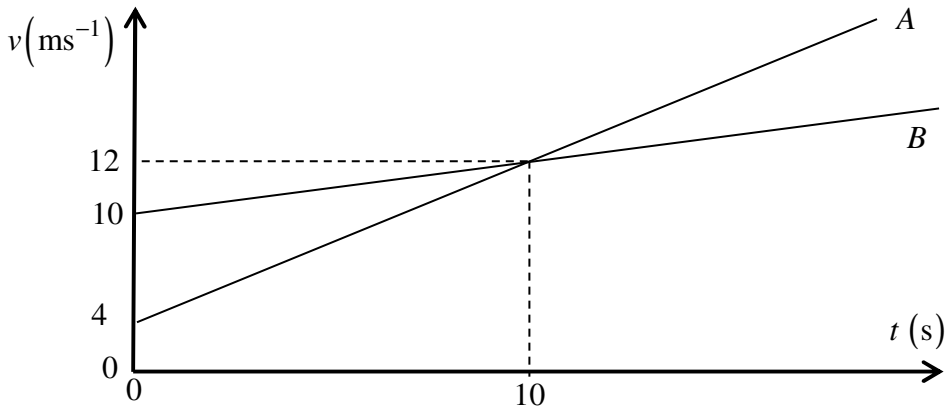
**f)** Determine the shortest distance between the two ships. **(3)**

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**Question 15**

Two trains, $A$ and $B$, each of length 130 m, are moving on adjacent straight horizontal tracks which are parallel to each other.

At time $t = 0$, the front ends of both trains pass a signal. The subsequent motion of each of the trains is shown in the speed time graph $(t, v)$, below.




Find the value of $t$ when the front end of $B$ is 110 m behind the back end of $A$. **(12)**