IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper F

Difficulty Rating: 2.9800/0.6623

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.

SECTION 1 – STATISTICS

Question 1

The table below shows the number of priests x, working in 8 different towns and the number of shoplifting incidents y, committed in a given month in the same 8 towns.

Town	A	B	C	D	E	F	G	H
x	15	12	11	25	23	19	19	22
y	310	281	215	328	305	277	300	k

a) Use a statistical calculator to find the product moment correlation coefficient between the number of priests and the number of shoplifting incidents, for the towns A to G. **(1)**

b) Interpret the value of the product moment correlation coefficient in the context of this question. **(1)**

c) Explain how the value of the product moment correlation coefficient between x and y will be affected if the burglaries were recorded in **hundreds**. **(1)**

d) Test, at the 5% level of significance, whether there is evidence of positive correlation between the number of priests and the number of shoplifting incidents, for the towns A to G. **(4)**

e) Comment on the statement

"… the priests are likely to be responsible for the shopliftings …" **(1)**

f) Use linear regression to estimate the value of k, for town H. **(3)**

g) Calculate the residual for town E. **(2)**

Question 2

The number of bottles of red wine sold by a local supermarket over a two week period is shown below.

22, 14, 11, 33, 32, 45, 4, 12, 13, 20, 27, 44, 30, 15.

a) Display the above data in an ordered stem and leaf diagram. **(3)**

b) Calculate the mean and the standard deviation of the data. **(4)**

c) Find the median and the quartiles of the data and use them to determine if there are any outliers. **(5)**

d) Draw a suitably labelled box plot for this data. **(3)**

e) Determine with justification the skewness of the data. **(2)**

Question 3

During the winter months, in a certain village in Scotland, the probability of a day having severe fog is 0.06.

a) Find the probability that in a given week there will be …

i. … no day with severe fog. **(2)**

ii. … three or more days with severe fog. **(2)**

It is known that on a given week there were three or more days with severe fog.

b) Determine the probability that there were exactly three days with severe fog in that week. **(3)**

Question 4

The continuous random variable X is Normally distributed with a mean of 9.5 and a standard deviation of 1.3.

a) Find $\mathrm{P}(X > 12)$. **(4)**

b) Determine the value of a such that $\mathrm{P}(X < a) = 0.1587$ **(4)**

Question 5

The battery lifetime of a certain make of laptop is claimed to be Normally distributed with a mean of 6.6 hours and variance of 3.9 hours^2.

The battery lifetimes of forty such laptops were measured and the mean was 6.1 hours.

Determine, at the 10% level of significance, whether the claim on the battery lifetime of the laptop is justified.

(6)

Question 6

It is estimated that 20% of the cars sold in a certain auction have been involved in serious accidents. The auction has a test which produces a positive result to indicate that a car has been involved in serious accident.

If a car **has** been involved in a serious accident the test will produce a positive result in 80% of the cases. If a car **has not** been involved in a serious accident the test will produce a positive result in 10% of the cases.

a) Draw a tree diagram to represent the above information. **(3)**

A car is selected at random.

b) Find the probability that this car will…

i. … test positive. **(2)**

ii. … be classed correctly by the test. **(2)**

c) Given that a car tests positive determine the probability it has been involved in a serious accident. **(2)**

The cars that test positive are further examined by a team of mechanics.

These teams of mechanics have a 90% probability of **correctly** identifying whether a car **has** been involved in an accident or **not**.

Another car is selected in the auction.

d) Determine the probability that this car has not been involved in a serious accident, it tested positive but the team of mechanics concluded it had not been involved in a serious accident. **(3)**

Question 7

The events A and B satisfy

$$\mathrm{P}(A) = 0.6,\ \mathrm{P}(B) = 0.52 \text{ and } \mathrm{P}(A \cup B) = 0.88.$$

a) Find the value of $\mathrm{P}(A \cap B)$ and hence illustrate this probability information in a fully completed Venn diagram. **(4)**

b) Determine …

i. … $\mathrm{P}(B|A)$. **(2)**

ii. … $\mathrm{P}(A'|B')$. **(2)**

c) State, giving a reason, whether A and B are …

i. … statistically independent. **(2)**

ii. … mutually exclusive. **(2)**

SECTION 2 - MECHANICS

Question 8

A car of mass 1500 kg is towing a trailer of mass 1000 kg by means of a light inextensible rope. The car is experiencing a constant air resistance of 200 N, while the corresponding constant air resistance on the trailer is 300 N.

The car and trailer are modelled as particles, with the tow rope remaining taut and horizontal throughout the motion.

a) Given that the driving force acting on the car is 750 N, determine …

i. … the acceleration of the system. **(3)**

ii. … the tension in the tow rope. **(2)**

Later in the journey, the car and the trailer are ascending on a road which inclined at $5°$ to the horizontal. The air resistance on the car and trailer are unchanged.

b) Assuming that the system now moves with constant speed, calculate …

i. … a new figure for the tension in the tow rope. **(3)**

ii. … a new figure for the driving force of the car. **(2)**

Question 9



The figure above shows a uniform rod AB of length 1.8 m and mass 3 kg, held in a horizontal position by two small smooth pegs C and D.

A particle of mass 12 kg, is placed at B.

Given that $|AC| = 0.3$ m and $|CD| = 0.4$ m, determine the magnitude of each of the forces exerted on the rod by the pegs. **(6)**

Question 10

A particle is projected from a point O on level horizontal ground with speed of $21\ \text{ms}^{-1}$ at an angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$.

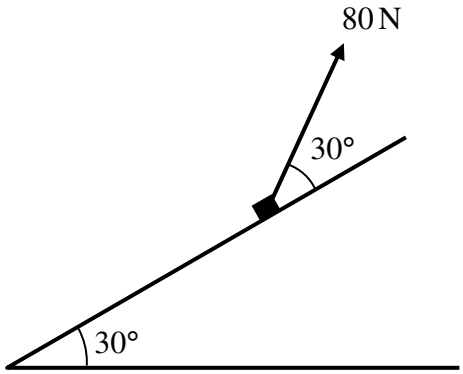
The particle is moving freely under gravity and lands at a point A on the ground, which is 43.2 m away from O.

a) Find the time it takes the particle to travel from O to A. **(3)**

b) Determine the greatest height above the ground reached by the particle during its flight. **(2)**

c) Show that the particle remains at a height of at least 4.5 m above ground for exactly $1\frac{5}{7}$ seconds. **(5)**

Question 11



A box of mass 10 kg is pulled by a rope on a fixed rough inclined plane. The rope is modelled as a light inextensible string and the box is modelled as a particle. The plane is at an angle of $30°$ to the horizontal, as shown in the figure above.

The rope lies in a vertical plane containing a line of greatest slope of the incline plane and is inclined at $30°$ to the plane. When the tension in the rope is 80 N the box is travelling up the plane, at constant speed.

The normal reaction between the box and the plane is R N.

Given that the magnitude of the friction between the box and the plane is μR, where μ is a positive constant, determine the value of μ.

(8)

Question 12

A car is travelling along a straight horizontal road with constant acceleration.

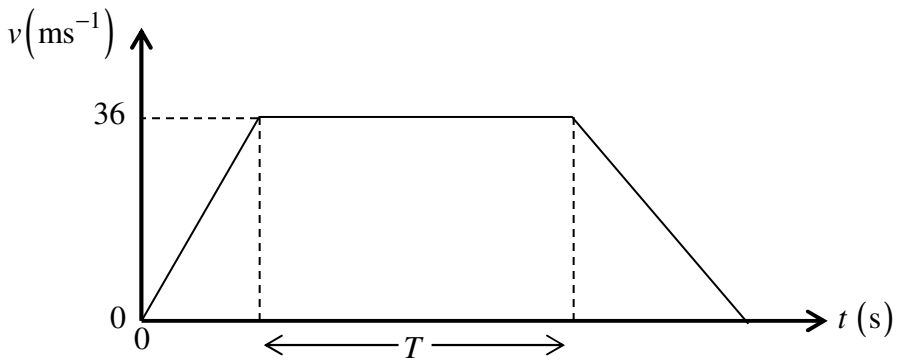
The car passes a point A with speed u ms^{-1}, where $u < 18$ and 12 seconds later passes a point B with speed 18 ms^{-1}.

The distance AB is 180 m.

a) Find the value of u. **(2)**

b) Calculate, correct to two decimal places, the time taken for the car to move from A to the midpoint of AB. **(4)**

Question 13



The figure above shows the speed time graph (t, v) of a train travelling along a straight horizontal track between two stations which are 6.3 km apart.

The train starts from rest at the first station and accelerates uniformly for 360 m, reaching a speed of 36 ms^{-1}. This speed is maintained for T s, before the train decelerates uniformly at 1.2 ms^{-2}, coming to rest as it reaches the second station.

a) Calculate the acceleration of the train. **(4)**

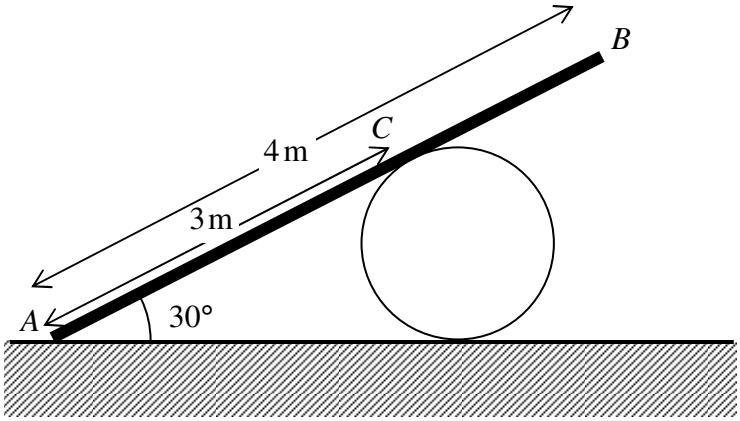
b) Determine the value of T. **(4)**

A high speed train also completes the same journey at exactly the same total time as the first train.

Starting from the first station, it accelerates uniformly to a top speed of u ms^{-1} and on reaching this speed it immediately decelerates uniformly coming to rest as it reaches the second station.

c) Sketch on the above diagram a speed time graph for journey of the second train and use it to determine the value of u. **(3)**

Question 14



The figure above shows a plank AB resting on a smooth cylinder which is fixed with its axis horizontal to rough horizontal ground. The plank is modelled a uniform rod of mass 10 kg and length 4 metres, resting in equilibrium on the cylinder at the point C, where AC is 3 metres. The end A of the plank rests in limiting equilibrium on the ground, inclined at an angle of $30°$ to the horizontal. The points A, B and C lie in a vertical plane which is perpendicular to the axis of the cylinder.

a) Find the normal reaction between the plank and the ground. **(8)**

b) Show that the coefficient of friction between the plank and the ground is $\frac{1}{3}\sqrt{3}$. **(2)**

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.

At noon a ship A is at the point with position vector $(5\mathbf{i}-7\mathbf{j})$ km, travelling with constant velocity $(3\mathbf{i}-4\mathbf{j})$ km h^{-1}.

a) Determine the bearing at which A is travelling. **(2)**

At noon ship B is at the point with position vector $(3\mathbf{i}+5\mathbf{j})$ km and travelling with constant velocity $(-2\mathbf{i}+8\mathbf{j})$ km h^{-1}.

b) Find the speed of B. **(2)**

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

c) Show clearly that

$$d=\sqrt{169t^2+308t+148}\ ,\ t\geq 0\,. \qquad \textbf{(4)}$$

d) Show further that the two ships do not collide in the subsequent motion. **(3)**

e) Calculate the time when the two ships are 25 km apart. **(3)**