IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper L

Difficulty Rating: 3.3633/0.7585

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 b

SECTION 1 - STATISTICS

Question 1

The table below shows the maximum temperature T °C on five different days and the corresponding ice cream sales, N, of a certain shop on those days.

T	15	20	25	30	35
N	69	165	172	200	232

a) State, with a reason, which is the explanatory variable in the above described scenario and state the statistical name of the other variable. **(2)**

b) Use a statistical calculator to determine …

i. … the value of the product moment correlation coefficient between T and N. **(1)**

ii. … the equation of the regression line between N and T, giving the answer in the form

$$N = a + bT,$$

where a and b are constants. **(2)**

c) Interpret in the context of this question the physical meaning of a and b. **(2)**

d) Use the equation of the regression line to estimate the value of N when …

i. … $T = 18°C$.

ii. … $T = 37°C$.

iii. … $T = 45°C$

Comment further on the reliability of each of these estimates. **(6)**

Question 2

The probability distribution of a discrete random variable X is given by

$$\mathrm{P}(X = x) = \begin{cases} \frac{1}{12} & x = 1, 2, 3, \ldots, 12 \\ 0 & \text{otherwise} \end{cases}$$

Determine $\mathrm{P}(X + 2 < 3X - 4 \leq 2X + 7)$. **(6)**

Question 3

Give two advantages and two disadvantages of the method of quota sampling. **(3)**

Question 4

The number of hours worked in a given week by a group of 64 freelance electricians is summarized in the table below.

Hours (nearest hour)	Frequency
1 – 10	5
11 – 20	16
21 – 25	14
26 – 30	17
31 – 40	10
41 – 59	2

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

b) Use the histogram to estimate the number of freelance electricians that worked between 15 and 37 hours during that week, correct to the nearest hour. **(3)**

c) Estimate the median of the data. **(3)**

Question 5

A teacher is investigating the students' method of getting back home and is told that 15% of the students gets back home by car.

He decides to investigate this fact further and decides to use a random sample of 36 students across all the school's year groups.

Stating your hypotheses clearly, find the critical region …

a) … for his test at the 6% level of significance. **(7)**

b) … for a similar test where the probability of rejecting at either tail must be as close as possible to 3%. **(2)**

Question 6

In the Southgate Academy Sixth Form the students are either left handed or right handed. The following information is also known.

- 0.6 of the students are female.
- 0.11 of the students are left handed.
- 0.10 of the female students are left handed.

a) Draw a fully completed tree diagram to display the above information. **(5)**

A student is selected at random from the Southgate Academy Sixth Form.

b) Determine the probability that the student is female and right handed. **(2)**

c) If the student is left handed, find the probability that the student is female. **(3)**

d) If the student is male, find the probability that the student is left handed. **(1)**

Question 7

The continuous random variable X has a Normal distribution with mean of 425 and a standard deviation of 20.

a) Determine the value of ...

i. ... $\mathrm{P}(X > 455)$ **(4)**

ii. ... $\mathrm{P}(395 < X < 455)$ **(2)**

b) Find the value of x, given further that

$$\mathrm{P}(850 - x < X < x) = 0.9722 . \quad \textbf{(5)}$$

It is believed that the mean of X could be less than 425, as the mean of a random sample of 12 independent observations of X was 417.

c) Test the validity of this belief, at 5% level of significance, stating clearly all the relevant quantities and hypotheses. **(6)**

Question 8

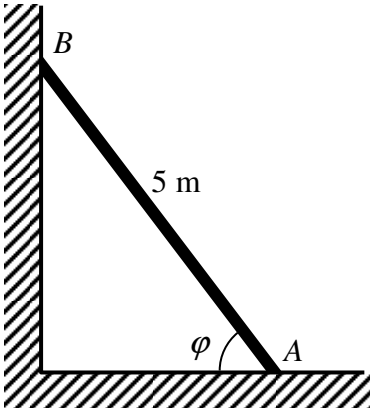
The events A and B satisfy

$$\mathrm{P}(A|B) = 1, \qquad \mathrm{P}(A|B') = \frac{1}{4}, \qquad \mathrm{P}(B) = \frac{7}{10} .$$

Find the value of $\mathrm{P}(B'|A)$. **(5)**

SECTION 2 - MECHANICS

Question 9



The figure above shows a ladder AB resting in equilibrium with one end A on rough horizontal ground and the other end B against a smooth vertical wall. The ladder is modelled as a uniform rod of length 5 metres and mass $20\,\text{kg}$, and lies in a vertical plane perpendicular to the wall and the ground, inclined at an angle φ to the horizontal.

When a person, which is modelled as a particle, of mass 60 kg stands at a point C on the ladder, where $AC = 4$ metres the ladder is at the point of slipping.

Given that the coefficient of friction between the ladder and the ground is $\frac{1}{4}$, find …

a) … the magnitude of the frictional force of the ground on the ladder. **(1)**

b) … the value of φ, to the nearest degree. **(5)**

Question 10

A particle is projected from a point O on level horizontal ground with speed of $45.5\ \text{ms}^{-1}$ at an angle β to the horizontal, where $\tan\beta = \frac{12}{5}$.

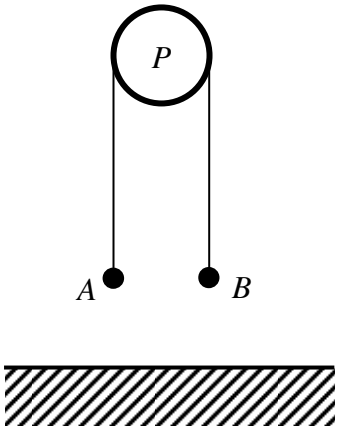
The particle is moving freely under gravity, reaching a greatest height of H m above the ground before it lands on the ground at a point P.

a) Find the flight time of the particle. **(4)**

b) Hence determine the distance OP and the value of H. **(4)**

c) Determine the speed of the particle 4 seconds after leaving O. **(4)**

Question 11



Two particles A and B of respective masses 2 kg and 5 kg are attached to the ends of a light inextensible string which passes over a smooth pulley P. The two particles are held at rest, at the same level above a horizontal floor with the portions of the strings not in contact with the pulley vertical. The system is then released from rest.

a) For the period before B reaches the floor, calculate in any order …

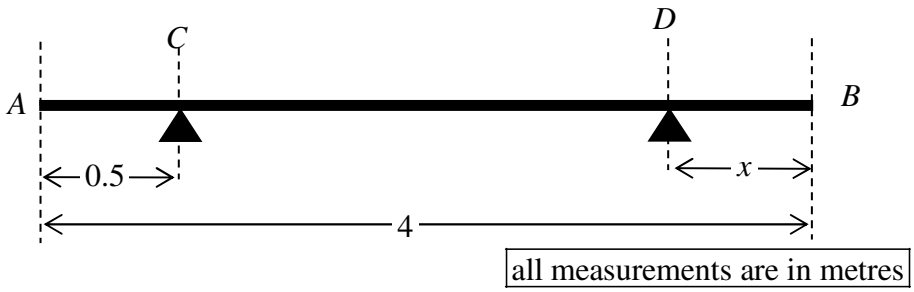
i. … the acceleration of the system.

ii. … the tension in the string. **(5)**

Eventually B reaches the floor 0.5 s after release and **does not** rebound. In the ensuing motion A does not reach P.

b) Determine the greatest height of A above the floor. **(6)**

Question 12



The figure above shoes a uniform rod AB of length 4 m and mass 100 kg.

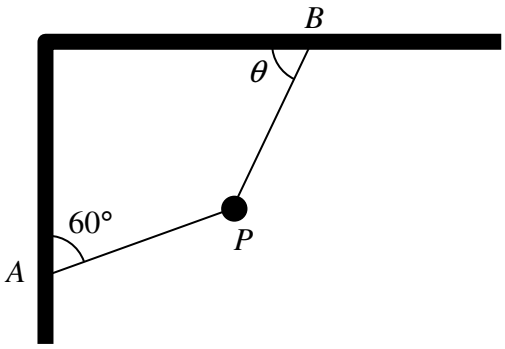
The rod rests in equilibrium in a horizontal position, on two supports at C and D, where $AC = 0.5$ m and $DB = x$ m.

a) Given that the reaction force at the support at D is three times as large as the reaction force at the support at C, determine the value of x. **(4)**

The support at D is next moved to a new position E, where $EB = 0.75$ m and an additional mass of m kg is placed at B. The rod remains in equilibrium in a horizontal position and the reaction force at the support at E is now twice as large as the reaction force at the support at C.

b) Calculate the value of m. **(5)**

Question 13



A particle P, of weight 300 N, is hanging in a equilibrium by two light inextensible strings, AP and BP, which lie in the same vertical plane.

It is further given that AP is forms an angle of $60°$ with a vertical wall and BP forms an angle θ with a horizontal ceiling.

Calculate the value of θ and the tension in BP, if the tension in AP is 120 N. **(7)**

Question 14

A particle is travelling along a straight line with constant acceleration $a\text{ ms}^{-2}$.

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

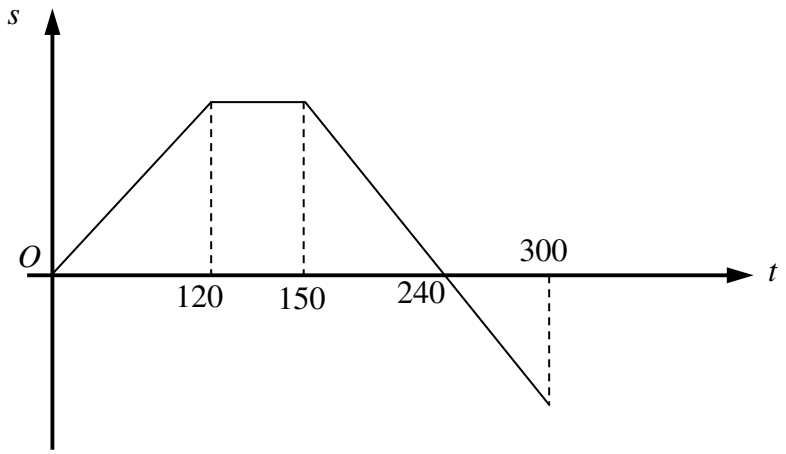
The particle is initially observed passing through A with speed $u\text{ ms}^{-1}$ and 7 s later is observed to be passing through B with speed 24 ms^{-1}, in the direction AB.

Finally the particle is passing through C, 10 s after passing through A.

Given that the distance $AC = 180\text{ m}$, determine in any order the value of a and the value of u.

(7)

Question 15



The figure above shows the graph of the **displacement**, s m, plotted against time, t s, of a particle travelling in a straight path. The graph consists of straight lines only.

The particle passes through a fixed point O with constant speed of $6.25\ \text{ms}^{-1}$ and maintains this speed for 120 s.

The particle is then at rest for a period of 30 s before resuming its motion for a further period of 150 s.

Given that the displacement of the particle is zero when $t = 240$, determine the **average speed** of the particle.

(8)

Question 16

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

At midnight a ship P is at the point with position vector $(-11\mathbf{i} - 24\mathbf{j})$ km and 4 hours later is at the point with position vector $(9\mathbf{i} + 20\mathbf{j})$ km.

a) Find the velocity of P, in vector form. **(3)**

At midnight another ship Q is at the point with position vector $(5\mathbf{i} - 10\mathbf{j})$ km and travelling with constant velocity $8\mathbf{j}$ km h^{-1}.

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

b) Show clearly that

$$d^2 = 34t^2 - 244t + 452, \ t \geq 0. \quad \textbf{(7)}$$

An observer on P can only see the lights of Q when d is 10 km or less.

c) Given that an observer on P sees the lights of Q for the first time at 2 a.m. find the time when the lights of Q move out of the sight of the observer on P. **(5)**