IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper W

Difficulty Rating: 4.03/1.0152

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.

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SECTION 1 - STATISTICS

Question 1

A London Mayoral candidate thinks that 35% of the voters will vote for him.

His campaign manager thinks that this percentage is in fact higher.

A random sample of 40 voters is polled and it is found that it contained 19 voters indicating their intention to vote in favour of this candidate.

a) Test at the 5% significance level the claim of the campaign manager. **(6)**

A larger random sample of 200 is then polled. It is found that it contained 84 voters indicating their intention to vote in favour of this candidate.

b) Use a distributional approximation, to retest at the 5% significance level the claim of the campaign manager. **(9)**

Question 2

The mean and standard deviation of 20 observations $x_1, x_2, x_3, ..., x_{20}$ are

$$\overline{x} = 18.5 \quad \text{and} \quad \sigma_x = 6.5 .$$

The mean and standard deviation of 12 observations $y_1, y_2, y_3, ..., y_{12}$ are

$$\overline{y} = 25 \quad \text{and} \quad \sigma_y = 7.5 .$$

Determine the mean and the standard deviation of all 32 observations. **(7)**

Question 3

It is required to take a sample of 50 pupils from a school with a population 750 pupils. The pupils of the school are allocated a three digit number 001 to 750 .

A string of numbers is generated, using the random function of a calculator.

The first few digits are shown below.

2, 7, 0, 1, 6, 3, 5, 9, 7, 1, 6, 3, 5, 4, 8...

The first pupil to be picked uses the 1^{st} , 2^{nd} and 3^{rd} digit in the above string of numbers, the second pupil to be picked uses the 2^{nd} , 3^{rd} and 4^{th} digit in the above string of numbers, the third pupil to be picked uses the 3^{rd} , 4^{th} and 5^{th} digit in the above string of numbers, and so on.

a) Write down the first ten number to picked for this sample, using this method. **(3)**

b) Explain why this is not a random method of sampling. **(1)**

Question 4

The probability that a student answers correctly the first question, of a multiple choice exam, is 0.2 .

A random sample of 30 students which sat this exam is considered.

a) Determine the probability that more than 5 but at most 10 students answered the first question correctly. **(2)**

Students earn 5 marks for answering the first question correctly but loose 2 marks for answering incorrectly.

b) Find the probability that the total number of marks scored by all 30 students, in answering the first question, is more than 17 . **(6)**

Question 5

A regular daily bus service leaves the Voder bus Station and arrives in the Hostend bus station some time later on the same day.

From its scheduled departure time from Voder, the bus will either leave on time or late but never early.

From its scheduled arrival time to Hostend, the bus will either arrive early, on time or late.

If the bus leaves Voder on time, the probability it arrives in Hostend early is 4%, on time 52% and late 21%.

The probability that the bus arrives in Hostend early is 6% and on time 69%.

a) Given that the bus arrives early in Hostend, determine the probability that it left Voder on time. **(5)**

b) Given that the bus arrives late in Hostend, find the probability that it left Voder late. **(2)**

Three consecutive days for this bus service are monitored.

c) Find the probability that these three days, the bus arrives early once, late once and on time once. **(3)**

Question 6

The events A and B are such so that

$$\mathrm{P}(B)=0.76, \qquad \mathrm{P}(B|A)=0.6, \qquad \mathrm{P}(A'\cap B')=0.$$

Find the value of $\mathrm{P}(A)$. **(7)**

Question 7

The volume of coffee, X ml, poured into a cup by a drink dispenser is thought to be a Normal variable with mean of 252 ml and a standard deviation of σ ml.

a) Find the value of σ, given further that

$$\mathrm{P}(X < a) = 0.82\% \quad \text{and} \quad \mathrm{P}(X > a + 10) = 5.48\% \ ,$$

where a is a positive constant. **(8)**

b) Determine the value of

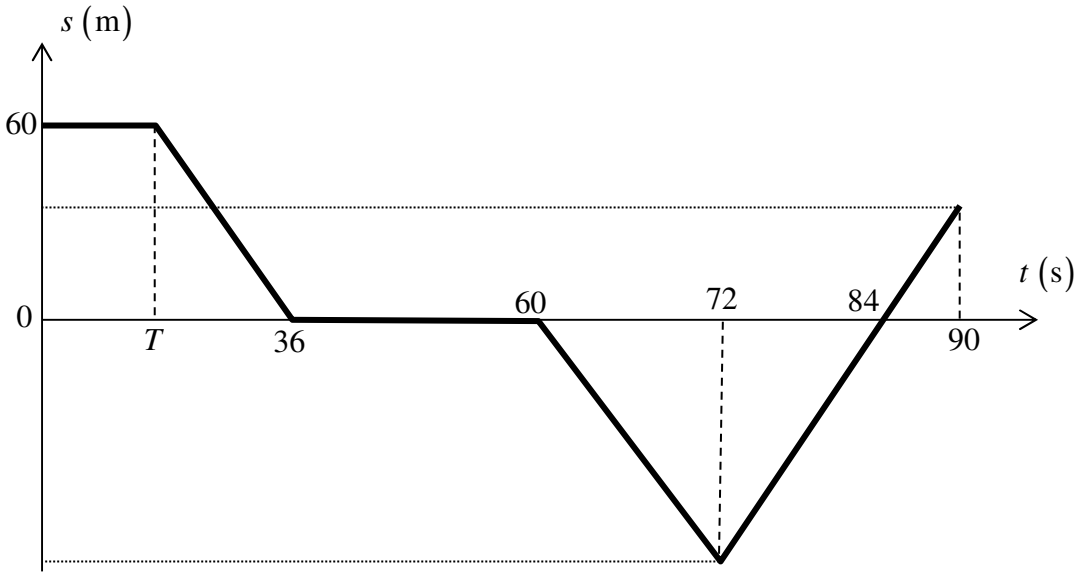
$$\mathrm{P}\left(X - 2a - 14 + \frac{64000}{X} < 0 \right). \qquad \textbf{(10)}$$

It is believed that the mean volume of coffee pored into each cup could be more than 252 ml, as the mean of a random sample of 5 such cups was 255 ml.

c) Test the validity of this belief, at 1% level of significance, stating clearly all the relevant quantities and hypotheses. **(6)**

SECTION 2 - MECHANICS

Question 8



The figure above shows the displacement time graph (t,s) of a particle moving in a straight line. The displacement of the particle is measured relative to a fixed origin O.

The particle, for $0 \le t \le 90$, is either at rest or has speed 3 ms^{-1}.

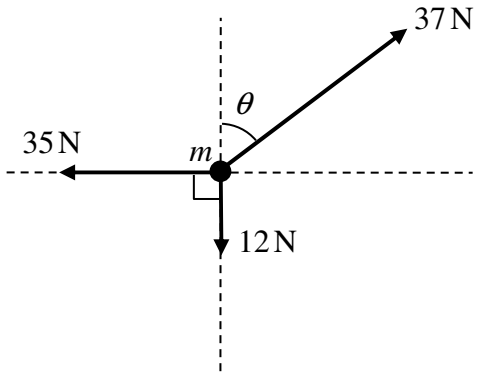
For $0 \le t \le 90$, draw a detailed ...

a) ... velocity time graph (v,t), showing clearly the velocity values at $t = 0$, T, 36, 60, 72, 84 and 90. **(6)**

b) ... distance time graph (d,t), showing clearly the total distance covered by the particle up and including $t = 0$, T, 36, 60, 72, 84 and 90. **(3)**

State the value of T explicitly in these graphs.

Question 9



The figure above shows 3 forces, which all lie on the same plane, acting on a particle of mass m kg. The particle remains in equilibrium when the magnitudes of these 3 forces and their relative directions are those shown in the figure.

When the 35 N force is suddenly removed the particle begins to move with constant acceleration of magnitude 14 ms^{-2}.

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

Question 10

The points A and B lie on a straight line, 240 m apart.

At time $t = 0$, a particle passes through A with speed 4 ms^{-1} heading towards B with constant acceleration 0.75 ms^{-2}.

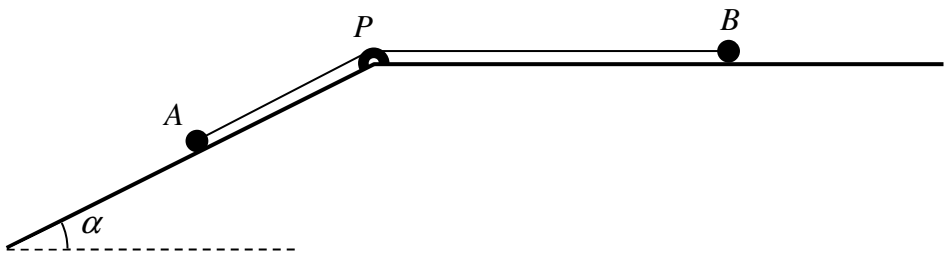
At time $t = 0$, another particle passes through B heading towards A with constant speed 5 ms^{-1}.

The particles meet at point C.

a) Determine the distance AC. **(7)**

b) On a set of suitable axes, draw a detailed displacement time graph for both particles, using A as the origin. **(3)**

Question 11



Two particles A and B have masses 0.5 kg and 0.2 kg, respectively. The particles are attached to the ends of a light inextensible string. Particle B is held at rest on a rough horizontal table. The string lies along the table and passes over a small smooth pulley P which is fixed to the edge of the table. Particle A is at rest on a smooth plane which is inclined to the horizontal at an angle α, where $\tan\alpha = 0.75$. The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in the figure above.

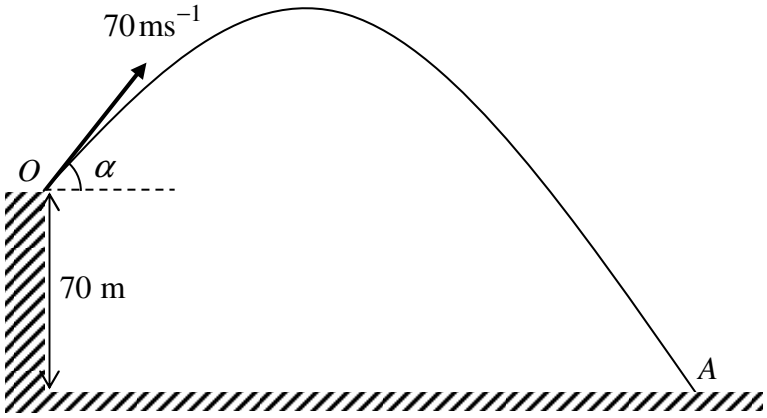
Particle B is released from rest with the string taut.

During the first 1.5 s of the motion B does not reach the pulley and A moves 2.25 m down the plane.

a) Find the tension in the string during the first 1.5 s of the motion. **(7)**

b) Calculate the coefficient of friction between B and the table. **(4)**

Question 12



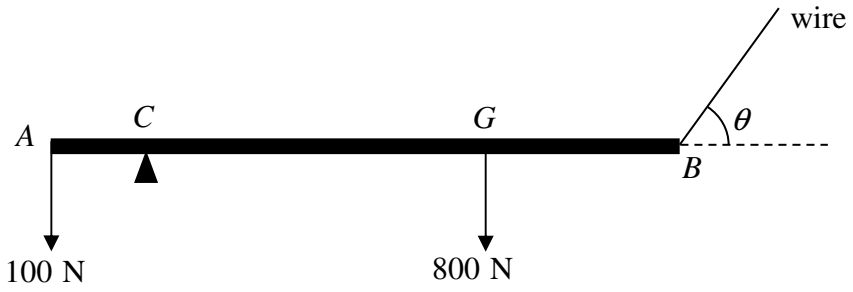
A particle is projected with a speed of 70 ms^{-1} at an angle of elevation α, where $\tan\alpha = \frac{3}{4}$, from a point O which is 70 m above level horizontal ground.

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 horizontal distance of A from O. **(7)**

b) Show that as the particle reaches A, it hits the ground at $45°$. **(4)**

Question 13



A thin rigid non uniform beam AB of length 6 m and weight 800 N has its centre of mass at G, where $AG = 4$ m. An additional weight of 100 N is fixed at A.

The beam lies in a horizontal position supported by a rough peg at C, where $AC = 1$ m, and a light inextensible wire attached at B.

When the wire is inclined at an angle θ to the horizontal, where $\sin\theta = 0.8$, the beam remains horizontal, in **limiting** equilibrium.

Calculate the tension in the wire and the value of the coefficient of friction between the peg and the beam. **(9)**

Question 14

The unit vectors $\mathbf{i}$ *and* $\mathbf{j}$ *are oriented due east and due north, respectively.*

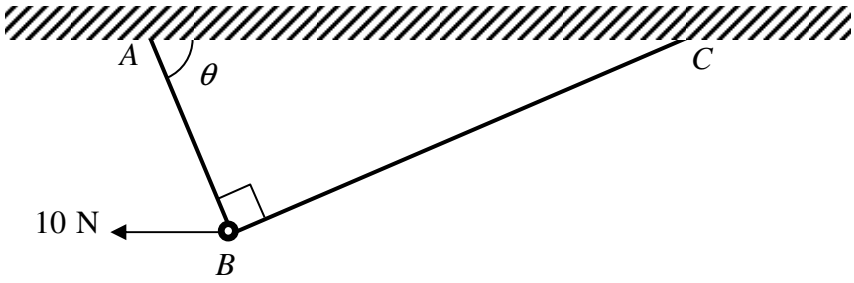
Two boats, A and B, are moving in the open sea with constant velocities given in vector form as $(7\mathbf{i}+3\mathbf{j})$ km h^{-1} and $(-3\mathbf{i}+9\mathbf{j})$ km h^{-1}, respectively.

At noon, B is on a bearing of 120° from A, 12 km away.

a) Determine, correct to the nearest m, the distance between A and B when B is due east of A. **(8)**

b) Find the time when the two boats are at the closest distance. **(6)**

Question 15



The figure above shows a smooth ring B, of weight 20 N, threaded by a string ABC whose end A and C are attached to a fixed horizontal ceiling.

The ring is modelled as a particle, and kept in equilibrium by a horizontal force 10 N as shown in figure. The points A, B, C and the horizontal force lie in the same vertical plane, which is perpendicular to the plane of the ceiling.

The string is light and inextensible, and the section AB forms an angle θ with the horizontal ceiling. The tension in the string is T N.

By forming two equations in $T\sin\theta$ and $T\cos\theta$, or otherwise, find the value of T and the value of θ.

(8)