IYGB GCE

Mathematics MMS

Advanced Level

Practice Paper U

Difficulty Rating: 4.3833/1.2371

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 events A and B satisfy

$$\mathrm{P}(A) = 0.4, \qquad \mathrm{P}(A|B) = 0.6, \qquad \mathrm{P}(A \cup B) = 2\mathrm{P}(A \cap B).$$

Find the value of $\mathrm{P}(B|A')$. **(9)**

Question 2

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

$$\mathrm{P}(X = r+1) = \begin{cases} \frac{2}{3}\mathrm{P}(X = r) & r = 1,2,3,4,5,... \\ 0 & \text{otherwise} \end{cases}$$

Determine $\mathrm{P}(2 \le X \le 4)$. **(6)**

Question 3

The number of miles Mark's motorbike can travel on a full tank of petrol, can be modelled by a Normal distribution with a mean of 135 and a standard deviation of 12.

a) Determine the probability that Mark can travel at least 165 miles on a full tank of petrol. **(4)**

b) Find, to the nearest mile, the longest journey that Mark can make, if he is to have at least a 90% chance of completing it on a single full tank of petrol. **(4)**

c) Given that Mark has a 90% chance of completing a journey on a single full tank of petrol find the probability that this journey will **not** exceed 165 miles **(4)**

Question 4

The test marks, x, of 20 students were coded and their results were summarized as

$$\sum(x-10) = 220 \quad \text{and} \quad \sum(x-10)^2 = 2720.$$

a) Use a detailed method to show that

$$\sum x^2 = 9120. \qquad \textbf{(9)}$$

b) Calculate the mean and standard deviation of the test marks of these students. **(4)**

Question 5

The events A, B and C are defined in the same probability space so that

$$\mathrm{P}(A) = \mathrm{P}(C) = \mathrm{P}(B' \cap C') = 0.4 \qquad \text{and} \qquad \mathrm{P}(A \cup B) = 0.58.$$

It is further given that A and B are independent, and A and C are mutually exclusive.

Find the value of $\mathrm{P}\left[(B \cap C') \cup (B' \cap C' \cap A')\right]$. **(9)**

Question 6

The sale records in "*Laptop World*", show that 35% of its customers buy insurance when they purchase a laptop.

A sample of 160 customers is considered.

The probability that less than x customers will buy insurance with their laptop purchase is 4.09%.

Determine the value of x. **(10)**

Question 7

A box contains 3 black balls and 7 white balls, all identical in size.

An experiment consists of drawing a ball out of the box and recording its colour.

- If the ball drawn is black, after its colour is recorded, the ball is replaced back into the box and an extra black ball is also placed in the box.
- If the ball drawn is white, after its colour is recorded, the ball is not replaced back into the box.

The experiment is attempted 3 consecutive times.

Given that in these 3 attempts both colours were recorded, determine the probability that a black colour was recorded twice. **(8)**

Question 8

During hot days, an ice cream van sells a large number of ice cream cones containing either 1, 2 or 3 scoops of ice cream.

The respective probabilities of a customer buying a 1, 2 or 3 scoop ice cream cone are $\frac{1}{6}$, $\frac{1}{2}$ or $\frac{1}{3}$.

A random sample of n customers is examined, each customer having bought an ice cream cone from this van. The probability that more than n scoops of ice cream are ordered by these n customers is greater than 0.9999.

Determine the smallest possible value of n. **(8)**

SECTION 2 - MECHANICS

Question 9

A particle P is moving on the x axis and its acceleration a ms^{-2}, t seconds after a given instant, is given by

$$a = 4t - 9, \ t \geq 0.$$

When $t = 1$, P is moving with a velocity of -3 ms^{-1}.

a) Find the minimum velocity of P. **(5)**

b) Determine the times when P is instantaneously at rest. **(3)**

c) Find the distance travelled by P in the first $4\frac{1}{2}$ seconds of its motion. **(7)**

Question 10

The motions of two cars, A and B, is observed as they travel between two sets of traffic lights, on a straight road, which are 600 m apart.

At time $t = 0$, A passes through the first set of lights, accelerating uniformly from a speed of 4 ms^{-1} to a speed 20 ms^{-1}.

As soon as this speed is reached it begins to decelerate uniformly for 30 s, coming to rest at the next set of traffic lights.

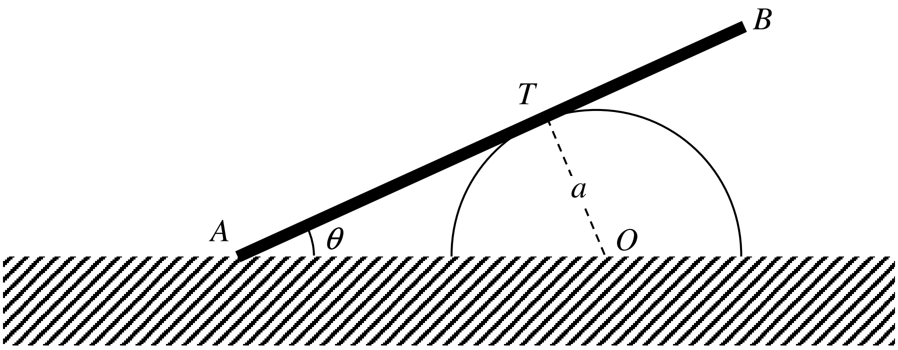
At time $t = 0$, B passes through the first set of lights, with constant speed of 12 ms^{-1}.

It maintains this speed until it begins to decelerate uniformly, coming to rest at the second set of lights at the **same time** as A.

a) Sketch, on the same speed time graph the motions of A and B. **(4)**

b) Find the deceleration of B, just as it arrives at the second set of lights. **(8)**

Question 11



A uniform rod AB, of length $2a$, is resting with its end A on rough horizontal ground and a point T on the rod in contact with a rough fixed prism of semicircular cross-section, of radius a. The rod lies in a vertical plane which is perpendicular to the axis of the prism, as shown in the figure above.

The coefficient of friction between the rod and the ground at A **and** between the rod and the prism at T, is μ, $0 < \mu < 1$.

When the rod is inclined at an angle θ to the horizontal, where $\tan\theta = \frac{3}{4}$, the rod is at the point of slipping.

Determine the value of μ. **(12)**

Question 12

Two cars, A and B, are travelling in the same direction along a straight road.

At a certain instant, A has speed 28 ms^{-1}, accelerating uniformly at 0.1 ms^{-2}.

At the same instant, B is 240 m behind A, travelling with speed 24 ms^{-1}, accelerating uniformly at 0.2 ms^{-2}.

Find the speed of B the instant it overtakes A. **(8)**

Question 13

A lift, of mass 400 kg, is being lowered into a vertical mineshaft by a cable attached to the top of the lift. A load of mass 80 kg is sitting firm on the floor inside the lift. The lift is lowered with constant downward acceleration.

There is a constant resistance of magnitude F N opposing the motion of the lift.

The load experiences a constant normal reaction of magnitude 768 N from the floor of the lift and there is a constant tension of 4500 N in the cable of the lift.

Determine the value of F. **(7)**

Question 14

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

At time $t = 0$ s, a particle of mass 4 kg, is sighted at the point A with position vector $(-17\mathbf{i} - 50\mathbf{j})$ m and moving with constant velocity $(-2\mathbf{i} + 2\mathbf{j})$ ms^{-1}.

At time $t = 10$ s, two constant forces $\mathbf{F}_1$ and $\mathbf{F}_2$ each of magnitude 50 N, begin to act on the particle until it passes through the point B, after a further period of 10 s.

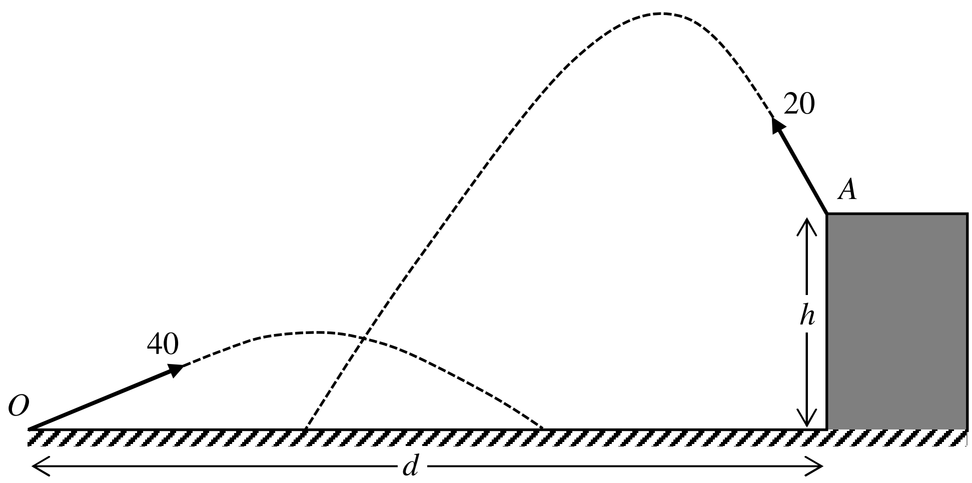
It is further given that

- $\mathbf{F}_1$ is acting in the direction $(3\mathbf{i} - 4\mathbf{j})$.

- $\mathbf{F}_2$ is acting in the direction $(-7\mathbf{i} + 24\mathbf{j})$.

Determine, correct to the nearest m, the distance between A and B. **(11)**

Question 15



The point O lies on level horizontal ground and the point A is at a horizontal distance d m away from O and at a height d m above the ground.

A particle is projected from O with speed 40 ms^{-1} at an angle of elevation $\arctan\left(\frac{3}{4}\right)$.

At the same time another particle is projected from A with speed 20 ms^{-1} at an angle of elevation $\arctan\left(\frac{4}{3}\right)$, as shown in the figure above.

The motion of the two particles takes place in the same vertical plane.

Assuming that there is no air resistance present, show that, if the two particles collide during their flights, then

$$d : h = 11 : 2.$$

(10)