CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2006

APPLIED MATHEMATICS

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CARIBBEAN ADVANCED PROFICIENCY EXAMINATIONS
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GENERAL COMMENTS

INTRODUCTION

The revised Applied Mathematics syllabus was followed this year for the second time. Of the one hundred and forty one candidates registered for the examination, one hundred and thirty three wrote all the required papers of Option C, while one candidate wrote only Paper 02 of Option C. One candidate wrote all the required papers of Option B and five wrote all the required papers of Option A. One candidate wrote the Alternative to the SBA Paper in Option C.

This is a one-Unit course comprising three papers and three options. However a candidate is required to take only ONE Option. Papers 01 and 02 were examined externally, while Paper 03 was examined internally by the teachers and moderated by CXC. Contributions from Papers 01, 02 and 03 to the Unit were 40 per cent, 40 per cent and 20 per cent respectively.

The three options are Option A, Option B and Option C.

Option A consists of Discrete Mathematics, Probability and Distributions and Statistical Inference. Option B consists of Discrete Mathematics, Particle Mechanics and Rigid Bodies, Elasticity, Circular and Harmonic Motion. Option C consists of Discrete Mathematics, Probability and Distributions and Particle Mechanics.

GENERAL COMMENTS

Approximately 91 per cent of the candidates obtained Grades I – V while 7 per cent obtained grade VI and 2 per cent obtained grade VII. The standard of work seen from most of the candidates in this examination was above average. Again this year, candidates appeared to be well prepared in Discrete Mathematics and generally answered the questions well. All of the candidates answered all of the questions in this section. There were a number of candidates who appeared to be well prepared in all three of their modules. However, there were a few candidates who seemed not well prepared in modules 2 and 3 of their respective option. In general, there were a large number of areas of strength displayed by many candidates, nevertheless, candidates need to pay more attention to their algebraic manipulation.

Areas of strength displayed by most candidates on this paper were as follows:

- conversion from logic symbols to words
- use of the distributive law
- construction of truth tables
- calculation of the earliest start time
- identification of the number of degrees from a vertex
- definition of a trail and a path
- construction of an activity network
- identification of the given lines and feasible region in a linear programming problem
- drawing the line $x + y = 5$
- formulation of the null and alternative hypotheses in words and symbols
- calculation of test statistics
- naming and justifying the use of given distributions
- calculating probabilities of events combined by unions and intersections using appropriate formulae

- calculation of P(A / B)
- calculating the expected value and variance of a linear combination of two independent random variables
- applying the formula for the binominal distribution
- using the Poisson distribution as an approximation to the binomial distribution.

Area weakness/errors exhibited by the candidates were as follows:-

- ability to convert from worked to symbols
- ability to simplify $c \wedge \sim c$
- omission of the non-negativity constraints in the linear programming problem
- calculation of the latest start time and hence the critical path
- ability to distinguish between the inverse, converse and contrapositive
- ability to calculate the mean for a given distribution.
- ability to calculate the number of degrees of freedom for a goodness-of-fit using a Poisson distribution of unknown mean
- justifying the position distribution as an approximation to the binominal distribution
- interpretation of the notation $E(Y^2)$ as $[E(Y)]^2$

Internal Assessment

Generally the topics chosen were suitable for candidates at this level. Again this year, most of the projects submitted by candidates were from the Discrete Mathematics Section. These projects were appropriate and were given adequate treatment by candidates. There was an understanding of what was required in the assessment but a number of candidates who tried to incorporate Mathematics from two or more modules including Module 1 experienced difficulty in doing so. It appeared that the hands-on approach in which candidates were afforded the opportunity to apply their mathematics in real life situations served them in good stead. Candidates appeared to have developed an overall appreciation of the mathematical concepts used in their projects and many used them with confidence. A few candidates were even able to go above and beyond what was expected of them.

Teachers' marking of the projects showed that they understood the criteria used and are well aware of the type of assessment used. There was generally close agreement between the marks awarded by the teachers and those by the CXC moderator.

Paper 01 Option C
SECTION A (Module 1: Discrete Mathematics)
Same for Options A and B

Question 1

This question tested the candidates' ability to

(a) formulate

- (i) simple propositions;
- (ii) the negative of simple propositions;
- (iii) compound propositions in symbols or in words;
- (iv) compound propositions that involve conjunctions, disjunctions and negatives;
- (v) conditional and bi-conditional propositions

(b) Use the laws of Boolean algebra (distributive, commutative, associative and the de Morgan's) to simplify Boolean expressions.

This question was fairly well done. Candidates were able to convert from logic symbols to words, use the distributive law and generally the order of propositions was followed. The difficulties manifested were in converting from words to symbols and in simplifying c ^ ~c as well as 0 V(c ^ d).

In Part (ii) some candidates omitted the use of brackets, while others placed them in the incorrect position.

Answers

1.

(a) (i) a) If there are clouds in the sky, then it is raining

OR

There are clouds in the sky, so it is raining.

(ii) $q \Rightarrow (r \vee \sim p)$

(b) $c \wedge (\sim c \vee d)$

$= (c \wedge \sim c) \vee (c \wedge d)$

$= o \vee (c \wedge d)$

$= c \wedge d$

Question 2

This question tested the candidates' ability to

(i) identify linear programming problems;
(ii) identify the objective function of a linear programming problem;
(iii) use the concept of slack variables and of basic and non-basic variables.

This question was reasonably well done. In many cases, the objective, in this case maximise was omitted. A few candidates did not completely write the objective function, (C =3x + 2y), while some others used the letter P instead of C. There were some cases where it was evident that the candidates were unclear as to what is an objective function and what is the constraint. Most candidates were able to interpret the table and convert it to a linear programming problem. The non-negativity constraints were generally omitted when setting up the constraints.

Answers

2.

Maximise $C = 3x + 2y$

Subject to $x + y \leq 6$

$2x + 3y \leq 14$

$x \geq 0, \; y \geq 0$

Question 3

This question tested the candidates' ability to establish the truth value of:

(i) compound propositions that involve conjunctions, disjunctions and negations;
(ii) represent a Boolean expression by a switching of logic circuit;

This question was generally well done. Candidates were able to correctly construct truth tables for a $\wedge$ b and a v b. Most candidates were able to identify the correct proposition for the burglar alarm system and the computer system as well as to give the valid explanation.

Answers

3.

(a)	a	b	a v b	a ^ b	OR	a	b	a v b	a ^ b
	T	T	T	T		1	1	1	1
	T	F	T	F		1	0	1	0
	F	T	T	F		0	1	1	0
	F	F	F	F		0	0	0	0

(b) (i) a v b, since the alarm would sound if at least one of the switches closed.

(ii) a $\wedge$ b, since access could only be obtained if both switches are closed.

Question 4

This question tested the candidate's ability to

(i) calculate the earliest and latest start times;
(ii) identify the critical path in a simple activity network.

This question was satisfactorily done. Candidates were able to calculate the earliest start time (EST), however the latest start time (LST) seemed to have posed problems for a large number of them. Consequently, they had difficulty obtaining the critical path. Even in those instances where EST and LST were correctly calculated, it was unclear whether the candidates knew how to obtain a critical path as they were unable to identify the correct critical path.

Answers

4.

(a)	Activity	Earliest Start Time (No. of Days)	Latest Start Time (No. of Days)
	A	0	0
	B	8	8
	C	8	10
	D	19	19
	E	14	14
	F	20	20

(b) Critical path: ABEDF

Question 5

This question tested the candidate's ability to explain and use the terms, trails and paths.

This question was fairly well done. In Part (a) (i) many candidates were able to identify that there was a repeat of an edge and a vertex in the case of the trail and the path respectively, but they did not identify the edge or the vertex that was repeated.

In Part (a) (ii) all candidates were able to state the degree of the vertices from the given diagram. In Part (b) many candidates were unable to draw a graph with the required number of degrees. Some candidates sketched two different graphs to display the information.

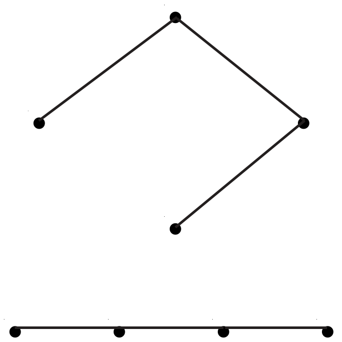
Answers

5.

(a) (i) a)	An edge is contained more than once in the sequence: BE
b)	A vertex is included more than once in the sequence: E

(ii)	Vertex	A	B	C	D	E
	Degree	2	3	3	2	4

(b) Two examples of possible graphs:



Paper 01 Option C
SECTION B (Module 2: Probability and Distributions)
Same for Option A

Question 6

This question tested the candidates' ability to model practical situations in which the binomial geometric and Poisson distribution are suitable.

This question was generally well done. The majority of candidates were familiar with the names of the distributions, and with the exception of the Poisson distribution, were able to state the parameters correctly.

Answers

(a) A is a binomial distribution n = 20 and p = 0.73
(b) B is a geometric distribution with p = 0.005
(c) C is a Poisson distribution with λ = 2

Question 7

This question tested the candidates' ability to:

(i) calculate probabilities of events combined by unions and intersections using appropriate formulae;
(ii) calculate P(A|B)
(iii) use the formula for Var(X) where X follows a geometric distribution.

In Part (a), candidates were able to use a correct formula to obtain $P(A \cap B)$ and then use this result to obtain the required value for $P(A \cap B)$.
In Part (b), candidates were generally able to state q/p^{2-} = 5/16 but surprisingly, many then incorrectly wrote q = 5 and p^2 =16. The invalidityof p = - 4, was stated by the majority of them.

Answers
(a) 2/3
(b) 4/5

Question 8

This question tested the candidates' ability to calculate

(i) $E(Y^2)$ given E(Y) and Var (Y);
(ii) the expected value and variance of a linear combination of two independent random variables;

Most candidates were able to find

E(X) given $E(X^2)$ and Var (X) as well

and E(5X – 3Y) given E(X) and E(Y).

However the calculation of Var (2X – Y) posed greater problems to candidates who incorrectly wrote

Var (2X – Y) = 4Var(X) – Var(Y) or 2 Var(X) – Var (Y) or $E(2X^2 - Y^2) - E(2X - Y)^2$

Answers

(a) 1.84
(b) -2.2
(c) 10
(d) 1.2

Question 9

This question tested the candidates' ability to

(i) model the practical situation by the binomial distribution;
(ii) apply the formula for the binomial distribution;
(iii) justify and use the Poisson distribution as an approximation to the binomial distribution.

This question was generally well done by the candidates. A few candidates neglected to put a negative sign in the probability distribution table (i.e. -2) or they found the variance instead of the standard deviation.

Answers

(a) 0.273
(b) 0.268
(c) 0.751

Question 10

This question tested the candidates' ability to identify and use the geometric distribution.

This question was not well done. One candidate did not respond. Candidates incorrectly identified the distribution as a binomial or Poisson distribution. Of the 2 candidates who correctly identifying the distribution as geometric, one incorrectly stated the formula for P(X=2) as q^2p.

Answer

62.88

Paper 01 Option C
SECTION C (Module 3: Particle Mechanics)
Same for Module 2 Option B

Question 11

This question tested the candidates' ability to apply the principle of linear momentum to two particles moving in a straight line.

This was a popular question attempted by a majority of candidates. They were able to use the concept of conversation of momentum, but in many cases experienced difficulty taking the direction of motion of body into account.
A common error was – Total momentum = (4 * 9) + (5*5),
instead of (4*9) – (5*5)

Stating the direction of the combined mass after impact was often neglected.

Answers

11/9 the bodies move in the direction of the 4 kg mass after collision.

Question 12

This question tested the candidates' ability to apply Newton's Laws of motion to a particle moving on an inclined plane with constant acceleration.

There appeared to be a great reliance on memory, rather than an understanding of resolving a force in a particular direction. For example, the presence of the force P was often neglected, and the normal section R, equated to 1200g Cos 30^o. Only the high scoring candidates were able to solve the problem.

Answers

7820 N

Question 13

This question tested the candidates' ability to find

(i) use a velocity-time graph to calculate displacements;
(ii) apply the appropriate equation of motion for constant acceleration in a straight line to calculate the time taken.

Few candidates used the diagram to solve the problem, but the majority proceeded to use the equations of motion for a body moving with constant acceleration. This approach led to failure in Part (c), when they assumed that the acceleration was constant for the first 16 m.

Answers

$10\ \frac{2}{3}$ s

Question 14

This question tested the candidates' ability to find

(i) the constant acceleration
(ii) the tension in the wire, for a body of given mass, connected by a weightless wire and moving vertically upwards from rest.

Candidates were able to use correctly the equation of motion to determine the acceleration. Using this value for acceleration, they then applied Newton's Law to find the tension in the wire, during acceleration and during the deceleration periods.

Answers

(a) (i) 2.4 ms^{-2} (ii) 61000 N (b) 37000 N

Question 15

This question tested the candidates' ability to use the equations of motion of a projectile.

Given the initial velocity u, and angle of projection Ü, candidates were required to

(a) show that the horizontal range is $\frac{u^2 \sin 2d}{g}$

(b) calculate the angle of projection for which the range is a maximum
(c) determine the time of flight.

This question proved to be difficult, as candidates seemed to know the results but were unable to prove them or apply them to solve the problem.

Answers

(b) 45^0
A. 57.7 s

Paper 02 Option C
SECTION A (Module 1: Discrete Mathematics)
Same for Options A and B

Question 1

This question tested the candidates' ability to

(a) formulate

(i) the negative of simple propositions;
(ii) compound propositions in symbols or in words;
(iii) compound propositions that involve conjunctions, disjunctions and negatives;

(b) establish the truth value of a compound proposition that involves conjunctions, disjunctions and negatives.

(c) state the converse, contrapositive and inverse of implications of propositions.

(d) use truth tables to

(i) determine whether a proposition is a tautology or a contradiction;
(ii) establish the truth value of the converse, contrapositive and inverse of implications of propositions;
(iii) determine equivalent propositions.

(e) use the activity network algorithm in drawing a network diagram to model a real world problem.

Generally this question was well done. In Part (a) many candidates were unable to correctly identify the propositions using the given terms inverse, converse and contrapositive.

In Part (b) most candidates were able to construct correctly the truth tables for $x \Rightarrow y$ and $\sim x \Rightarrow \sim y$. Candidates were able to identify the statements $x \Rightarrow y$ and $\sim x \Rightarrow \sim y$ as logically equivalent, but a few of them had problems clearly communicating the answer.

In Part (c), some candidates introduced unnecessary additional symbols to express the given proposition. Having constructed the truth table for this proposition it became evident that some candidates did not understand the significance of getting all zeros in the answer.

In Part (d), no candidate displayed the activity network algorithm to construct the activity Network. Nevertheless many candidates were still able to correctly construct the activity network, while a few candidates incorrectly placed the duration on the network. There were those who did not include the direction by using arrows and did not give the correct precedents to D.

Answers

1.

(a) (i) Inverse

(ii) Converse

(iii) Contrapositive

(b) (i)

X	Y	~X	~Y	$X \Rightarrow Y$	$\sim Y \Rightarrow \sim X$
T	T	F	F	T	T
T	F	F	T	F	F
F	F	T	F	T	T
F	F	T	T	T	T

OR

X	Y	~X	~Y	$X \Rightarrow Y$	$\sim Y \Rightarrow \sim X$
1	1	0	0	1	1
1	0	0	1	0	0
0	1	1	0	1	1
0	0	1	1	1	1

(iii) $x \Rightarrow y$ and $\sim y \Rightarrow \sim x$ are logically equivalent, since the corresponding terms in their truth tables are the same.

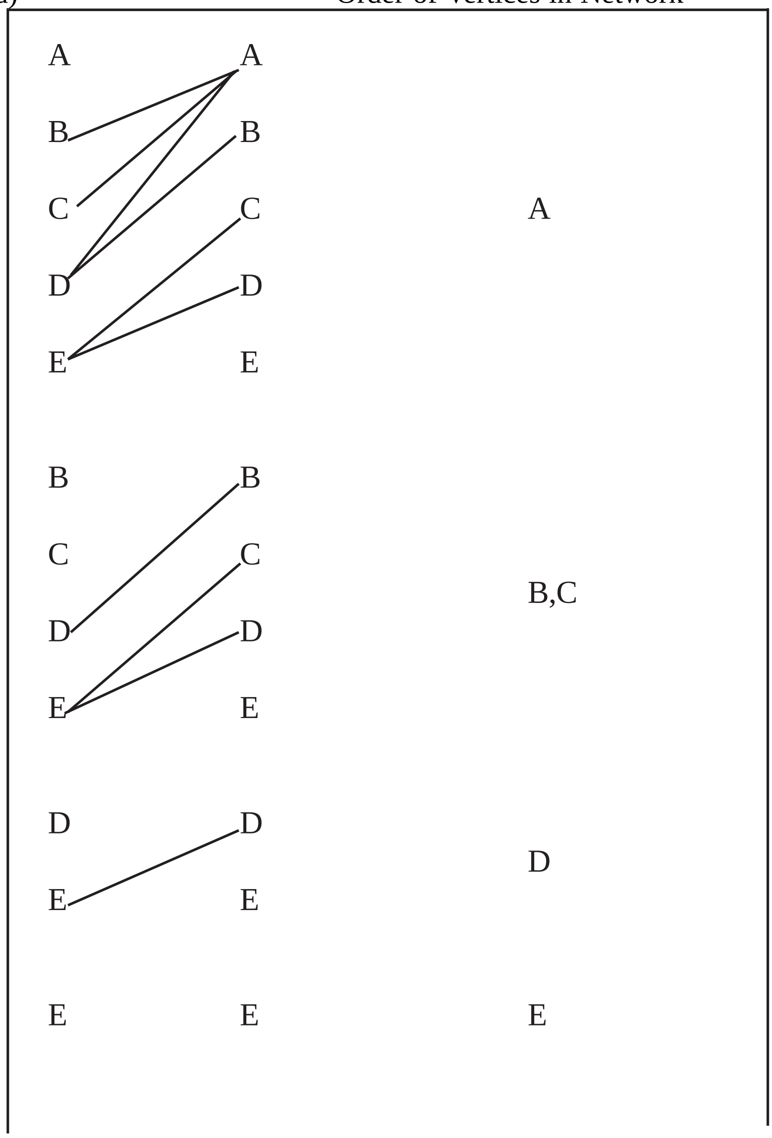
(c) (ii)

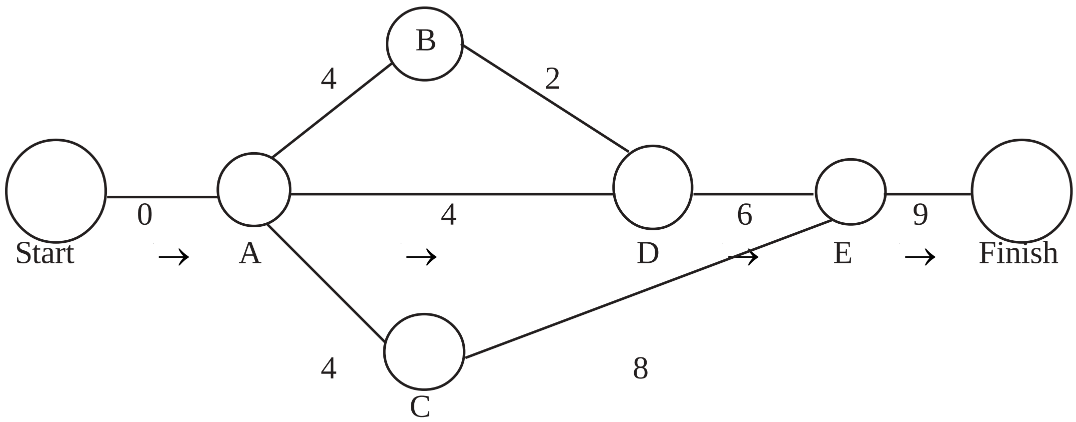
P	~P	P^ ~P	OR	P	~P	P^ ~p
T	F	F		1	0	0

(i) P∧ ~P

Since all the terms in its truth table are F10, ‘To have your cake and eat it’, that is, p∧ ~p is a contradiction.

(d) Order of Vertices in Network





<u>Question 2</u>

This question listed the candidates' ability to

(i) identify and graph linear inequalities in two variables;
(ii) determine the solutions set that satisfies a set of linear inequalities in two variables;
(iii) determine the feasible region of a linear programming problem;
(iv) formulate linear programming model in two variables from real world data.

Generally this question was fairly well done. In Part (a), the answers given were not in a structured format, that is

Minimize … write the objective function here
Subject to … give the constraints here

The objective function and constraints were mixed up, hence variables were not clearly and completely defined. Some constraints were not represented as an inequality but rather as an equality. Non-negativity constraints were generally omitted. Candidates need to exercise caution when simplifying inequalities. Some candidates did not seem to understand the concepts of "at least" and "at most".

Part (b) was generally well done. Lines were labeled accurately, but some candidates were unable to determine the feasible region correctly. Those who obtained the incorrect feasible region used $x + 2y \leq 7$ instead of $x + 2y \geq 7$. All candidates were able to correctly draw the line $x + y = 5$, however few candidates were able to correctly obtain A (the maximum) and B (the minimum) using the line $x + y = 5$. In several instances, the A and B identified were not in the feasible region. Both methods of determining

$60x + 24y \geq 1200$

optimal points need to be taught, that is by considering intersection of parallel lines with the vertices as well as considering the value of the objective function at the vertices of the feasible region.

Answer

2.

(a)

x: no. of large trucks used
y: no. of small trucks used

Minimize 240x + 100y

Subject to

$x + y \leq 50$

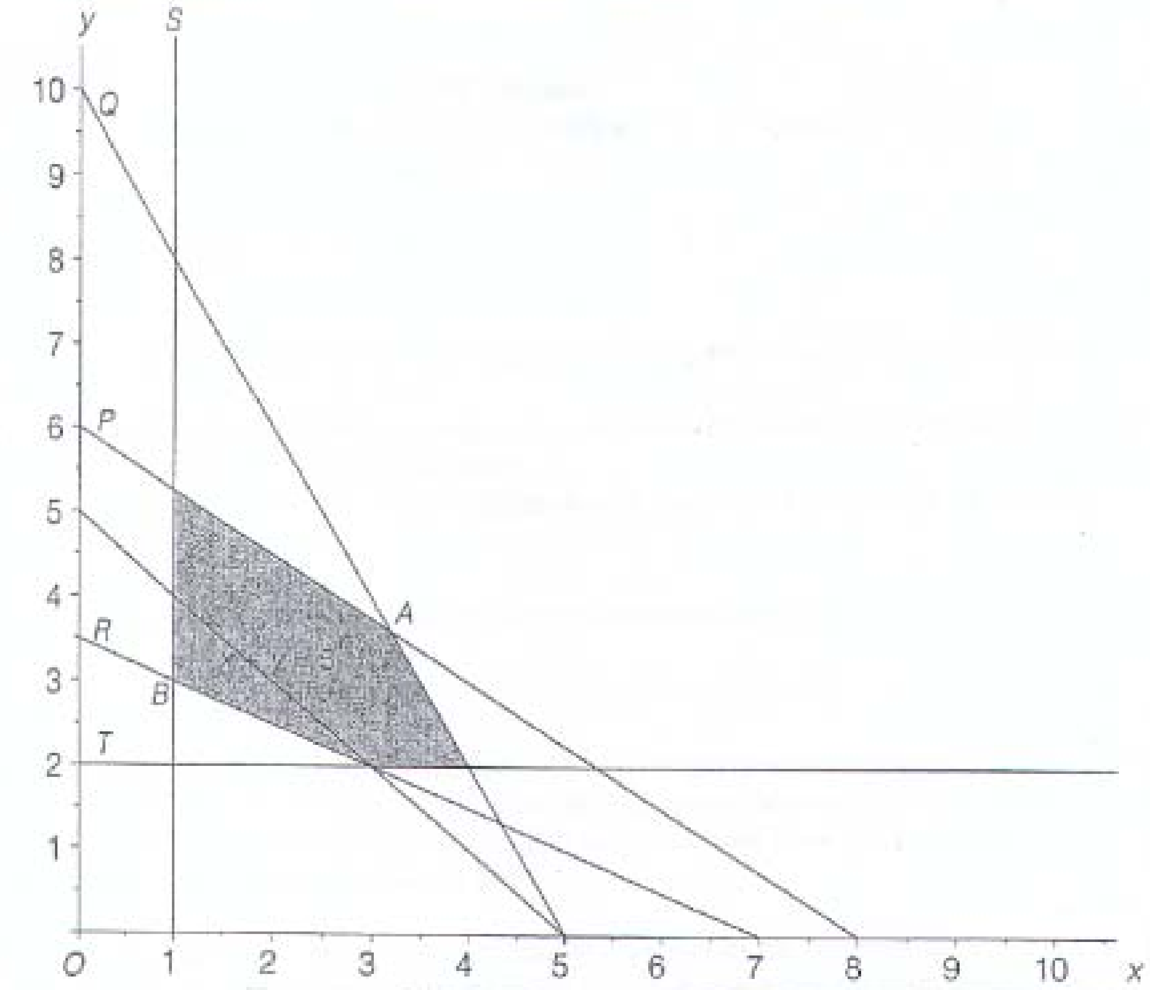
$x \leq 25$

$y \geq 15$

$x \geq 0, y \geq 0$

x, y integers

(b)



Paper 02 Option C
SECTION B (Module 2: Probability and Distributions)
Same for Option A

Question 3

This question tested the candidates' ability to;

(i) use a cumulative distribution function to solve problems involving probabilities;
(ii) calculate probability, expected value, and probability density function for a cumulative distribution function;
(iii) apply the properties of probability density function to determine the value of the constant;
(iv) calculate probability, for a probability distribution function.

This question was not as well done as expected. In part (a) (i) only two students were able to state the value of P(X = ½) correctly. Instead candidates integrated between the limits ½ and 1. For Part (ii), candidates seemed unfamiliar with F(x) and so replaced it with f(x) and then proceeded to integrate between limits ½ and ¾.

In Part (iii), many candidates correctly differentiated F(x) to get f(x), but were unable to obtain a full score because they did not define the probability density function over the entire range, that is for x < 0 and $x \geq 0$.

$\int_1^{y_n}$

Candidates generally performed better in Part (b) than Part (a). They were able to show that $k = \frac{4}{15}$, and many of them were able to find the expected value of Y, however some of those who were unable to find E(Y) defined it as $\sum y$ f(y) and did not complete the solution, while a few recovered.

In Part (c) the concept of P(Y $\leq$ y_n) as $f(y)dy = \frac{n}{100}$ was not well demonstrated. Many candidates did not include the lower limit, but these correctly wrote the value of the probability as 0.3.

Answers

(a) (i) 0 (ii) 0.28125 (iii) x +½ $0 \leq x \leq 1$
0 otherwise

(b) (ii) 1.65 (iii) 1.53

Question 4

This question tested the candidates' ability to:

(i) calculate the number of ordered arrangements of n objects taken r at a time without restrictions;
(ii) calculate the number of selections of n objects taken r at a time with restrictions;
(iii) calculate the probability of an event A in a possibility space S using independent events and the formula $P(A) = \frac{n(A)}{n(S)}$ where n(A) and n(S) are obtained from appropriate counting techniques.

Some good responses were obtained in this question. Some candidates gave a number for the answer with no intermediate steps and in cases where these values were incorrect, the candidate ended up losing all of the marks. Candidates need to be encouraged to display all steps in their working to gain full marks.

In Part (a) (i), some candidates interpreted the 12 students like 12 objects of which 7 were of one type and 5 of another type and so gave their answer as
12!/ (7!5!) instead of 12!

Many candidates were unable to deal with the various restrictions

In Part (b), there were a few candidates who calculated the probability using 'with replacement' rather than 'without replacement'.

Answers

(a)
(i) 479001600
(ii) 39916800
(iii) 3628800
(iv) 7257600
(v) 224985600

(b) 35/66

Paper 02 Option C
SECTION C (Module 3: Particle Mechanics)
same for Module 2 Option B

Question 5

This question tested the candidates' ability to

(i) apply Newton's Laws of motion to a system of two particles, connected by a light inextensible string passing over a smooth fixed light pulley moving on an inclined plane with constant acceleration;
(ii) use the work-energy theorem to solve problems.

The question was attempted by a majority of candidates all of whom attempted to apply Newton's Law. They however failed to take into account the component of the weight along the plane, and too often the equation T = 12a was seen, instead of T - 12 g sin α = 12a.

(b) Given the mass of a vehicle, and its distance traveled in accelerating from a given speed to a greater speed, candidates were required to determine the average tractive force of the vehicle.

Few candidates applied the principle of 'work done = change in Kinetic Energy".
The majority used the equation of motion $v^2 = u^2 + 2as$ to calculate the acceleration, and then applied: Force = mass x acceleration.

Answers (a) (i) 2.94 ms^{-2} (ii) 54.9 N (iii) 116 N

(b) 805 N

Question 6

The question tested the candidates' ability to:

(i) apply $a = v\dfrac{dv}{dx}$
(ii) using Newton's Laws of motion to a constant mass moving in a straight line
(iii) formulate a first order differential equation to model the linear motion of the mass when the applied force is proportioned to its velocity.

The candidates were given the mass of a body which was moving forward with velocity v ms^{-1} against a variable force of resistance proportional to v^2, producing a forward constant thrust of given magnitude. It was required to (a) Sketch a diagram to show the forces acting on the system and the direction of the acceleration.

(b) Show that the motion of the body may be modeled by the differential equation $ds/dv = \dfrac{14v}{36-v^2}$ given that the body starts from rest and that $a = 0$ ms^{-2} when $v = 6ms^{-1}$.

Part (a) was well done by candidates, who drew correct diagrams showing clearly the forces and direction of motion.

(b) Few candidates were able to solve this problem, as it appeared that they were not familiar with expressing acceleration in the form $v\,dv/ds$.

Paper 01 Option B
SECTION C (Module 3: Rigid Bodies)

Question 11

This question required candidates to calculate the elastic potential energy in a spring, given its natural length, stretched length, and modulus of elasticity. This question was well done, and did not present any difficulty as candidates were familiar with, and able to apply the necessary formula to obtain the result.

In the second part of the question, it was required to find the velocity of a particle which was attached to the spring, and released from rest to pass through a given point.

The principle of conservation of energy was applied, and the velocity calculated.

Answer

(a) 2.43 J (b) 1.27 ms^{-1}.

Question 12

Candidates were required to consider the motion of a particle attached to one end of a light inelastic string, and moving in a horizontal circle, while a second particle was hanging freely from the other end of the string which passed through a fixed ring

Difficulty was experienced by candidates in considering the circular motion of the particle. They appeared to be unfamiliar with the direction and magnitude of the acceleration for motion in a circle. This resulted in a poor performance on this question.

Answer

3.96 ms^{-1}

Question 13

Candidates were required to determine the ratio of the radius to the height, of a regular cylinder, attached to a hemisphere of equal radius, so that the centre of mass of the solid formed is on the plane of the intersection of two figures.

This was not a popular question. Candidates did not attempt to take moments at any stage. If the centre of mass of the solid is at G, then equating the moments about G to 0, provides the equation from which is determined that the ratio is $1:\sqrt{3}$

Question 14

This question described a uniform ladder with one end resting on smooth horizontal ground, and the other resting against a rough vertical wall. The ladder is kept in equilibrium by a force P applied to the end of the ladder on the ground. Candidates were required to (a) draw a diagram showing the forces acting on the ladder (b) show that the least magnitude of P required to prevent the ladder from slipping down the wall is equal to a given expression.

Part (a) was well done, showing forces clearly. In Part (b) majority of candidates were able to resolve in horizontal and vertical directions correctly. However, they experienced difficulty in attempting to take moments.

Question 15

In this question, it was stated that the depth of water in a harbour may be modelled by simple harmonic motion with equation $d^2x/dt^2 = -\omega^2 x$ where x, is the depth of water at time t.

Given the depth of water at low tide and at high tide, and the times of occurrence of these on a particular day, candidates were asked to -

a. state the value of the amplitude a.
b. state the value of the period, and hence determine the value of ω
c. write an equation expressing x in terms of t, if x = a, when t = 0

This was not a popular choice. Candidates clearly associated SHM with vibrating springs or swinging pendulums, and not with tides.

Answers

(a) 3 (b) Period = 12.5 hrs, $\omega = 4\pi/25$ (c) x=3 cos $4\pi/25\, t$

Paper 02 Option B
SECTION C (Module 3: Rigid Bodies)

Question 5

Given a particle suspended from a fixed point by light elastic string of given modules of elasticity, candidates were required to investigate the motion, showing that while the string is taut the particle will describe SHM.

This was not a popular question. Candidates experienced difficulty from the outset, as they were unable to determine a starting point from which to work towards a solution.
For example: Let the particle be a distance x from O at time t. This would then allow them to apply Hooke's Law to obtain an expression for T, in terms of x and a.

At this point Newton's Law will be applied, and the required differential equation for SHM seen.

Answers

(b) $\sqrt{(2ga)}$ (e) $2\pi\sqrt{(a/4g)}$

Question 6

This question considered the motion of a body P from rest at the top of O of a smooth sphere, centre C. Candidates were required to use the energy equation to find an expression for the normal force acting on the body, and the value of the angle, OCP, at which the particle leaves the surface of the sphere.

Candidates were unable to obtain an expression $r\omega$, for the velocity of the particle moving with circular motion. They also experienced difficulty with the acceleration $r\omega^2$, towards the centre of the sphere. Resulting from this was their inability to obtain the energy equation and the normal equation of motion.

Answers

(c) 48.2^0

Paper 02 Option A
SECTION B (Module 3: Statistical Inference)

Question 5

This question tested the candidates' ability to:

(i) formulate null and alternative hypotheses;
(ii) carry out χ^2 goodnes-of-fit test for a Poisson distribution of unknown mean

This question was quite well done. Most candidates had difficulty calculating the mean of the data given. Problems were also experienced calculating the number of degrees of freedom for a goodness-of-fit using the Poisson distribution when the mean was unknown. These candidates used $n - 1$ rather than $n - 2$. Most of the candidates were able to calculate the expected frequencies, but care must be taken to ensure that the total of these equal to the total of the observed frequencies. Generally candidates were able to state the null and alternative hypotheses and calculate the test statistic.
Candidates correctly combined classes in the case where the expected frequency was less than 5.

Answers

(a) 1.7 (b) H_0:X~P_o(1.7) (c) 18.268,31.056,26.398,14.959,6.3575,2.9615

(d) (i) 3, (ii) 7.815 (e) 4.121 (f) accept H_0 and conclude that X ~ P_o(1.7)

Question 6

This question tested the candidates' ability to formulate hypotheses and test the null hypothesis for the population mean using a p – value approach when a sample is drawn from a normal distribution using a z test.

Almost all candidates were able to formulate null and alternative hypotheses in words and symbols and name the distribution and justify its use. Some candidates experienced difficulty in obtaining the correct p-value because of inaccurate calculation.

Answers

(a) H_0: $\mu \geq 5$ (b) since the sample size $n = 40 > 30$ is large by central limit theorem a normal distribution is used in the test and in calculation the p-value. (c) 0.0174 (d) reject H_0 if $p<0.05$
(b) reject H_0 and calculate that the mean weight loss is less than 5kg.