BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

1

A train starts from a station X and moves with constant acceleration 0.6m s^{-2} for 20 s. The speed it has reached after 20 s is then maintained for T seconds. The train then decelerates from this speed to rest in a further 40 s, stopping at a station Y.

(a) Sketch a speed-time graph to illustrate the motion of the train.

Given that the distance between the stations is 4.2km, find

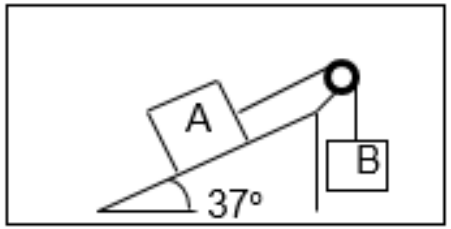
(b) The value of T,

(c) The distance travelled by the train while it is moving with constant speed.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

2



A and B are particles connected by a light inextensible string which passes over a smooth fixed pulley attached to a corner of a smooth plane inclined at 37^{o}. Particle B hangs freely. If A has mass 3kg, find the mass of B given that the system is in equilibrium.

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BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

3

The test marks of 14 students are displayed in a stem-and-leaf diagram, as shown below.

0	
1	2 6
2	1 3 5
3	w x 4 8 y z
4	6 7 7

Key: 1 | 6 means 16 marks

(a) Find the lower quartile.

(b) Given that the median is 32, find the values of w and x.

(c) Find the possible values of the upper quartile.

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BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

4

A factory stores screws in packets. A small packet contains 100 screws and a large packet contains 200 screws. The factory keeps small and large packets in the ratio 4:3 respectively.

A random sample of 3 packets is taken from the factory and Y_1, Y_2 and Y_3 denote the number of screws in each of these packets.

(a) List all the possible samples.

(b) Find the sampling distribution of $\bar{Y}$.

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BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

5

If the random variable X is such that $X \sim B(10, p)$ where $p < \frac{1}{2}$ and variance $\sigma^2 = \text{Var}(X) = 1\frac{7}{8}$, find

(a) p

(b) The mean (or expected value) $\mu = E(X)$

(c) $P(X = 2)$

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

6

Linda regularly takes a taxi to work five times a week. Over a long period of time she finds the taxi is late once a week. The taxi firm changes her driver and Linda thinks the taxi is late more often. In the first week, with the new driver, the taxi is late 3 times. You may assume that the number of times a taxi is late in a week has a Binomial distribution.

Test, at the 5% level of significance, whether or not there is evidence of an increase in the proportion of times the taxi is late. State your hypotheses clearly.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

7

The table shows data from the large data set on the daily mean air temperature and the daily mean pressure during May and June 2015 in Beijing.

Temperature (°C)	17.5	18.5	18.0	24.6	22.2	23.1	27.3
Pressure (hPa)	1010	1011	1012	997	1009	998	1002

Test at the 2.5% level of significance the claim that there is negative correlation between the daily mean air temperature and the daily mean pressure. State your hypotheses clearly.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

8

Solve the following equations give an exact answer

(a) $2\ln 2x - 6\ln 2 = \ln(x-3)$

(b) $\ln(x+1) - \ln x = 1$

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

9

In the expansion of $\left(1+\frac{x}{2}\right)^n$ in ascending powers of x the coefficient of x^2 is 30. (n is positive integer)

(a) Find n

(b) Find the first 4 terms of the expansion

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

10 i

a) A particle of mass 2.5 kg is subjected to a constant force $F = (1.2i + 0.9j)N$. The initial velocity of the particle is $(0.6i - 1.3j)ms^{-2}$. Find the velocity of the particle after 5 seconds

b) A particle starts from rest and moves with acceleration $((2 + e^{-2t})i + (4e^{-2t})j)\ ms^{-2}$. Find its distance from the initial position after 1.2 seconds

c) The velocity of a particle moving in a plane is given by $v = \begin{pmatrix} 2 - 3t^2 \\ 4t - 1 \end{pmatrix} ms^{-1}$. Show that the particle never returns to its initial position

d) A particle is acted upon by two forces $F_1 = \big((c - 1)i + (1 - 2c)j\big)N$ and $F_2 = \big((2c + 1)i + (c - 3)j\big)N$. The particle moves in the horizontal plane with acceleration $(3i)ms^{-2}$. Find the value of c

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

10 ii

a) Points A and B have position vectors $a = \begin{pmatrix} 2 \\ 2 \\ 1 \end{pmatrix}$ and $b = \begin{pmatrix} 1 \\ -1 \\ 3 \end{pmatrix}$. Points C lies on AB so that $AC : BC = 2 : 3$. Find the position vector of C.

b) Points P and Q have position vectors $p = 2i - j - 3k$ and $q = i + 4j - k$

a) Find the position vector of the midpoint M of PQ

b) Point R lies on the line PQ such that $QR = QM$. Find the coordinates of R

c) Given that $\boldsymbol{a} = \boldsymbol{i} - \boldsymbol{j} + 3\boldsymbol{k}$ and $\boldsymbol{b} = 2q\boldsymbol{i} + \boldsymbol{j} + q\boldsymbol{k}$, find the values of scalars p and q such that $p\boldsymbol{a} + \boldsymbol{b}$ is parallel to vector $\boldsymbol{i} + \boldsymbol{j} + \boldsymbol{k}$

d) a) Find a vector of magnitude 6 parallel to $\begin{pmatrix} 4 \\ -1 \\ 1 \end{pmatrix}$

b) Find a vector of magnitude 3 in the same direction as $2i - j + k$

TAP FOR ANSWERS

a) It is found that the lifespan of a certain brand of laptop batteries follows normal distribution with mean 16 hours and standard deviation 5 hours. A particular battery has a lifespan of 10.2 hours
   i. How many standard deviations below the mean is this?
   ii. What is the probability that a randomly chosen laptop battery has a lifespan shorter than this.

b) Ali is an athlete and a double mathematician. When Ali competes in long jump competitions, the length of his jumps are normally distributed with mean 5.2 m and standard deviation 0.7m
   i. What is the probability that Ali will record a jump between 5 m and 5.5 m

   Ali needs to jump 6 m to qualify for the school team
   ii. What is the probability that he will qualify with a single jump
   iii. If he is allowed three jumps, what is the probability that he will qualify for the school team
   iv. What assumptions did you have to make in your answer to c? Are these likely to be met in this situation

c) Masses of species of cat have a normal distribution with mean 16kg and variance 16 kg^2. Estimate the number in a sample of 2000 such cats that will have a mass above 13 kg.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

12

a) A fair coin is tossed 100 times. Find the probability that there are more than 60 heads using
   a) the binomial distribution
   b) The normal approximations

   What is the percentage error using the normal distribution in this situation

a) Data collected over a long period of time indicate that 23% of children contract a certain disease. Following a public awareness campaign, a doctor conducts a survey to find out whether this proportion has decreased. She uses a random sample of 3000 children and conducts a hypothesis test at the 2.5% significance level. Use an appropriate normal distribution to find the approximate critical region of this test.

TAP FOR ANSWERS

(In this question, $\overline{X_n}$ represents the sample mean, with n being the size of the sample)

Find the following probabilities.

a) If $X \sim N(4,100)$, find $P(\bar{X}_4 < 6)$
b) If $X \sim N(20,125)$, find $P(\bar{X}_5 > 16)$
c) If $X \sim N(0,1)$, find $P(-0.5 < \bar{X}_{10} < 1)$
d) If $X \sim N(0,10)$, find $P(0 < \bar{X}_4 < 3)$

TAP FOR ANSWERS

14

Two small blocks, A and B, connected by a light inextensible string, lie with B above A on the line of greatest slope of a rough plane inclined at $30°$ to the horizontal. Block A has mass 2.5 kg and block B has mass 1.5 kg. The connected string is 1 metre long and block A begins 2 metres along the slope.

The coefficient of friction between each block and the surface is 0.15

The system is released from rest at time $t = 0$; when block A reaches the foot of the slope, its motion stops immediately. Find the time at which B collides with A.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

14 b

A particle P with mass 4.5 kg lies on a rough plane inclined 30° to the horizontal. A light inextensible string connects to P, runs parallel with the line of greatest slope of the plane to a smooth peg, then vertically downwards through a smooth, free ring R, with mass 2 kg and then vertically upwards to attach to a fixed points S.

The coefficient of friction between P and the plane is 0.15

a) Let a be the acceleration of the ring when the system is released from rest. By considering the distance moved by each object, explain why the acceleration of P is $2a$.
b) By considering forces on P, find an equation linking a and T with friction F
c) Find the direction and magnitude of the frictional force
d) Determine whether P will remain stationary, move up the slope or move down the slope when the system is released from rest. Also calculate the acceleration of P.

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

15

5. Look at the columns for “Wind Direction” and “Cardinal Direction” for Camborne in 2015. On July 7th the Wind Direction was 90 and the Cardinal Direction was East. On August 5th the Wind Direction was 180 and the Cardinal Direction was South.

a) What is the name for the system used to measure Wind Direction?

b) Convert the following Wind Directions to Cardinal Directions

i) 270 ii) 135 iii) 225

iv) 202.5 v) 310 vi) 20

c) Find the smallest bearing that would give a Cardinal Direction of

i) East ii) South East iii) North North-West

iv) East South-East

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

16

Complete this old spec paper
https://www.madasmaths.com/archive/iygb_practice_papers/c2_practice_papers/c2_q.pdf

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

1 - Answers

(b) 320 seconds

(c) 3840m

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

2 - Answers

1.81 kg (3sf) = 1.8 kg (2sf) (2sf because of use of g to 2sf)

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

3 - Answers

(a) $Q_1 = 23$

(b) $w = x = 30$

(c) 38 or 39

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

4 - Answers

(a) There are 8 possible samples

(b)

m	100	$\frac{400}{3}$	$\frac{500}{3}$	200
$P(M = m)$	0.1866	0.4198	0.3149	0.0787

(round probabilities to 4sf if you write them as decimals)

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

5 - Answers

(a) 0.25

(b) 2.5

(c) 0.2816

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

6 - Answers

Test statistic X : r.v. the number of times the taxi is late

$H_0: p = \frac{1}{5}$ $H_1: p > \frac{1}{5}$

X ~ B(5,1/5) (assuming H_0)

$P(x \geq 3) = 0.0579$

0.0579 > 0.05 therefore do not reject H_0.
There is insufficientevidence to suggest an increase in number of times taxi is late.

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

7 - Answers

$r = -0.7925$ (4 s.f.), $H_0: \rho = 0, H_1: \rho < 0$, critical value -0.7545. Reject H_0.
There is evidence that temperature and pressure are negatively correlated.

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

8 - Answers

(a) 4, 12

(b) $\frac{1}{e-1}$

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

9 - Answers

(a) $n=16$

(b) $1 + 8x + 30x^2 + 70x^3$

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

10 i - Answers

(a) $(3i + 0.5j)ms^{-1}$
(b) $2.35\ m$
c) Proof
d) -2

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

10 ii - Answers

a) $\begin{pmatrix} 1.6 \\ 0.8 \\ 1.8 \end{pmatrix}$

b) i) $\frac{3}{2}i + \frac{3}{2}j - 2k$ ii) $\left(\frac{1}{2}, \frac{13}{2}, 0\right)$

c) $p = \frac{3}{8}, q = \frac{1}{8}$

d) i) $\begin{pmatrix} 4\sqrt{2} \\ -\sqrt{2} \\ \sqrt{2} \end{pmatrix}$ ii) $\begin{pmatrix} \sqrt{6} \\ -\sqrt{1.5} \\ \sqrt{1.5} \end{pmatrix}$

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

11 - Answers

a) i) 1.16 ii)0.123

b) i) 0.2783 ii) 0.1265 iii) 0.3335 iv) Assumes that attempts are independent and that probability of success is constant, but Ali might get tired also pressure builds up.

c) 1547

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

12 - Answers

a) i) 0.0176 ii) 0.0179 iii) 1.7%

b) $X < 645$

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

13 - Answers

a) 0.655
b) 0.788
c) 0.942
d) 0.471

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

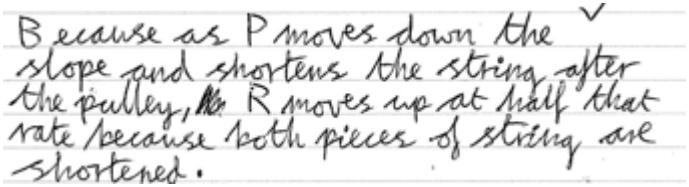
14 a - Answers

t = 1.286 s

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

14 b - Answers

a) 

b) $4.5g\sin(30^o) - F - T = 4.5 \times (2a)$ (assuming particle slides down the slope)

c) $F=0.15 \times 4.5g\cos(30^o) = 5.73$ N (3sf) (up slope)

d) $1.30\ ms^{-2}$ (3f) = $1.3\ ms^{-2}$ (2sf)
P moves down the slope

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

15 - Answers

a) Bearings

b) i) West ii) South East iii) South West

iv) South by South West v) North West

vi) North by North East

c) i) 78.75 ii) 123.75 iii) 326.25 iv) 101.25

TAP TO RETURN

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 15B

16 - Answers

https://www.madasmaths.com/archive/iygb_practice_papers/c2_practice_papers/c2_q_solutions.pdf

TAP TO RETURN