BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 17B

1

Data was collected about height above sea level, x metres, and the temperature, y^oC, at 7.00 am., on the same day in summer at nine places in Europe.

The PMCC was calculated to be -0.975.

Test this for negative correlation at the 5% significance level . Interpret your result in context.

TAP FOR ANSWERS

2

Find any point(s) of inflection of the following functions.

(a) $f(x) = \cos^2 x - 2\sin x, 0 < x < 2\pi$

(b) $f(x) = -\frac{x^3-2x^2+x-1}{x-2}, x \neq 2$

(c) $f(x) = -\frac{x^3}{x^2-4}, x \neq \pm 2$

3

a Write down two conditions under which the normal distribution may be used as an approximation to the binomial distribution.

A company sells orchids of which 45% produce pink flowers.

A random sample of 20 orchids is taken and X produce pink flowers.

b Find $P(X = 10)$.

A second random sample of 240 orchids is taken.

c Using a suitable approximation, find the probability that fewer than 110 orchids produce pink flowers.

d The probability that at least q orchids produce pink flowers is 0.2. Find q.

TAP FOR ANSWERS

4

A train engine of mass 6400kg is pulling a carriage of mass 1600kg along a straight horizontal railway track. The engine is connected to the carriage by a shunt which is parallel to the direction of motion of the coupling. The shunt is modelled as a light rod.

The engine provides a constant driving force of 12000N. The resistances to the motion of the engine and the carriage are modelled as constant forces of magnitude R N and 2000N respectively.

Given that the acceleration of the engine and the carriage is 0.5 ms^{-2}.

(a) find the value of R

(b) show that the tension in the shunt is 2800N

TAP FOR ANSWERS

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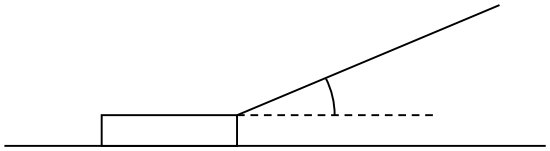
(a) A particle is projected upwards with a speed of 14 m s^{-1}. Find for how long it is above 2 m.

(b) A ball is thrown vertically upwards from a height 1.6m above the ground, with a speed of 7 m s^{-1}. Find the speed when it hits the ground.

TAP FOR ANSWERS

6



A sledge has mass 30 kg. The sledge is pulled in a straight line along horizontal ground by means of a rope. The rope makes an angle 20° with the horizontal, as shown in Figure 3. The coefficient of friction between the sledge and the ground is 0.2. The sledge is modelled as a particle and the rope as a light inextensible string. The tension in the rope is 150 N. Find, to 3 significant figures,

(a) the normal reaction of the ground on the sledge,

(b) the acceleration of the sledge

When the sledge is moving at 12 m s^{-1}, the rope is released from the sledge.

(c) Find, to 3 significant figures, the distance travelled by the sledge from the moment when the rope is released to the moment when the sledge comes to rest.

TAP FOR ANSWERS

7

The random variable X is normally distributed with mean μ and variance σ^2.

a Write down the distribution of the sample mean $\overline{X}$ of a random sample of size n. **(1 mark)**

A construction company wishes to determine the mean time taken to drill a fixed number of holes in a metal sheet.

b Determine how large a random sample is needed so that the expert can be 95% certain that the sample mean time will differ from the true mean time by less than 15 seconds. Assume that it is known from previous studies that $\sigma = 40$ seconds. **(4 marks)**

TAP FOR ANSWERS

8

Two helicopters P and Q are moving in the same horizontal plane. They are modelled as particles moving in straight lines with constant speeds. At noon P is at the point with position vector $(20\mathbf{i} + 35\mathbf{j})$ km with respect to a fixed origin O. At time t hours after noon the position vector of P is $\mathbf{p}$ km. When $t = \frac{1}{2}$ the position vector of P is $(50\mathbf{i} - 25\mathbf{j})$ km. Find

(a) the velocity of P in the form $(a\mathbf{i} + b\mathbf{j})$ km h^{-1},

(b) an expression for $\mathbf{p}$ in terms of t.

At noon Q is at O and at time t hours after noon the position vector of Q is $\mathbf{q}$ km. The velocity of Q has magnitude 120 km h^{-1} in the direction of $4\mathbf{i} - 3\mathbf{j}$. Find

(c) an expression for $\mathbf{q}$ in terms of t,

(*d*) the distance, to the nearest km, between P and Q when $t = 2$.

TAP FOR ANSWERS

Now, Integrate the following functions using an appropriate method when required:

(a) $\int$ -sin(3x +1) dx

(b) $\int 4\cos\left(\frac{x}{2}\right)$ dx

(c) $\int$ tanx dx

(d) $\int$ cot4x dx

(e) $\int \sec^5 2x \tan 2x$ dx

(f) $\int$ tan5x dx

(g) $\int \sin^2 6x$ dx

(h) $\int 3\cos^2 2x$ dx

(i) $\int 3\tan^2 4x$ dx

TAP FOR ANSWERS

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A curve C has equation $y = \frac{1}{2}e^{2x} - 4x + 1, \quad x \epsilon R$
The point P lies on C where x = ln 4.

(a) Show that the equation of the tangent to the curve is y = 12x +9 – 32 ln2

The point Q lies on C where x = ln 2.
The normal to the curve at the point Q meets the tangent to the curve at the point P, at the point R.

(b) Show that the co-ordinates of R are (ln2, 9 – 20ln2)

TAP FOR ANSWERS

BHASVIC MαTHS
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11

A particle P of mass 0.5 kg moves under the action of a single force **F** Newtons. At time t seconds, the velocity **v** m s^{-1} of P is given by;

$$\mathbf{v} = 3t^2\mathbf{i} + (1 - 4t)\mathbf{j}.$$

Find:

(a) the acceleration of P at time t seconds,

(*b*) the magnitude of **F** when $t = 2$.

TAP FOR ANSWERS

12

A circle has parametric equations $x = 4\sin t - 3, \quad y = 4\cos t + 5.$

(a) Find the Cartesian equation of the circle

(b) Draw a sketch of the circle

(c) Find the exact coordinates of the points of intersection of the circle with the y axis

TAP FOR ANSWERS

13

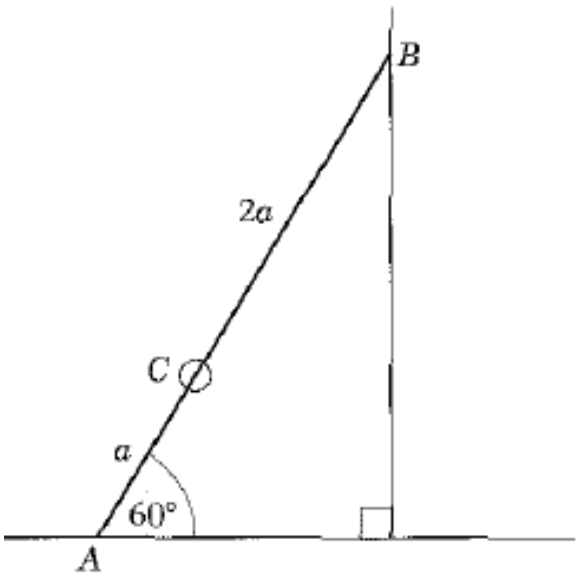
(a) Show that $\cos^4 x \equiv \frac{1}{8}\cos 4x + \frac{1}{2}\cos 2x + \frac{3}{8}$

(b) Hence find $\int \cos^4 x \, dx$

TAP FOR ANSWERS

BHASVIC MαTHS
A1 DOUBLES ASSIGNMENT 17B

14



A ladder AB, of mass m and length $3a$, has one end A resting on rough horizontal ground. The other end B rests against a smooth vertical wall. A load of mass $2m$ is fixed on the ladder at the point C, where $AC = a$.
The ladder is modelled as a uniform rod in a vertical plane perpendicular to the wall and the load is modelled as a particle. The ladder rests in limiting equilibrium at an angle of $60°$ with the ground.

Find the coefficient of friction between the ladder and the ground.

For the above problem, draw a complete and clear force diagram, including F_{max} and R at A, perpendicular reaction S at B, the weight of the ladder, and the weight of the load at C.
Friction is limiting so you can use $F_{max} = \mu R$
You can take moments about any point you like. Point A is easy then the equation will not have F_{max} or R.
However, you can take moments about a point not even on the ladder – if you choose the point where R and S intersect, these forces will not then be in the equation, and you can find F_{max} directly.
Construct three equations, then solve to find the coefficient of friction.

TAP FOR ANSWERS

15

A test statistic has distribution $B(30, p)$. Given that:

$$H_0: p = 0.4, H_1: p < 0.4$$

(a) Find the critical region for the test statistic at the 5% significance level

A test statistic has distribution $B(40, p)$. Given that:

$$H_0: p = 0.2, \quad H_1 : p \neq 0.2$$

(b) Find the critical region for the test statistics at the 5% significance level

TAP FOR ANSWERS

16

Complete this old spec paper

https://www.madasmaths.com/archive/iygb_practice_papers/c2_practice_papers/c2_r.pdf

TAP FOR ANSWERS

1 - Answers

Reject H_0. The greater the altitude the lower the temperature.

TAP TO RETURN

2 - Answers

(a) $\left(\frac{\pi}{6}, -\frac{1}{4}\right), \left(\frac{5\pi}{6}, -\frac{1}{4}\right)$

(b) (1, -1)

(c) (0, 0)

TAP TO RETURN

3 - Answers

a n large, p close to 0.5. **b** 0.1593

c 0.5772 **d** 115

TAP TO RETURN

4 - Answers

(a) 6000N

(b) Proof

TAP TO RETURN

5 - Answers

(a) 2.56 seconds

(b) $9.0ms^{-1}$

TAP TO RETURN

6 - Answers

(a) 243N

(b) $3.08 ms^{-2}$

(c) 36.7m

TAP TO RETURN

7 - Answers

a $X \sim N\left(\mu, \frac{\sigma^2}{n}\right)$ **b** Need $n = 28$ or more

TAP TO RETURN

8 - Answers

(a) 60**i** - 120**j**

(b) **p** = 20**i** + 35**j** + (60**i** - *120***j**)t

(c) **q** = 96t**i** - 72*t***j**

(d) 80 km

TAP TO RETURN

9 – Answers

(a) $\frac{1}{3}\cos(3x+1)+c$

(b) $8\sin\left(\frac{x}{2}\right)+c$

(c) $-\ln(cosx)+c$

(d) $\frac{1}{4}\ln(sin4x)+c$

(e) $\frac{1}{10}\sec^5 2x+c$

(f) $-\frac{1}{5}\ln(cos5x)+c$

(g) $\frac{1}{2}x-\frac{1}{24}sin12x+c$

(h) $\frac{3}{2}x+\frac{3}{8}sin4x+c$

(i) $\frac{3}{4}tan4x-3x+c$

TAP TO RETURN

10 - Answers

Proof

TAP TO RETURN

11 - Answers

(a) $6t\mathbf{i}-4\mathbf{j}$ (b) 6.32 N

TAP TO RETURN

12 - Answers

(a) $(x+3)^2+(y-5)^2=16$

(b) check desmos

(c) $(0,5+\sqrt{7}),(0,5-\sqrt{7})$

TAP TO RETURN

13 - Answers

(a) $\cos^4 x = (\cos^2 x)^2 = \left(\frac{1+\cos 2x}{2}\right)^2 = \frac{1}{4} + \frac{1}{2}\cos 2x$
$+ \frac{1}{4}\cos^2 2x = \frac{1}{4} + \frac{1}{2}\cos 2x + \frac{1}{4}\left(\frac{1+\cos 4x}{2}\right)$
$= \frac{3}{8} + \frac{1}{2}\cos 2x + \frac{1}{8}\cos 4x$

(b) $\frac{1}{32}\sin 4x + \frac{1}{4}\sin 2x + \frac{3}{8}x + c$

TAP TO RETURN

14 - Answers

$\mu = 0.22$

TAP TO RETURN

15 - Answers

$(a)\ x \leq 7$

(b) $x \leq 2$ and $x \geq 14$

TAP FOR ANSWERS

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16 - Answers

https://www.madasmaths.com/archive/iygb_practice_papers/c2_practice_papers/c2_r_solutions.pdf

TAP FOR ANSWERS