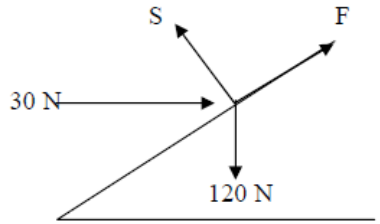
Exam Questions – Set 6 - Answers

1.

(a)



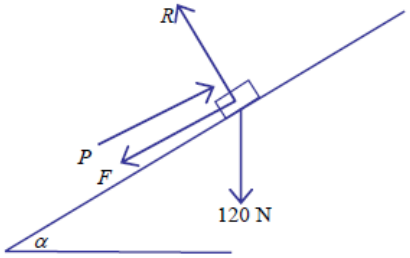
Resolving perpendicular to the plane:

$S = 120\cos\alpha + 30\sin\alpha$ — M1 A1 A1

$= 114$ * — A1

(4)

(b)



Resolving perpendicular to the plane:

$R = 120\cos\alpha$ — M1 A1

$= 96$ — A1

$F_{max} = \frac{1}{2}R$ — M1

Resolving parallel to the plane:

In equilibrium: $P_{max} = F_{max} + 120\sin\alpha$ — M1 A(2,1,0)

$= 48 + 72 = 120$ — A1

(8)

(c)	$30+F=120\sin\alpha$ **OR** $30-F=120\sin\alpha$ So $F=42\text{N}$ acting up the plane.	M1 A1 A1 **(3)**

2.

(i)		$a=k+0.06t$ $k+0.06(20)=1.3$ $k=1.3-1.2=0.1$	**B1** **M1** **A1** **[3]**	**1.1** **1.1** **1.1**	E E E	Use of $t=20$ and $a=1.3$ in their a	
(ii)		$s=0.05t^2+0.01t^3(+c)$ $t=0, s=0\Rightarrow c=0$ $t=20, v=14$ $s_1=0.05(20)^2+0.01(20)^3$ $25^2=14^2+2(1.3)s_2$ Total distance $=s_1+s_2=265\,\text{m}$	**M1*** **A1ft** **B1** **B1ft** **dep*M1** **M1** **A1** **[7]**	**3.1a** **1.1** **2.1** **1.1** **3.4** **3.3** **2.2a**	E E A E C A A	Attempt to integrate – all powers increased by 1 (but not just multiplying by t) $s=\frac{1}{2}kt^2+0.01t^3$ From a correct expression for s $12+20k$ Finding distance travelled after 20 s (for reference $s_1=100$) Use of $v^2=u^2+2as$ with $v=25$ and $a=1.3$ and their u All previous marks must have been awarded	If $c=0$ stated then must give a reason

3.

(a)		$k(1+2+3+4+5) \quad (=1)$	**M1**	**3.3**	Allow $15k \ (=1)$		
		$k = \frac{1}{15}$	**A1**	**1.1**	May be implied		
		$P(X=3) = 3 \times \frac{1}{15}$ or $\frac{3}{15} \quad (=0.2$ **AG**$)$	**A1**	**2.1**	Must see $3 \times \frac{1}{15}$ or $\frac{3}{15}$ and answer 0.2		
			[3]				
(b)		$\begin{matrix}1 & 2 & 3 & 4 & 5\end{matrix}$ $\frac{1}{15} \quad \frac{2}{15} \quad \frac{3}{15} \quad \frac{4}{15} \quad \frac{5}{15}$ oe 0.07, 0.13, 0.2, 0.27, 0.33	**M1** **A1**	**1.2** **1.1**	M1 for ≥ 3 probs correct, ft their k cao. Allow decimals **(2 dp)** SC: Table with all five probs = 0.2: M1	Allow $X=0$ or $X=6$ or $X=6+$ if prob shown as 0	
			[2]				
(c)		Both parts. Allow mixture of methods					
(c)	**(i)**	$\frac{3}{15} \times \frac{4}{15} + \frac{2}{15} \times \frac{5}{15}$ oe	**M1**	**3.4**	Correct products added, ft their table	**Special cases** **2-way table** Count 4 pairs M1 But if (b) correct: M0	**All probs = 0.2** $0.2^2+0.2^2$ M1 But if (b) correct: M0
		$\times 2$	**M1**	**3.1a**	$2\times$(Sum of two products of probs)	$\div 25$ M1	$2\times(0.2^2+0.2^2)$ Allow without $2\times$ M1
		$= \frac{44}{225}$ or 0.196 (3 sf)	**A1**	**1.1**	cao	= 0.16 A0	= 0.16 A0
			[3]				
(c)	**(ii)**	P(one value is 2 & $T=7$) $= 2\times\frac{2}{15}\times\frac{5}{15}$	**M1**	**3.4**	Allow without "2×", ft their table	Count 2 pairs M1	2×0.2^2 M1
		$=\frac{4}{45}$	**A1f**	**1.1**	ft their table (except if all probs = 0.2)	A0	= 0.08 A0
		$\frac{P(\text{one value is 2 \& } T=7)}{P(T=7)} \quad (\frac{\frac{4}{45}}{\frac{44}{225}}$ or $= \frac{0.0889}{0.196})$	**M1**	**2.1**	Allow any probability Their (c)(i) or their $P(T=7)$	$\div 4$ M1	$\frac{0.08}{0.16}$ M1
		$= \frac{5}{11}$ or 0.455 (3 sf)	**A1**	**1.1**	cao NB not 0.454	= 0.5 A0	= 0.5 A0
			[4]		Eg: If (i) $\frac{22}{225}$, $\frac{2}{45} \div \frac{22}{225} = \frac{5}{11}$ M1A0M1A0		

4.

H_0: $\mu = 13.3$, H_1: $\mu < 13.3$ $z = \frac{12.48 - 13.3}{\sqrt{12.25/50}} = -1.6566$ $[p = 0.0488]$ $[12.25/50 = 0.245]$ < -1.645 $[p < 0.05]$	B2 M1 A1 B1
CV $13.3 - 1.645\sqrt{\frac{12.25}{50}} = 12.4857\ldots$ $12.48 < \text{CV}$	M1 B1 A1
Reject H_0. Significant evidence that animals in zoos have shorter expected lifetime	M1 A1ft 7

5.

(a)	$[P(T>20)=]\ P\left(Z>\frac{20-18}{5}\right)$	M1
	$P(Z>0.4)=1-0.6554$	M1
	$=$ **0.3446** or awrt **0.345**	A1
		(3)
(b)	Require $P(T>20 \mid T>15)$ or $\frac{P(T>20)}{P(T>15)}$	M1
	$\frac{\text{"(a)"}}{P(Z>\frac{15-18}{5})} = \frac{\text{"(a)"}}{P(Z>-0.6)}$, $= \frac{\text{"0.3446"}}{0.7257}$ or $\frac{\text{"0.345"}}{0.726}$	M1, A1ft
	$=0.47485\ldots=$ awrt **0.475**	A1
		(4)
(c)	$P(T>d \mid T>15)=0.5$ or $P(T<d \mid T>15)=0.5$	M1
	$P(T>d)$ or $P(15<T<d)=0.5\times$"0.7257" =[0.36285]	A1ft
	$P(T<d)=$"0.63715"	M1
	So $\frac{d-18}{5}=0.35$ (calculator gives 0.35085…)	A1
	$d=19.754\ldots$ = awrt **19.8**	A1cso
	(Accept 19 mins 45(secs) or 19:45 but 19.45 is A0)	(5)

6.

(a)	$\tan\theta=\frac{3}{4}$; bearing is 37° **(nearest degree)**	M1; A1
		(2)
(b)		
(i)	$\mathbf{p}=(\mathbf{i}+\mathbf{j})+t(2\mathbf{i}-3\mathbf{j})$	M1 A1
(ii)	$\mathbf{q}=(-2\mathbf{j})+t(3\mathbf{i}+4\mathbf{j})$	A1
(iii)	$\mathbf{PQ}=\mathbf{q}-\mathbf{p}=(-\mathbf{i}-3\mathbf{j})+t(\mathbf{i}+7\mathbf{j})$	M1 A1
		(5)
(c)		
(i)	$-1+t=0$	M1
	$t=1$ or 3pm	A1
(ii)	$-1+t=-(-3+7t)$	M1
	$t=\frac{1}{2}$ or 2.30 pm	A1
		(4)