Godalming College

Mechanics 10 – Statics 2 : Solutions

Section 1

1. In all cases, vertical component of tension plus normal reaction force = weight of box

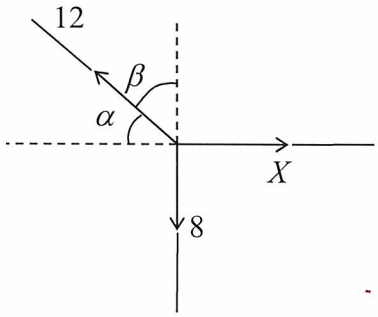
(a) Horizontal component of tension **equals** μR, the maximum value for friction

(b) Horizontal component of tension **exceeds** μR, the maximum value for friction

(c) Horizontal component of tension **equals** μR, the maximum value for friction

(d) Horizontal component of tension **is less than** μR, the maximum value for friction

2. (*a*)



R(↑) $8 = 12\cos\beta$ or $12\sin\alpha$

$\Rightarrow \beta = 41.8°$ or $\alpha = 48.2°$

$\Rightarrow \theta = 138.2°$

(*b*) R(→) $X = 12\cos 41.8°$ (or $12\sin 48.2°$)

$= 8.94$

3.

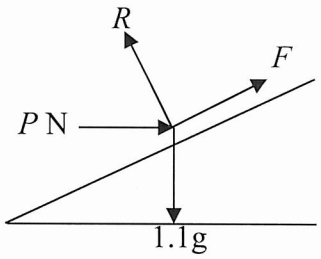
(a) Temperatures generally lower in Perth, so 15.2 most likely from there. Jacksonville generally warmest, so expect 25.12 from Jacksonville and 22.0 from Beijing

(b) Both mean and standard deviation would fall – values would be very small, bringing the mean down, but are closer to the mean than the current standard deviation, bringing this down too.

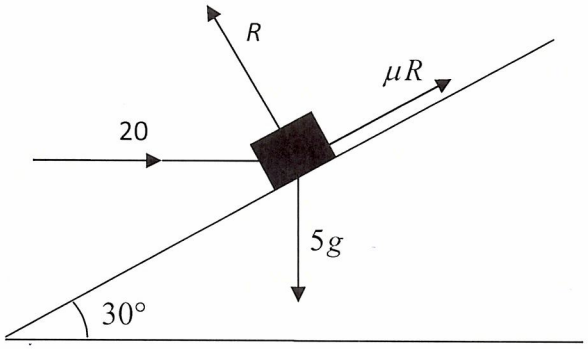
Section 2

1.

$F = P\cos 50^o$	M1 A1
$F = 0.2R$ seen or implied.	B1
$P\sin 50^o + R = 15g$	M1 A1 A1
Eliminating R; Solving for P; $P =$ 37 (2 SF)	M1; M1;A1
	[9 marks]

2. (a)		**B2** **-1 e.e.o.o.** **(labels not needed)** **(2)**
(b)	$F = \frac{1}{2}R$ $(\uparrow),\ R\cos\alpha + F\sin\alpha = mg$ $R = \dfrac{1.1g}{(\cos\alpha + \frac{1}{2}\sin\alpha)} = 9.8\ \text{N}$ $(\rightarrow),\ P + \frac{1}{2}R\cos\alpha = R\sin\alpha$ $P = R(\sin\alpha - \frac{1}{2}\cos\alpha)$ $= 1.96$	**B1** **M1 A2** **M1 A1 (6)** **M1 A2** **M1** **A1 (5)** **[13 marks]**
3.	↗ $4\cos\alpha + F = W\sin\alpha$ ↖ $R = 4\sin\alpha + W\cos\alpha$ $F = 0.5R$ $\cos\alpha = 0.8$ or $\sin\alpha = 0.6$ $R = 20N$ ** GIVEN ANSWER $W = 22N$	**M1 A1** **M1 A1** **B1** **B1** **M1 A1** **A1** **(9)**
OR	→ $R\sin\alpha = 4 + F\cos\alpha$ ↑ $R\cos\alpha + F\sin\alpha = W$ $F = 0.5R$ $\cos\alpha = 0.8$ or $\sin\alpha = 0.6$ $R = 20N$ ** GIVEN ANSWER $W = 22N$	**M1 A1** **M1 A1** **B1** **B1** **M1 A1** **A1** **(9)** **[9 marks]**

4.



(a) $\perp$ plane $\quad R = 20\cos 60° + 5g\cos 30°$ — **M1 A2(1,0)**

$= 52.4\ (\text{N})$ or 52 — **A1**

(4)

(b) $\quad F_r = \mu R$ — **B1**

P plane $\quad F + 20\cos 30° = 5g\cos 60°$ — **M1 A2(1, 0)**

Leading to $\mu = 0.137$ or 0.14 — **A1**

(5)

[9 marks]

5.

μR — **B1**

$R = 2g\cos 20° + 40\cos 60°$ — **M1 A2**

$F = 40\cos 30° - 2g\cos 70°$ — **M1 A2**

$$\mu = \frac{40\cos 30° - 2g\cos 70°}{2g\cos 20° + 40\cos 60°}$$ — **M1 M1**

$= 0.73$ or 0.727 — **A1**

[10 marks]

TOTAL 50 marks