

Mechanics 6 - Friction SOLUTIONS

SECTION 1

	MEDIAN	IQR	OUTLIERS	SKEW
PERTH	15°C	4°C	NONE	SLIGHT -
JACKSONVILLE	27°C	2°C	1 UPPER	SLIGHT -
BEIJING	26°C	4°C	1 UPPER 1 LOWER	SYMMETRICAL

Perth has lowest mean Temp, followed by Beijing & Jacksonville both with similar medians (26°C, 27°C). Both Beijing and Perth have larger spreads of temps. Compared to Jacksonville. The distributions are all mainly symmetric and J and B have outliers.

$$F = ma$$

2) a) $R = 10g \cos 30^\circ = \underline{84.9N}$ b) $10g \sin 30^\circ - 40 = 10a$
 $a = \underline{0.9 \text{ m/s}^2 \text{ DOWN PLANE}}$

3) x: $Q = 10 \sin 30^\circ + 10 \cos 30^\circ = \underline{13.7N}$
 y: $P + 10 \sin 30^\circ = 10 \cos 30^\circ \Rightarrow \underline{P = 3.7N}$

4) $u = 2, v = 18, t = 10, a?$ $v = u + at \Rightarrow 18 = 2 + 10a$
 $\Rightarrow a = \frac{16}{10} = \underline{1.6 \text{ m/s}^2}$
 $s = ut + \frac{1}{2}at^2 = 2 \times 10 + \frac{1}{2} \times 1.6 \times 100 = \underline{100m}$

SECT 2

$F = NR$ F_{MAX} $F = ma$

1) a) i) $F_{MAX} = \frac{1}{7} \times 10g = \underline{(14N)}$ ii) $a = 0$ ✓
 $14N > 10N$ so REST ✓ $F = 10N$ ✓

b) i) $\uparrow R = 28 + 10 \times 9.8 = 126N$ ✓ ii) $a = 0$ ✓
 $F_{MAX} = \frac{1}{7} \times 126 = \underline{(18N)}$
 $18N > 10N$ so REST ✓ $F = 10N$ ✓

c) i) $\uparrow R + 28 \sin 30^\circ = 10g$ ✓
 $R = 84N$ ✓
 $F = \frac{1}{7} \times 84 = \underline{12N}$ ✓
 $28 \cos 30^\circ = 24.2 > 12N$
 so ACCELERATE ✓

ii) $24.2 - 12 = 10 \times a$ ✓
 $a = \underline{1.2 \text{ m/s}^2}$ ✓

2) a) $\downarrow R = 5g = 49\text{N}$ ✓ $F = ma$ $24 - f = 5a \Rightarrow f = 24 - 10 = 14\text{N}$ ✓
 $N = f/R = 14/49 = 2/7$ ✓

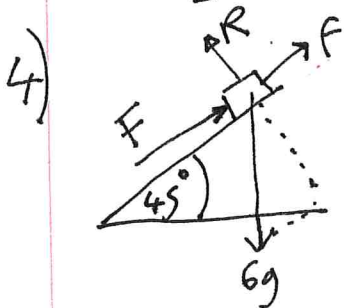
b) $\downarrow R + 29 = 5g \Rightarrow R = 20\text{N}$ ✓ $F = ma$ $10 - f = 5 \times 1 \Rightarrow F = 5\text{N}$ ✓
 $N = f/R = 5/20 = 1/4$ ✓

c) $\downarrow R + 40 \sin 60^\circ = 5g$ ✓ $f = ma$ $40 \cos 60^\circ - f = 5 \times 3$ ✓
 $R = 14.4\text{N}$ ✓ $f = 5\text{N}$ ✓
 $N = f/R = 5/14.4 = 0.35$ ✓

3) a) DOWN PLANE $10g \sin 10^\circ = 17.0\text{N}$ ✓ $F_{\text{MAX}} = \frac{1}{4}R = \frac{1}{4} \times 10g \cos 10^\circ = (24.1\text{N}) F_{\text{MAX}}$ ✓
 as $24.1 > 17$ AT REST ✓
 $F = 17\text{N}$ ✓

b) DOWN PLANE $10g \sin 4^\circ = 23.7\text{N}$ ✓ $f = \frac{1}{4}R = \frac{1}{4} \times 10g \cos 4^\circ = (23.8\text{N}) F_{\text{MAX}}$ ✓
 as $23.8 > 23.7$ AT REST ✓
 $F = 23.7\text{N}$ ✓

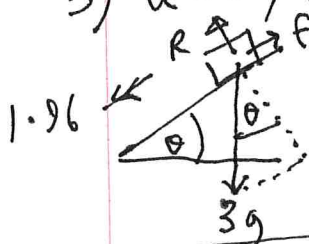
c) DOWN PLANE $10g \sin 20^\circ = 33.5\text{N}$ ✓ $f = \frac{1}{4}R = \frac{1}{4} \times 10g \cos 20^\circ = 23\text{N}$ ✓
 as $33.5 > 23$ ACCELERATES ✓



$N = \frac{1}{2}$ \perp to plane: $R = 6g \cos 45^\circ = 41.6\text{N}$ ✓
 $f = \mu R$: $f = \frac{1}{2} \times 41.6\text{N} = 20.8\text{N}$ ✓
 \parallel plane: $F + f = 6g \sin 45^\circ$

$\Rightarrow F + 20.8 = 41.6$ ✓
 $\Rightarrow F = 20.8\text{N}$ ✓

5) $u = 0, v = 4.9, t = 2.5, a?$ $v = u + at \Rightarrow 4.9 = 0 + a \times 2.5 \Rightarrow a = 1.96\text{m/s}^2$ ✓



\parallel slope $F = ma$ ✓
 $3g \sin \theta - f = 3 \times 1.96 \Rightarrow 3g \times \frac{3}{5} - 3 \times 1.96 = f$
 $\Rightarrow f = 11.76\text{N}$ ✓

$\sin \theta = \frac{3}{5}$ ✓
 $\cos \theta = \frac{4}{5}$ ✓

\perp slope $R = 3g \cos \theta = 3g \times \frac{4}{5} = 23.52\text{N}$ ✓
 $N = f/R = \frac{11.76}{23.52} = \frac{1}{2}$ ✓