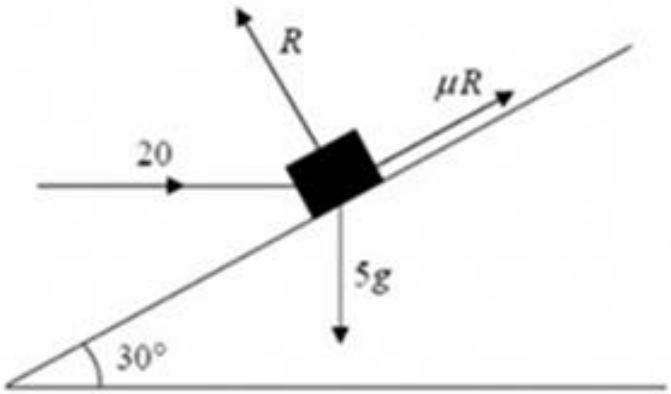
Pure 2 Applied Chapter 7: Statics on a Slope – Exam Questions (Answers)

Q1.

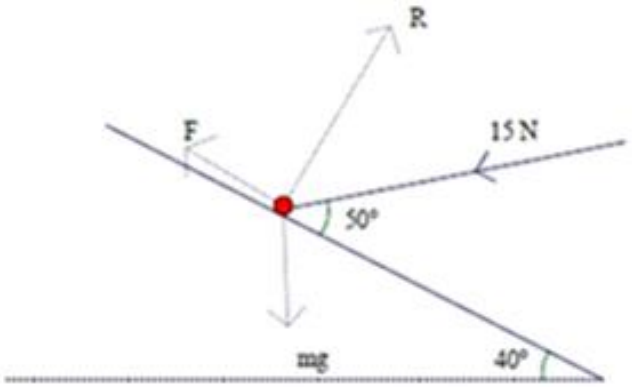


(a)	⊥ plane	$R = 20\cos 60° + 5g\cos 30°$		M1 A2(1.0)
		$= 52.4\ (\text{N})$	or 52	A1 **(4)**
(b)		$F_r = \mu R$		B1
	P plane	$F + 20\cos 30° = 5g\cos 60°$		M1 A2(1, 0)
		Leading to $\mu = 0.137$	or 0.14	A1 **(5)**

Q2.

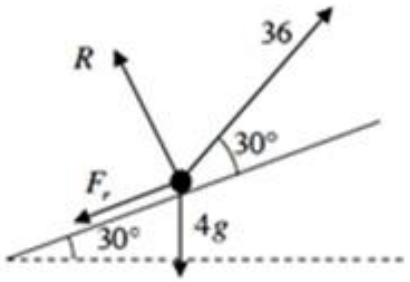
↗	$4\cos\alpha + F = W\sin\alpha$	M1 A1
↖	$R = 4\sin\alpha + W\cos\alpha$	M1 A1
	$F = 0.5R$	B1
	$\cos\alpha = 0.8$ or $\sin\alpha = 0.6$	B1
	$R = 20N$ ** GIVEN ANSWER	M1 A1
	$W = 22N$	A1
		(9)
→	$R\sin\alpha = 4 + F\cos\alpha$	M1 A1
↑	$R\cos\alpha + F\sin\alpha = W$	M1 A1
	$F = 0.5R$	B1
	$\cos\alpha = 0.8$ or $\sin\alpha = 0.6$	B1
	$R = 20N$ ** GIVEN ANSWER	M1 A1
	$W = 22N$	A1
		(9)

Q3.

a	 Perpendicular to the slope: $R = 2.7g\cos 40 + 15\cos 40$ $= 31.8$ (N) or 32 (N)	M1A2 A1 (4)
b	Parallel to the slope: $F = 2.7g\sin 40 - 15\cos 50 \quad (F = 7.366..)$ Use of $F = \mu R$ $\mu = \dfrac{2.7g\sin 40 - 15\cos 50}{R} = 0.23$ or 0.232	M1A2 M1 A1 (5)
c	Component of wt parallel to slope $= 2.7g\sin 40° \ (= 17.0)$ $F_{max} = 0.232 \times 2.7 \times g \times \cos 40° = 4.7...$ (N) $17.0 > 4.70$ so the particle moves	B1 M1A1 A1

Q4.

(a)



$R + 36\sin 30° = 4g\cos 30°$ M1 A1

$R \approx 15.9, 16$ M1 A1

(4)

(b)

Use of $F_r = \mu R$ B1

$36\cos 30° = F + 4g\sin 30°$ M1 A1

$\mu = \dfrac{36\cos 30° - 4g\sin 30°}{R} \approx 0.726$ M1 A1

0.73

(5)

(c)

After force is removed

$R = 4g\cos 30°$ B1

$-\mu 4g\cos 30° - 4g\sin 30° = 4a$ M1 A1

$a = (-)11.06\ldots$

$v^2 = u^2 + 2as \Rightarrow 0^2 = 16^2 - 2\times 11.06\ldots \times s$ M1

$s = \dfrac{16^2}{2\times 11.06\ldots} \approx 11.6$ (m) A1

12

(5)

Q5.

$F = \mu R$ B1

(↖). $R = 10\sin\alpha + 5g\cos\alpha$ (45.2) M1 A2

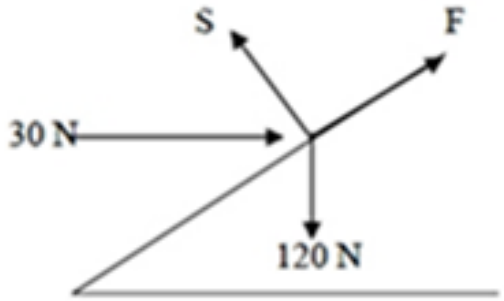
(↗). $F = 5g\sin\alpha - 10\cos\alpha$ (21.4) M1 A2

$\mu = \dfrac{g\sin\alpha - 2\cos\alpha}{2\sin\alpha + g\cos\alpha} = 0.47$ or 0.473 M1 A1

9

Q6.

(a)



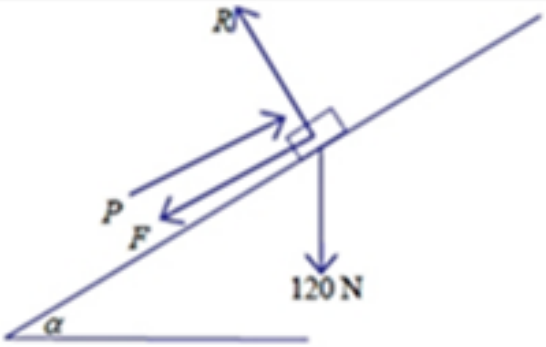
Resolving perpendicular to the plane:

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

So $F = 42$N acting up the plane. — A1

(3)