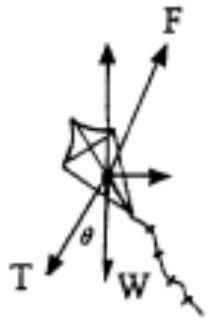
Mark Scheme Resolving Past Paper Questions

Jan 2002 to Jan 2009

3(a)



components at right angles ✓ **Q3 Jan 2002**
vertical component in line with weight ✓
(both components to start from the •)

(*2*)

(b)(i) (horizontal component) = 25 sin θ = 12 (or 13) N (12.5) ✓
(± 0.5 N if scale drawing)

(ii) (vertical component) = 25 cos θ = 22 N (21.7) ✓
(± 0.5 N if scale drawing) (*2*)

(c)(i) vertical component of F = 21.7 + 2.5 = 24 N (24.2)
[or 25 (24.5)] ✓ (allow C.E. from (b))

(ii) horizontal component of F = 12 (or 13) N ✓ (12.5) (allow C.E. from (b))

(iii) $F = \sqrt{(12.5^2 + 24.2^2)}$ ✓ (allow C.E. from parts (I) and (ii))
= 27 N (27.2) [or 28 (28.2)] ✓ (26 N to 29 N if scale drawing)
[if θ measured on diagram and F cosθ used, ✓ ✓ (same tolerance)] (*4*)
(*8*)

4 **Q4 Jun 2003**

(a)(i) horizontal component of the tension in the cable ✓

(a)(ii) vertical component of the tension in the cable ✓ (*2*)

(b)(i) $T_{vert} = 250 \times 9.81 = 2500$ N ✓ (2452 N)

(b)(ii) $T_{horiz} = 1200$ N ✓

(b)(iii) $T^2 = (1200)^2 + (2500)^2$ ✓
$T = (1.44 \times 10^6 + 6.25 \times 10^6)^{1/2} = 2800$ N ✓ (2773 N)
(if use of T_{vert} = 2450 N then T = 2730 N)
(allow C.E. for values from (b)(i) and (b)(ii))

(b)(iv) $\tan\theta = \dfrac{1200}{2500}$ ✓
$\theta = 26^\circ$ ✓
(allow C.E. for values from (b)(i) and (b)(ii)) (*6*)
(*8*)

Question 2

Q2 Jan 2005

(a) vector quantities have direction (as well as magnitude)
and scalar quantities do not ✓ (*1*)

(b) vector: e.g. velocity, acceleration, momentum ✓
scalar: e.g. mass, temperature, energy ✓ (*2*)

(c)(i) addition of forces (12 + 8) ✓
(use of $F = ma$ gives) $a = \frac{(12+8)}{6.5} = 3.1\ \text{m s}^{-2}$ ✓ $(3.08\ \text{m s}^{-2})$

(ii) subtraction of forces (12 − 8) ✓
$a = \frac{(12-8)}{6.5} = 0.62\ \text{m s}^{-2}$ ✓ $(0.615\ \text{m s}^{-2})$ (*4*)

(*7*)

Question 2			
(a)	(i)	horizontal component = 850 × cos 42 ✓ = 630 N ✓ (632 N)	**5**
	(ii)	vertical component = 850 × sin 42 = 570 N ✓ (569 N) (if mixed up sin and cos then CE in (ii))	
	(iii)	weight of girder = 2 × 570 = 1100 N ✓ (1142 N) (use of 569 N gives weight = 1138 N) (allow C.E. for value of vertical component in (ii))	
	(iv)	arrow drawn vertically downwards at centre of girder ✓	

Q2 Jun 2005

Question 6		
(a)	component (parallel to ramp) = $7.2 \times 10^3 \times \sin 30$ ✓ (= 3.6×10^3 N)	**1**
(b)	mass = $\frac{7.2\times10^3}{9.81} = 734\,(\text{kg})$ ✓ $a = \frac{3600}{734} = 4.9(1)\ \text{m s}^{-2}$ ✓	**2**
(c)	(use of $v^2 = u^2 + 2as$ gives) $0 = 18^2 - (2 \times 4.9 \times s)$ ✓ $s = 33(.1)$ m ✓ (allow C.E. for value of a from (b))	**2**
(d)	frictional forces are acting ✓ increasing resultant force [or opposing motion] ✓ hence higher deceleration [or car stops quicker] ✓ energy is lost as thermal energy/heat ✓	**Max 2**

Q6 Jun 2005

Question 6			
(a)	(i)	(horizontal) force = zero ✓ **Q6 Jan 2006**	3
	(ii)	(vertical) force = $2 \times 15 \sin 20$ ✓ $= 10(.3)$ N ✓	
(b)	(i)	weight (of block) = $10(.3)$ N ✓ (allow C.E. for value from (a) (ii))	3
	(ii)	resultant force must be zero ✓ with reference to an appropriate law of motion ✓	
		Total	**6**

Question 3		Q3 Jan 2007		
(a)	(i)	(use of $F_H = F \cos \theta$ gives) resultant force = $2 \times 6500 \cos 35$ resultant force = 11 000 N (10 649) (1 out of 2 if only one component given)	✓✓	4
	(ii)	(use of work = force × distance gives) work = $11\,000 \times 1.5 \times 60$ work = 990 000 J (958 408) (if use 10 649 then 960 000 J)	✓✓	
(b)		there is an opposing force **or** mention of friction/drag work is done on this force **or** overall resultant force is zero	✓✓	2
(c)		initially accelerates as horizontal component increases (so) forward force now larger than drag **or** resultant force no longer zero **or** now a resultant forward force eventually reaches new higher constant speed	✓✓✓	max 3
		Total		9

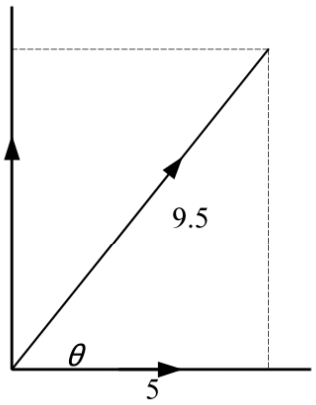
1

Q1 Jan 2004

(a)(i) a quantity that has magnitude only
[or has no direction] ✓

(ii) any two: e.g. energy ✓
temperature ✓ *(3)*

(b)(i)

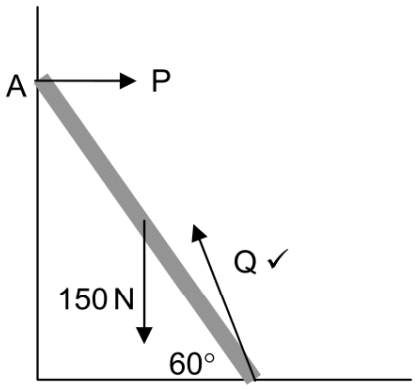


scale ✓
5 N and 9.5 N ✓
correct answer (8.1 N ± 0.2 N) ✓

[or $9.5^2 = 5.0^2 + F^2$ ✓
$F^2 = 90.3 - 25$ ✓
$F = 8.1$ N ✓ (8.07 N)]

(ii) $\cos\theta = \frac{5.0}{9.5}$

gives $\theta = 58°$ ✓ (± 2° if taken from scale diagram) *(4)*
(7)

Question 2			
(a)	(i)	to balance (**or** oppose) the weight ✓ **or** stop ladder moving downwards	**2**
	(ii)	to balance P ✓ **or** stop slipping or stop ladder moving right	
(b)		**Q2 Jun 2007**  correct arrow ✓	**1**
(c)	(i)	43 N ✓	**2**
	(ii)	150 N ✓	
(d)		increases (in magnitude) ✓ as greater downward force (**or** vertical component increase) ✓ direction moves closer to vertical ✓	**3**
		Total	**8**

Q5 Jan 2008

Question 5			
(a)	(i)	(use of $F = ma$) a = 1.9 × 10^5/5.6 × 10^4 = 3.4 m s^{-2} ✓	3
	(ii)	(use of $v^2 = u^2 + 2as$) $82^2 = 2 \times 3.4 \times s$ ✓ s = 989 m ✓ c.e. from (i)	
(b)		air resistance increases with speed ✓ hence runway will be longer ✓	2
(c)	(i)	(use of $F_h = F\cos\theta$) F_h = 1.9 × 105 × cos 22 F_h = 1.8 × 105 N ✓	2
	(ii)	Fv = 1.9 × 10^5 × sin 22 = 7.1 × 10^4 N ✓	
		Total	**7**

Q2 Jun 2008

Question 2		
(a)	**resultant** force must be zero ✓ because sledge is moving at constant velocity ✓ (or zero acceleration)	2
(b)	parallel component = 4.5 × 9.81 × sin 22 = 16.5 N ✓ perpendicular component = 4.5 × 9.81 × cos 22 = 41 N ✓ (if components swapped -1) (if no g then 1 max but must have unit as kg)	2
(c)	same as (b) (i) e.g. 16.5 N ✓ same as (b) (ii) e.g. 41 N ✓ (ignore units)	2
		6

Q2 Jan 2009

Question 2			
(a)	(i)	vector has direction **and** a scalar does not ✓	4
	(ii)	scalar examples; any two e.g. speed, mass, energy, time, power vector examples; any two e.g. displacement, velocity, acceleration, force or weight ✓✓✓ for 4 correct, ✓✓ for 3 correct, ✓ for 2 correct	
(b)	(i)	horizontal component (= 2.8 cos 35) = 2.3 (kN) (2293.6) ✓ vertical component (= 2.8 sin 35) = 1.6 (kN) (1606.0) ✓	5
	(ii)	power = force × velocity **or** 2.3 kN × 8.3 m s^{-1} ✓ (ecf from 2 (b) (i)) = 1.9 × 10^4 (19037 or 19100) ✓ ecf **W** (or J s^{-1}) ✓ (or 19 W (or kJ s^{-1}))	
(c)		(area of cross-section of cable =) $\pi \times (\frac{1}{2}\ 0.014)^2$ ✓ = 1.5(4) × 10^{-4} (m^2) ✓ stress (= F/A) = $\frac{2800\ \text{N}}{1.54\times10^{-4}\ \text{m}^2}$ (allow ecf here if attempt to calculate area) ✓ = 1.8(2) × 10^7 ✓ ecf **Pa** (or N m^{-2}) ✓	5
		Total	**14**