1. Physical Quantities and Units

1.4 Scalars and vectors

Paper 2

Marking Scheme

Q1.

(b)(ii)	$u = 22 \times \sin 40°$ $= 14 \text{ m s}^{-1}$	**A1**

Q2.

(a)	a quantity with magnitude and direction	**B1**

Q3.

(a)(i)	(component =) 4.8 sin 30° = 2.4 (N)	**A1**

Q4.

(a)	scalar and vector have magnitude	**B1**
	vector has direction (and scalar does not have direction)	**B1**

Q5.

(a)(iii)	$v^2 = 3.6^2 + 4.9^2$	**C1**
	$v = 6.1 \text{ m s}^{-1}$	**A1**
	$\theta = \tan^{-1} (3.6 / 4.9)$ $= 36°$	**A1**

Q6.

(c)(i)	(component of weight =) $mg \sin\theta$	**A1**

Q7.

(b)(i)	vertical component $= 45 \sin 37°$ $= 27 \text{ N}$	**A1**

Q8.

(a)	solid straight line drawn between centre of sphere at X and at Y	**B1**

Q9.

(a)	acceleration: vector electrical resistance: scalar momentum: vector *1 mark for two correct, 2 marks for all three correct*	**B2**

Q10.

(c)(ii)	$\theta = \sin^{-1} (2.9 / 25)$ $= 6.7°$	**A1**

Q11.

(b)(iii)	(velocity =) $15 \cos 60° = 7.5 \text{ (m s}^{-1}\text{)}$ **or** (velocity =) $15 \sin 30° = 7.5 \text{ (m s}^{-1}\text{)}$	**A1**

Q12.

(c)(i)	(component =) 5.2 sin 56° = 4.3 (N) **or** 5.2 cos 34° = 4.3 (N)	**A1**

Q13.

(a)	density and temperature indicated as scalars	**B1**
	acceleration and momentum indicated as vectors	**B1**
(c)	displacement is zero (so) average velocity is zero	**B1**

Q14.

(a)	(component =) 96 sin 38° = 59 (N) **or** 96 cos 52° = 59 (N)	**A1**

Q15.

(b)(i)	vertical component = 54 sin 35° = 31 N	**A1**

Q16.

(b)	$F = Eq$	**C1**
	$= 1.3 \times 10^4 \times 3.7 \times 10^{-9}$ $= 4.8 \times 10^{-5}$ N	**A1**
(c)	$F^2 = (4.8 \times 10^{-5})^2 + (5.4 \times 10^{-5})^2$ so $F = 7.2 \times 10^{-5}$ N **or** $F = [(4.8 \times 10^{-5})^2 + (5.4 \times 10^{-5})^2]^{0.5}$ so $F = 7.2 \times 10^{-5}$ N	**A1**
(d)	electric force is constant (because field strength/E is constant)	**B1**
	weight is constant (and so resultant force constant)	**B1**

Q17.

(a)	scalar quantity has (only) magnitude	**B1**
	vector quantity has magnitude and direction	**B1**

Q18.

(a)	a scalar has magnitude (only)	**B1**
	a vector has magnitude and direction	**B1**
(b)	power: scalar temperature: scalar momentum: vector *(two correct 1 mark, all three correct 2 marks)*	**B2**
(c)(i)	arrow labelled R in a direction from 5° to 20° north of west	**B1**
(c)(ii)	$v^2 = 28^2 + 95^2 - (2 \times 28 \times 95 \times \cos 115°)$ **or** $v^2 = [(95 + 28\cos 65°)^2 + (28\sin 65°)^2]$	**C1**
	$v = 110\ \text{ms}^{-1}$ ($109.8\ \text{ms}^{-1}$)	**A1**
	or (scale diagram method)	
	triangle of velocities drawn	**(C1)**
	$v = 110\,\text{ms}^{-1}$ (allow 108–112 ms^{-1})	**(A1)**

Q19.

(b)(i)	vertical component of velocity = $(5.5^2 - 4.6^2)^{1/2} = 3.0\ (\text{ms}^{-1})$ **or** $5.5\cos\theta = 4.6$ (so $\theta = 33.2°$) **and** $5.5\sin 33.2° = 3.0\ (\text{ms}^{-1})$	**A1**

Q20.

(a)	$v_x = (6.0^2 - 4.8^2)^{1/2} = 3.6\ (\text{ms}^{-1})$ **or** $6.0\sin\theta = 4.8$ (so $\theta = 53.1°$) **and** $v_x = 6.0\cos 53.1° = 3.6\ (\text{ms}^{-1})$	**A1**