Questions on Motion – Mark Scheme

1. Correct lines from:

- joule (J) to N m
- watt (W) to J s^{-1}
- newton (N) to kg m s^{-2}

B2

Note: *2 marks for all correct*
1 mark for two correct
0 marks for none or one correct

[2]

2. (a) (i) $v^2 = u^2 + 2as$ C1

$0 = (80)^2 + 2 \times a \times 120$ C1

$a = (-)\ 26.7\ (m\ s^{-2})$ ignore sign A1

(ii) $t = (0 - 80) / -26.7$ C1

$t = 3.0\ (s)$ A1

(b) (time lost by) car A = (3 + 9 + 4) = 16 B1

car B was 17 behind C1

Car B takes 2 s to travel the 160 m / Car B 19 behind B1

Hence car A 3 s ahead (19 – 16) A1

[9]

3. (i) scalar named B1

has (only) magnitude / size / value (**not** quantity) B1

(ii) vector named B1

has magnitude and direction B1

allow one out of two for a vector has direction and a scalar does not

[4]

4. (a) (i) $v^2 = 0 + 2 \times 9.8(1) \times 30$ C1

$v = 24.\ (3)$ (m s^{-1}) A1
(–1 if g = 10 is used, once only on the paper)
(zero scored if s = 36 m is used)

(ii) $s = ut + ½\ at^2$ or $v = u + at$ or $s = (u + v)t / 2$

$30 = 0 + ½ \times 9.8(1) \times t^2$ $t = 24.3 / 9.8$ $t = 2 \times 30/24.3$ C1

$t = 2.5$ (s) A1

(b) In the air: weight / force due to gravity
(allow air resistance if included as well) B1

(Hence) constant acceleration / acceleration at 9.8 m s^{-2}
(allow reduced acceleration / terminal velocity if air resistance included) B1

In water: weight and (large) fluid resistance / upthrust / buoyancy B1

Hence deceleration / slows down B1

[8]

5. (i) velocity B1
travels in two opposite directions or equivalent words / increasing and decreasing displacement B1

(ii) **Z** any peak or trough / A / B / 0 / 3.0 / 6.0s B1
M any point where gradient is a maximum (1.0 – 1.6 or 4.4 – 5.0 s) B1
If M and Z are given on the diagram then max 1

(iii) tangent to curve drawn B1
values given correct from graph C1
answers correct for maximum in range of 1.3 to 1.5 A1

[7]

6. (i) *N* is normal to the ramp (judged by eye)

Allow marks even if the labels N and F are omitted

B1

F is parallel and up the ramp

B1

(ii) $F = W \sin\theta$

B1

[3]

7.

scalar	vector
density	acceleration
energy	displacement
power	weight
speed	
time	

All correct scores 4 4

6, 7 correct scores 3

4, 5 correct scores 2

2, 3 correct scores 1

[4]

8.(a) (i) 1. mass = 360 / 9.8 36.7 (kg) (allow 2sf) B1

(ii) 2. density = mass / volume C1

$= 36.7 / 4.7 \times 10^{-3}$

$= 7.8 \times 10^{-3}$ A1

unit kg m^{-3} B1

(ii) right angled triangle with an additional correct angle marked M1

set of correct force labels and correct arrows A1

algebra shown or scale given C1

tension = 270 (N) or value in the range 255 to 285 (N) A1

(b) (i) tension is a vector / has magnitude and direction B1

direction involved in addition / the tensions or ropes act in different directions B1

(ii) sum =270 sin37 + 360 sin53 B1

=162.5 + 287.5 B1

(or one mark each for values of 162.5 and 287.5 seen) = 450 (N) A0

[12]

9. (a) (i) **1** Horizontal component = 24cos30 C1
= 21 (20.8) (N) A1

2. vertical component = 24sin30
= 12 (12.0) (N) A1

(ii) vertical force = 65 + 12 M1

= 77 A0

(iii) horizontal force = 20.8 (note ecf for 20.8 component)
resultant = $[(77)^2 + (20.8)^2]^{1/2}$ C1
= 80 (79. 8) (N) A1
(or by vector triangle need correct labels and arrows for C1 mark)

(iv) 80 (79.8)(N) / equal to (iii) allow ecf B1
the resultant force needs to be zero or forces need
to balance above value to give no acceleration or constant velocity B1

(b) (i) P = F / A C1

= 77 / 4.2×10^{-3}

= 18000 (18333) (Pa) A1

(ii) more / increases
downward / vertical component (of P) will be greater B1
(for larger angles)

[11]