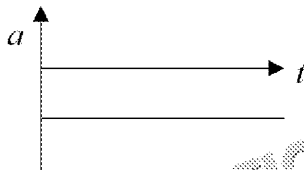


Solutions to Materials and mechanics – Test B

1. quantity with magnitude [1]
only/no direction [1]

2. (a) change in velocity [1]
(b)



- (i) *a* on vertical / *t* on horizontal; ignore presence of units if correct [1]
or: just time [1]

- (ii) *a* negative value [1]
(c) graph starting negative, possibly constant for a time [1]
becoming zero [1]
Ignore shape by which line reaches zero

3. (a) (i) (resultant²) = $2.6^2 + 3.9^2$ [1]
(resultant²) = 21.97 [1]
resultant = 4.6(9) N [1]

(ii) $\tan^{-1}\left(\frac{2.6}{3.9}\right)$ [1]

Accept use of sin or cos with answer from (i)
= 33.7° [1]

- (b) speed / distance moved / kinetic energy [1]

4. (a) kNm / kilonewton metres [1]

- (b) (i) $12\,000 \times 15$ [1]
= 180 000 (Nm) or 1.8×10^5 (Nm) [1]
 4500×7.5 [1]
= 33 750 (Nm) or 3.375×10^4 (Nm) [1]
 $33\,750 + 180\,000 = 213\,750$ Nm
or 2.14×10^5 Nm [1]
(ii) Anticlockwise moment = 213 750 (Nm) =

$\frac{213\,750}{8.2}$ [1]
 $2.6(1) \times 10^4$ N [1]

Accept value to 2 or 3 s.f. not in standard form

5. (a) use of $v^2 = u^2 + 2as$ stated or substitution [1]
 $v = 0$ [1]

$s = \frac{12^2}{19.62}$ [1]

Can be used to award MP1 and MP2

7.3(4) m [1]

- (b) use of any equation of motion containing t [1]
correct substitution [1]
Allow ecf from (a)
time to reach max height $t = 1.22$ s [1]
total time = $2t = 2.4(5)$ s [1]

6. (a) speed = distance / time or $v = \frac{\Delta s}{\Delta t}$ [1]

distance = length of card [1]
time = time from light gate [1]

- (b) v^2 on vertical axis [1]
 s / drop height on horizontal axis [1]

For 2 marks
 $v^2 = u^2 + 2as$ where $u = 0$ or gradient =
 $2g$ or $g = \frac{\text{gradient}}{2}$ [1]

7. (a) dependent variable – acceleration / time for card to pass through light gate [1]

control variables – same distance
(b) acceleration
graph of v^2 with gradient (because)
(c) trolley not time / total each time the load

8. density = $\frac{\text{mass}}{\text{volume}}$

$\frac{2.71 \times 15.2}{1000}$ [1]
= 41.2 g [1]
Answer must be in g

9. (a) momentum = 26 240 kg m s⁻¹
momentum = 20 060 kg m s⁻¹
total momentum (Ns / kg m s⁻¹) after collision

speed =

= 5.1 / 5.0

- (b) total kinetic energy + (0.5 × 5 × 5)
total kinetic energy = 117 882 J
so collision is inelastic

10. (a) $W = Fs$ cos 0°
= 700 kJ

Accept any value for cos 0°

- (b) forwards drag force are equal

11. $\frac{1}{2}mv^2 = mg\Delta h$
 $v^2 = 2g\Delta h$ [1]
 $v = \sqrt{2g\Delta h}$ [1]

12. (a) $F = k\Delta L$

$\frac{2757}{2.7}$
Nm⁻¹ [1]

- (b) $\frac{1}{2}F\Delta L$ or

1.5(0) J [1]

- (c) 0.0035 (kg)

standard deviation
 $1.50 = \frac{1}{2}$

rearrange for kinetic energy
 $v = 29(3)$

13. (a) (i) micrometres

- (ii) 0.6

- (b) (i) m²

- (ii) none

- (iii) Pa

- (c) do not stop cushion

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