3.1 Mechanics: Quantities, Units and Kinematics: 30-minute Pack

Total Marks

EDEXCEL 9MA0 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Convert a time of 4 minutes 30 seconds into seconds.

(Total for Question 1 is 1 mark)

2 State the SI unit of speed.

(Total for Question 2 is 1 mark)

3 A parcel moves at a constant speed of 0.8 m/s along a conveyor belt for 25 seconds. Find the distance it travels.

(Total for Question 3 is 1 mark)

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4 A car accelerates uniformly from rest to a speed of 24 m/s in 15 seconds. It then travels at this constant speed for a further 20 seconds before decelerating uniformly to rest in 8 seconds. The car is modelled as a particle moving in a straight line.

(a) Find the acceleration of the car during the first 15 seconds. **(2)**

(b) Find the distance travelled by the car during the first 15 seconds. **(2)**

(c) Find the deceleration of the car during the final 8 seconds. **(2)**

(d) Calculate the total distance travelled by the car during the whole 43 second journey. **(3)**

(e) Hence find the average speed of the car for the whole journey, giving your answer to 3 significant figures. **(2)**

(Total for Question 4 is 11 marks)

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5 A ball is thrown vertically upwards from a point 1.5 m above horizontal ground with speed 14 m/s. The ball is modelled as a particle moving freely under gravity, with $g = 9.8$ m/s^2.

(a) Find the maximum height above the ground reached by the ball. **(3)**

(b) Find the time taken for the ball to return to the point from which it was thrown. **(2)**

(c) Find the total time from the instant of release until the ball hits the ground, giving your answer to 3 significant figures. **(4)**

(d) State, with a reason, the likely effect on the ball's actual maximum height, compared with the value found in part (a), if air resistance is not in fact negligible. **(1)**

(Total for Question 5 is 10 marks)

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Mark scheme · 3.1 Mechanics: Quantities, Units and Kinematics: 30-minute Pack

Question 1

270 cao **B1**

Answer: 270 s

Question 2

m/s (or m s^{-1}) oe **B1**

Answer: m/s

Question 3

20 cao **B1**

Answer: 20 m

Question 4

(a) use a = (v - u)/t with v=24, u=0, t=15 **M1**

(a) 1.6 m/s^2 cao **A1**

(a) Answer: 1.6 m/s^2

(b) s = 1/2(u+v)t with u=0, v=24, t=15, or ft from (a) **M1**

(b) 180 m cao **A1**

(b) Answer: 180 m

(c) a = (0-24)/8 **M1**

(c) 3 m/s^2 (deceleration) cao **A1**

(c) Answer: 3 m/s^2

(d) distance at constant speed = 24 x 20 = 480 m **M1**

(d) distance decelerating = 1/2(24+0)(8) = 96 m **M1**

(d) 756 m cao (180+480+96) **A1**

(d) Answer: 756 m

(e) average speed = total distance / total time = 756/43 ft from (d) **M1**

(e) awrt 17.6 m/s **A1**

(e) Answer: 17.6 m/s (3 s.f.)

Question 5

(a) use $v^2 = u^2 - 2gs$ with v=0, u=14, g=9.8 to find the height above the point of release **M1**

(a) $s = 14^2/(2 \times 9.8)$ correctly evaluated **M1**

(a) 11.5 m cao (height above release point of 10 m, plus the initial 1.5 m) **A1**

(a) Answer: 11.5 m

(b) t = 2u/g **M1**

(b) awrt 2.86 s **A1**

(b) Answer: 2.86 s (3 s.f.)

(c) form $4.9t^2 - 14t - 1.5 = 0$ (or equivalent using $s = ut - 1/2\ g\ t^2$ with displacement -1.5 from the release point) **M1**

(c) rearrange correctly into a solvable quadratic **M1**

(c) apply the quadratic formula **M1**

(c) awrt 2.96 s, rejecting the negative root **A1**

(c) Answer: 2.96 s (3 s.f.)

(d) the actual maximum height would be less than 11.5 m, because air resistance would act against the ball's motion as it rises, decelerating it further (oe) **B1**

(d) Answer: The actual maximum height would be less than 11.5 m, because air resistance decelerates the ball further as it rises (oe).

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