## Kinematics – 2022 June AS

1. March/2022/Paper\_9709/42/No.2

A particle $P$ is projected vertically upwards from horizontal ground with speed $u$ m s <sup>-1</sup> . $P$ reaches a maximum height of 20 m above the ground.		
(a)	Find the value of $u$ . [2]	
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<b>(b)</b>	Find the total time for which $P$ is at least 15 m above the ground. [3]	
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A cyclist starts from rest at a fixed point $O$ and moves in a straight line, before coming to rest $k$ seconds later. The acceleration of the cyclist at time $t$ s after leaving $O$ is $a$ m s <sup>-2</sup> , where $a = 2t^{-\frac{1}{2}} - \frac{3}{5}t^{\frac{1}{2}}$ for $0 < t \le k$ .		
(a)	Find the value of $k$ . [4]	
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<b>(b)</b>	Find the maximum speed of the cyclist. [3]	

**2.** March/2022/Paper\_9709/42/No.6

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reac	ar starts from rest and moves in a straight line with constant acceleration for a distance thing a speed of $25 \mathrm{ms^{-1}}$ . The car then travels at this speed for $400 \mathrm{m}$ , before decelerating est over a period of $5 \mathrm{s}$ .	e of 200 m, guniformly
(a)	Find the time for which the car is accelerating.	[2]
(b)	Sketch the velocity–time graph for the motion of the car, showing the key points.	[2]
(c)	Find the average speed of the car during its motion.	[2]

**3.** June/2022/Paper\_9709/41/No.1

4.	June/2022/	/Paper_	_9709/41/No.6	
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A particle starts from a point O and moves in a straight line. The velocity  $v \, \text{m s}^{-1}$  of the particle at time  $t \, \text{s}$  after leaving O is given by

$$v = k(3t^2 - 2t^3),$$

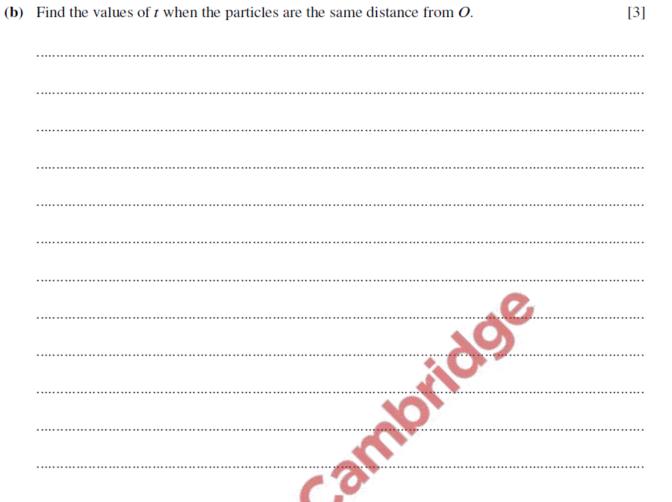
where k is a constant.

Verify that the particle returns to $O$ when $t = 2$ .	
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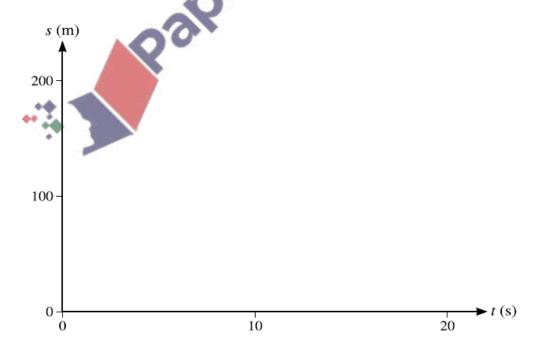
<b>(b)</b>	It is given that the acceleration of the particle is $-13.5\mathrm{ms^{-2}}$ for the positive value of $t$ at which $v=0$ .
	Find $k$ and hence find the total distance travelled in the first two seconds of motion. [6]
	<b>10.0</b>

A particle $A$ , moving along a straight horizontal track with constant speed $8 \mathrm{ms^{-1}}$ , passes a fixed point $O$ . Four seconds later, another particle $B$ passes $O$ , moving along a parallel track in the same direction as $A$ . Particle $B$ has speed $20 \mathrm{ms^{-1}}$ when it passes $O$ and has a constant deceleration of $2 \mathrm{ms^{-2}}$ . $B$ comes to rest when it returns to $O$ .		
<ul><li>(a) Find expressions, in terms of t, for the displacement from O of each particle t seconds after B passes O.</li><li>[3]</li></ul>		
60		

**5.** June/2022/Paper\_9709/42/No.4



(c) On the given axes, sketch the displacement-time graphs for both particles, for values of t from 0 to 20.



6.	June/2022/Paper	9709/42/No.7
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A particle P moves in a straight line. The velocity  $v \, \text{m s}^{-1}$  at time t seconds is given by

$$v = 0.5t$$
 for  $0 \le t \le 10$ ,  
 $v = 0.25t^2 - 8t + 60$  for  $10 \le t \le 20$ .

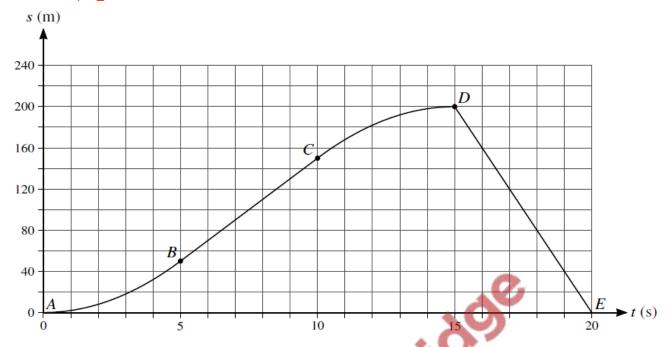
Sh	ow that there is an instantaneous change in the acceleration of the particle at $t = 10$ .	[3]
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Find the total distance covered by $P$ in the interval $0 \le t \le 20$ .	[6]
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A particle $P$ is projected vertically upwards from horizontal ground. $P$ reaches a maximum height of 45 m. After reaching the ground, $P$ comes to rest without rebounding.		
(a)	Find the speed at which $P$ was projected. [2]	
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<b>(b)</b>	Find the total time for which the speed of $P$ is at least $10 \mathrm{m  s^{-1}}$ . [3]	
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**7.** June/2022/Paper\_9709/43/No.2

## **8.** June/2022/Paper\_9709/43/No.3



The displacement of a particle moving in a straight line is s metres at time t seconds after leaving a fixed point O. The particle starts from rest and passes through points P, Q and R, at times t = 5, t = 10 and t = 15 respectively, and returns to O at time t = 20. The distances OP, OQ and OR are SO in SO in and SO in respectively.

The diagram shows a displacement-time graph which models the motion of the particle from t = 0 to t = 20. The graph consists of two curved segments AB and CD and two straight line segments BC and DE.

Find the speed of the particle between $t = 5$ and $t = 10$ .	[1]

Find the acceleration of the particle between $t = 0$ and $t = 5$ , given that it is con	
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Find the average speed of the particle during its motion.	
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9.	June/2022/Paper_	9709/43/No.7
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A particle P moves in a straight line through a point O. The velocity  $v \, \text{m s}^{-1}$  of P, at time  $t \, \text{s}$  after passing O, is given by

$$v = \frac{9}{4} + \frac{b}{(t+1)^2} - ct^2,$$

where *b* and *c* are positive constants. At t = 5, the velocity of *P* is zero and its acceleration is  $-\frac{13}{12}$  m s<sup>-2</sup>.

(a)	Show that $b = 9$ and find the value of $c$ .	[5]

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