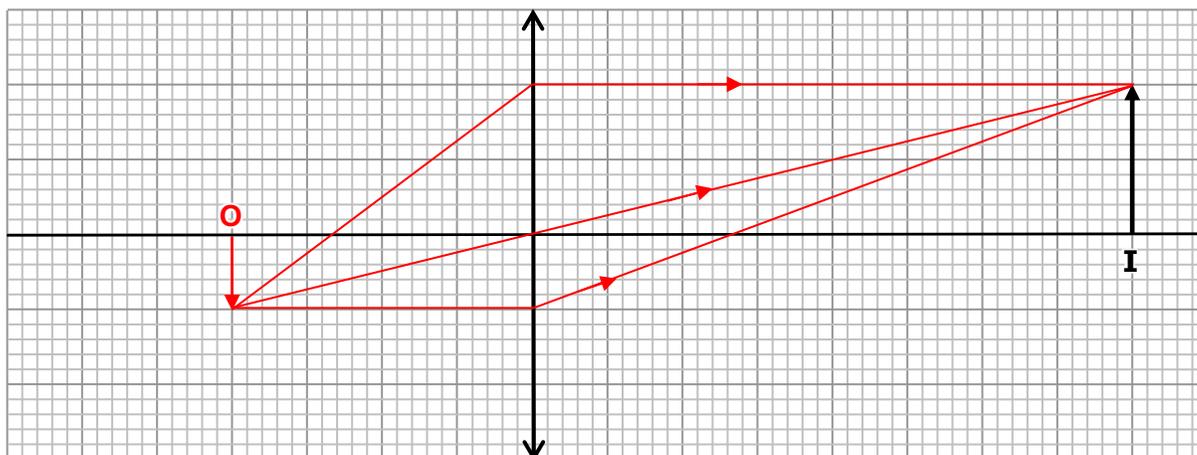


Answer Scheme

Q1 D Q2 B Q3 B Q4 A Q5 A Q6 A Q7 A

8 (a) and (b)



- Accurate position and orientation of **O** ( $\pm 1$  small square) [1]
- Any 2 principal rays [2]  
 (any missing arrows – 1)
- (c) Reading off the grids: 2.7 cm [C1]  
 $f = 2.7 \times (4/1) = 10.8 \text{ cm}$  ( $10.7 \pm 0.8 \text{ cm}$ ) [1]  
 Alt: allow answers based on lens formula ( $1/f = 1/32 + 1/16$ ) *(no working: – 1)*
- (d) Magnified and inverted [1]
- 9(a) The rate of change of displacement is constant [1]  
 OR the speed is constant and object is moving in a fixed direction  
constant speed in a straight line  
acceleration is zero
- (b) Considering gradient of the graph from  $t = 0$  to  $t = 10 \text{ s}$ ,  
 $(v-20) / (10) = (35-20)/6$  [1]  
 $v = 45 \text{ m s}^{-1}$  [1]  
 OR  $a = (v-u) / t = (35-20)/(6) = 2.5 \text{ m s}^{-2}$  [1]  
 $v = u + at = 20 + 2.5(10) = 45 \text{ m s}^{-1}$  [1]

(c)  $t = 6.0 \text{ s}$  [1]  
(accept 6 s)

(d) Displacement of lorry =  $35 t$  [1]  
Displacement of police car =  $0.5(20+45)(10) + 45(t-10)$  [1]

When both vehicles have the same displacement,  
Area under the graph for lorry = area under the graph for the police car

$$35 t = 0.5(20+45)(10) + 45(t-10)$$

$$35 t = 325 + 45 t - 450$$

$$t = 12.5 \text{ s} \quad [1]$$

Alt:

distance  $d$  between the vehicles at  $t = 10\text{s}$

$$d = 0.5 \times 6 \times (35 - 20) - 0.50 \times (10 - 6) \times (45 - 35)$$

$$= 25 \text{ m} \quad [1]$$

Since the police car travels at  $45 \text{ m s}^{-1}$  and the lorry travels at  $35 \text{ m s}^{-1}$ , the distance between the two vehicles decreases by  $(45 - 35) = 10 \text{ m}$  per second [1]

OR  $\left\{ \begin{array}{l} d = (45 - 35) \times t_1 \text{ (area between graphs from 10 s to } t) \\ 25 = 10 t_1 \end{array} \right. \rightarrow t_1 = 2.5 \text{ s}$

$$\begin{aligned} \text{time } t &= 10 \text{ s} + 25/10 \text{ s} \\ &= 12.5 \text{ s} \end{aligned} \quad [1]$$

(e)  $v^2 = u^2 + 2 a s$  [1]  
 $0 = 35^2 + 2a (30)$  [1]  
 $a = -20.4 \text{ m s}^{-2}$  [1]

award answer mark if student shows  $a = -20.4 \text{ m s}^{-2}$  in workings but states the magnitude in the answer line.

OR use v-t graph:  
area under graph:  $\frac{1}{2} ut = s \rightarrow t$   
gradient of graph =  $a$

11(a) let  $a$  be the acceleration of Q

$$\text{i.e. } a = \frac{v-u}{t} = \frac{60-0}{25} \quad \textcircled{1} \quad a = 2.4 \text{ m s}^{-2} \quad \textcircled{1}$$

11b) distance travelled by P =  $\frac{1}{2} \times 60 \times 25 = 750 \text{ m}$

$$\text{distance travelled by Q} = (\frac{1}{2} \times 60 \times 10) + (15 \times 60) = 1200 \text{ m}$$

$\textcircled{1}$  for both distances to be correct

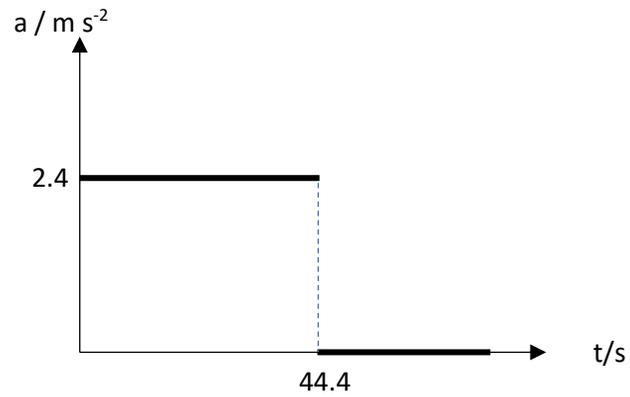
$$\text{Distance apart} = 1200 - 750 = 450 \text{ m} \quad \textcircled{1}$$

11c) P accelerated uniformly so its velocity at time  $t$ ,  $v = (60/25) t = 2.4 t$   $\textcircled{1}$   
P and Q must have travelled the same distance.

$$\frac{1}{2} (60 \times 10) + (t - 10)(60) = \frac{1}{2} vt = \frac{1}{2} (2.4 t) t \quad \text{①}$$

$$300 + 60t - 600 = 1.2 t^2$$

Solving gives  $t = 44.4 \text{ s}$  ①



11d)

Labelled axes correctly with units. ①

Constant value of  $a = 2.4 \text{ m s}^{-2}$  until  $t = 44.4 \text{ s}$  then zero after that. ①

11e) The velocity is decreasing at a decreasing rate ①