

Question 1 (Answer: **D**)

- Acceleration is the only vector here – it is a rate of change of velocity.
- Charge, kinetic energy and wavelength are all scalars.
- Charge can be negative, but a sign is not a direction in space.

Question 4 (Answer: **C**)

- Two equal forces give a resultant along the bisector of the angle between them.
- $R = 2F \cos(\theta/2) = 2 \times 6.0 \times \cos 30^\circ = 10.4 \text{ N}$.
- D would need the forces parallel; A would need 120° between them.

1(a)(i)	$v_H = 28 \times \cos 34^\circ$ $= 23 \text{ m s}^{-1}$
	$v_V = 28 \times \sin 34^\circ$ $= 16 \text{ m s}^{-1}$
1(a)(ii)	time = $16 / 9.81 = 1.6 \text{ s}$
1(a)(iii)	horizontal straight line at $v = 23 \text{ m s}^{-1}$ from $t = 0$ to $t = 3.2 \text{ s}$
1(a)(iv)	straight diagonal line starting at a positive velocity from $t = 0$ to $t = 3.2 \text{ s}$, crossing the time axis
	line starting at $v = 16 \text{ m s}^{-1}$ and ending at $v = -16 \text{ m s}^{-1}$
	line passing through $v = 0$ at $t = 1.6 \text{ s}$
1(b)(i)	product of mass and velocity
1(b)(ii)	$F = \Delta p / t$
	$= 13 / 3.2$
	$= 4.1 \text{ N}$
1(b)(iii)	$m = \Delta p / v$
	$= 13 / (2 \times 16)$
	$= 0.41 \text{ kg}$
	or
	$m = F / g$
	$= 4.06 / 9.81$
	$= 0.41 \text{ kg}$

Question 1 (Answer: **C**)

- Weight is a force, and every force has a direction as well as a size.
- Pressure, temperature and work are all scalars.
- Work is a product of two vectors that yields a scalar, so it has no direction of its own.

Question 4 (Answer: **B**)

- X points up and to the right, Y down and to the right, at equal angles.
- In $X + Y$ the vertical parts cancel and the horizontal parts add, so it points to the right.
- $-Y$ points up and to the left, so in $X - Y$ the horizontal parts cancel and $X - Y$ points up.

Question 4 (Answer: **C**)

- X sits 30 mm from YZ, because $\sqrt{50^2 - 40^2} = 30 \text{ mm}$.
- Each half of the elastic pulls along its own 50 mm length, so its component along P is $4.0 \times 30 / 50 = 2.4 \text{ N}$.
- Both halves pull the same way along P, so the total is $2 \times 2.4 = 4.8 \text{ N}$.

1(a)	acceleration and displacement identified as vectors (and no others)
	speed, temperature and gravitational potential energy identified as scalars (and no others)
1(b)(i)	$W = Fs$ or $W = mas$
	$s = v^2 / 2a$ or $a = v^2 / 2s$ or $as = v^2 / 2$
	$W = ma(v^2 / 2a)$ or $W = m(v^2 / 2s)s$ or $W = m(v^2 / 2)$ and (so E_K) = $\frac{1}{2}mv^2$
	OR
	$W = Fs$ or $W = mas$
	$F = mv / t$ and $s = \frac{1}{2}vt$
	$W = mv / t \times \frac{1}{2}vt$ and (so E_K) = $\frac{1}{2}mv^2$
	OR
	$W = Fs$ or $W = mas$
	$a = v / t$ and $s = \frac{1}{2}vt$
	$W = m(v / t)(\frac{1}{2}vt)$ and (so E_K) = $\frac{1}{2}mv^2$
	OR
	$W = Fs$ or $W = mas$
	$a = v / t$ and $s = \frac{1}{2}at^2$
	$W = m(v / t)(\frac{1}{2} \times (v / t) \times t^2)$ and (so E_K) = $\frac{1}{2}mv^2$

1(b)(ii)	kinetic energy = $\frac{1}{2}mv^2$ = $\frac{1}{2} \times 920 \times 17^2$ = 1.3×10^5 J
1(b)(iii)	$P = W/t$
	= $(4.7 \times 10^4 + 1.3 \times 10^5) / 5.8$
	= 3.1×10^4 W
1(b)(iv)	(at/after $t = 5.8$ s) the kinetic energy (of the car) does not change / work is done only against resistive forces / no work is done to accelerate (the car) so (power output is) less