fundamentals 17

SECTION A

You should spend a maximum of 40 minutes on this section.

Write your answer for each question in the box provided.

Answer **all** the questions.

1 Which pair contains one vector and one scalar quantity?

A	velocity	V	acceleration	V
B	displacement	V	force	V
C	kinetic energy	S	work done	S
D	momentum	V	distance	S

Your answer D **[1]**

w d = energy
scalar & transferred

3 Which quantity is followed by a reasonable estimate of its order of magnitude?

A	weight of an apple	10^0 N
B	volume of a table tennis ball	10^3 cm^3
C	wavelength of infra-red radiation	10^4 m
D	temperature of Sun's surface ~ 5000 K	10^5 K

Your answer **[1]**

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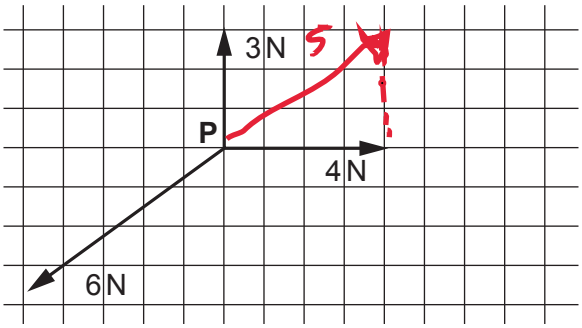
11 The three forces in this vector diagram act in one plane on an object **P**.



What is the magnitude and direction of the resultant?

A 1 N ↙

B 1 N ↗

C 1 N →

D 11 N ↙

Your answer [ ] **[1]**

12 A car travelling at $10\,m\,s^{-1}$ is brought to rest in a braking distance of 10 m.

Using the same average braking force, in what distance can the car be brought to rest from a speed of $40\,m\,s^{-1}$?

A 20 m

B 40 m

C 80 m

D 160 m

it is the same car, with the same mass in both cases witht he same force and since F=ma they will have the same value of a=-5m/s2

Your answer D **[1]**

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3 This question is about the force on a sail of a land yacht, a small vehicle that is powered by the wind.

Fig. 3.1

(a) Explain how air particles exert a pressure on a sail and why, when no wind is blowing, the sail experiences the same pressure on both sides.

Pressure is caused by air particles colliding with the sail. As they do so both the particles and the sail experience a change in momentum. Force produced is equal to the rate of change of this momentum. When there is no wind there is an equal number of collisions on each side meaning the pressure is the same.

[3]

(b) A sail has an area 8.0 m^2. A wind of velocity 18.0 $m\,s^{-1}$ strikes the sail at 90° to the surface of the sail. It is assumed that the velocity of the wind falls to zero when it strikes the sail.

Calculate the force on the sail and suggest why the assumption may not be accurate.

density of air = 1.2 $kg\,m^{-3}$

Mass of air which stops in 1 second

$18 \times 8 \times 1.2 = 172.8$

$\Delta p = mv \Rightarrow 172.8 \times 18 = 3110.4$ N

Air pushes out round the sides of the sail

force on sail = ... N **[4]**

(c) A constant force of 300 N strikes the sail of a land yacht at an angle of 50° to the direction of motion of the vehicle as shown in Fig. 3.2. The mass of the yacht and rider is 135 kg.

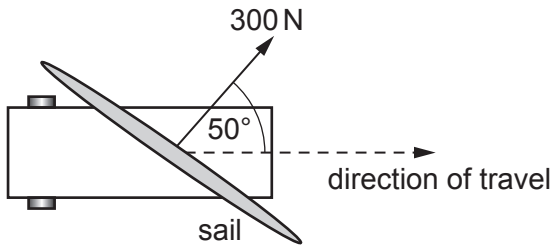


Fig. 3.2

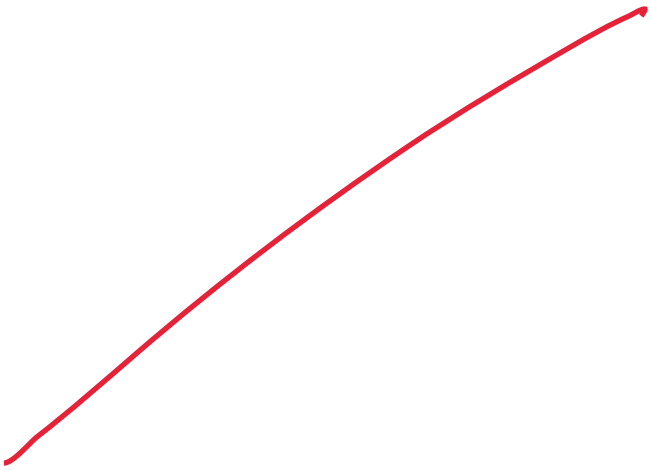
Calculate the time for the land yacht to travel 50 m in the direction shown. The yacht starts from rest. Ignore resistive forces.

$F_x = 300 \cos 50$ $\quad \frac{F}{m} = a \Rightarrow a = 1.43 \text{ m/s}^2$

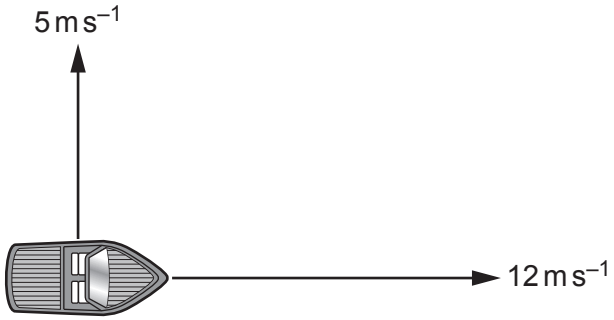
$s = ut + \frac{1}{2}at^2 \Rightarrow \frac{2 \times 50}{1.43} = t^2$

$\Rightarrow t = 8.4 \text{ s}$

time = ... s **[4]**



5 A boat travels eastwards with a velocity of $12\,m\,s^{-1}$.
A current from the south pushes the boat northwards at a velocity of $5\,m\,s^{-1}$.



What is the magnitude of the resultant velocity of the boat?

A $7\,m\,s^{-1}$

B $13\,m\,s^{-1}$

C $17\,m\,s^{-1}$

D $169\,m\,s^{-1}$

Your answer ☐ **[1]**

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24 A ball is kicked from horizontal ground at a velocity of $15\,m\,s^{-1}$ at an angle of 20° to the horizontal.

How long will the ball remain in the air before hitting the ground?
Ignore any effects of air resistance.

A 0.5 s

B 1.0 s

C 1.4 s

D 2.9 s

$u_y = 15.5 \sin 20$

$V_y = 0$

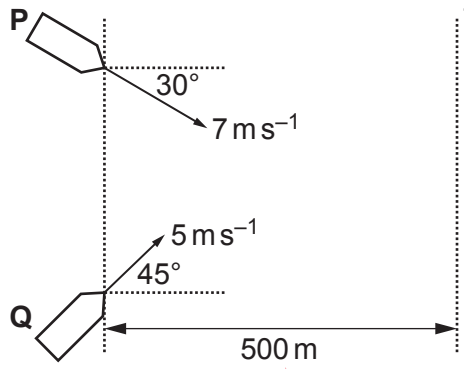
$V = u + 9.8t$

This is time to top, so double

Your answer

[1]

25 The diagram shows two boats **P** and **Q** sailing at constant velocity towards the finish line.



$V_{px} = 7\cos 30$

$t_p = 82$

$V_{qx} = 5\cos 45$

$t = \frac{d}{s}$

$t_q = 141$

$\sin\theta = \frac{o}{h}$

$s = \frac{d}{t}$

Which statement is correct?

A Boat **P** wins by 1.4 s.

B Boat **Q** wins by 29 s.

C Boat **P** wins by 59 s.

D Boat **Q** wins by 198 s.

Your answer

[1]