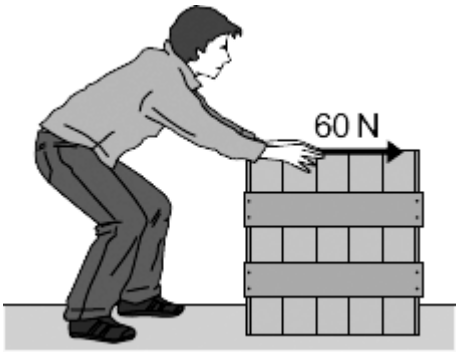
P8 Forces – In balance, task 1

Foundation Questions

Q1.

The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



My Revision Notes AQA GCSE Physics for A* – C,
Steve Witney, © Philip Allan UK

(a) The crate moves at a constant speed in a straight line

(i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1)

(ii) State the size of the friction force acting on the moving crate.

_____ N

Give the reason for your answer.

_____

_____

(2)

(b) Calculate the work done by the worker to push the crate 28 metres.

Show clearly how you work out your answer and give the unit.

Choose the unit from the list below.

joule **newton** **watt**

_____

_____

Work done = _____

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(3)

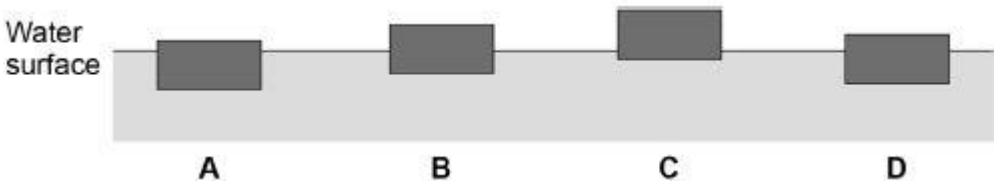
(Total 6 marks)

Q2.

Figure 1 shows four blocks of different materials floating on water.

The four blocks are the same volume.

Figure 1



(a) Which of the blocks has the smallest weight?

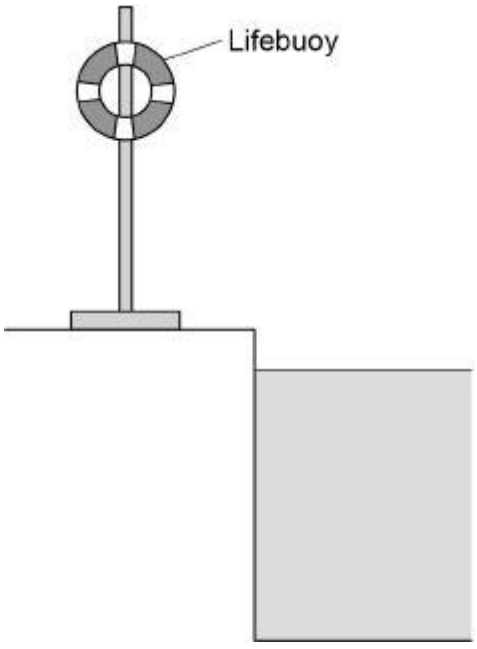
Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

Figure 2 shows a lifebuoy next to a deep swimming pool.

Figure 2



(b) The lifebuoy has a mass of 2.5 kg.

gravitational field strength = 9.8 N/kg

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Calculate the weight of the lifebuoy.

Use the equation:

weight = mass × gravitational field strength

_____

_____

_____

Weight = _____ N

(2)

(c) When thrown into the water the lifebuoy floats. The two forces acting on the lifebuoy are the weight of the lifebuoy downwards and upthrust upwards.

How big is the upthrust on the lifebuoy compared to the weight of the lifebuoy?

Tick **one** box.

The upthrust is greater than the weight. ☐

The upthrust is less than the weight. ☐

The upthrust is the same as the weight. ☐

(1)

(d) Write down the equation which links acceleration, mass and resultant force.

_____

(1)

(e) A rope is used to pull the lifebuoy to the side of the swimming pool.

A resultant force of 4.0 N acts on the lifebuoy.

The mass of the lifebuoy is 2.5 kg.

Calculate the acceleration of the lifebuoy.

_____

_____

_____

Acceleration = _____ m/s^2 [3]

(Total 8 marks)

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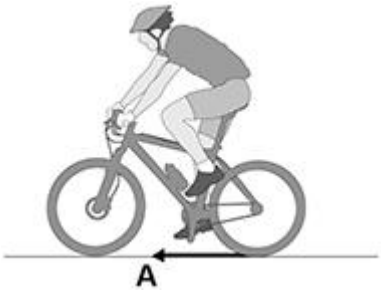
Higher Questions

Q3.

Figure 1 shows a cyclist riding a bicycle.

Force **A** causes the bicycle to accelerate forwards.

Figure 1



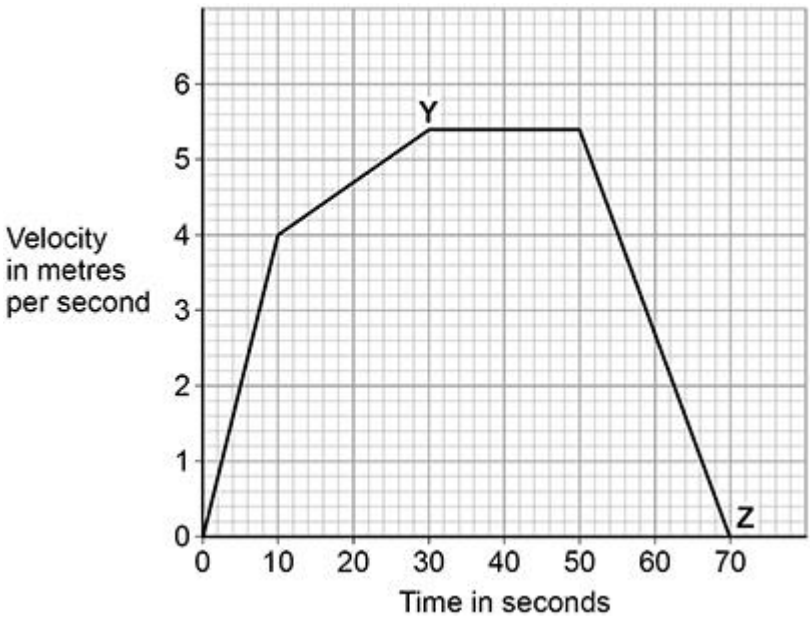
(a) What name is given to force **A**?

_____

(1)

Figure 2 shows how the velocity of the cyclist changes during a short journey.

Figure 2



(b) Determine the distance travelled by the cyclist between **Y** and **Z**.

_____

_____

_____

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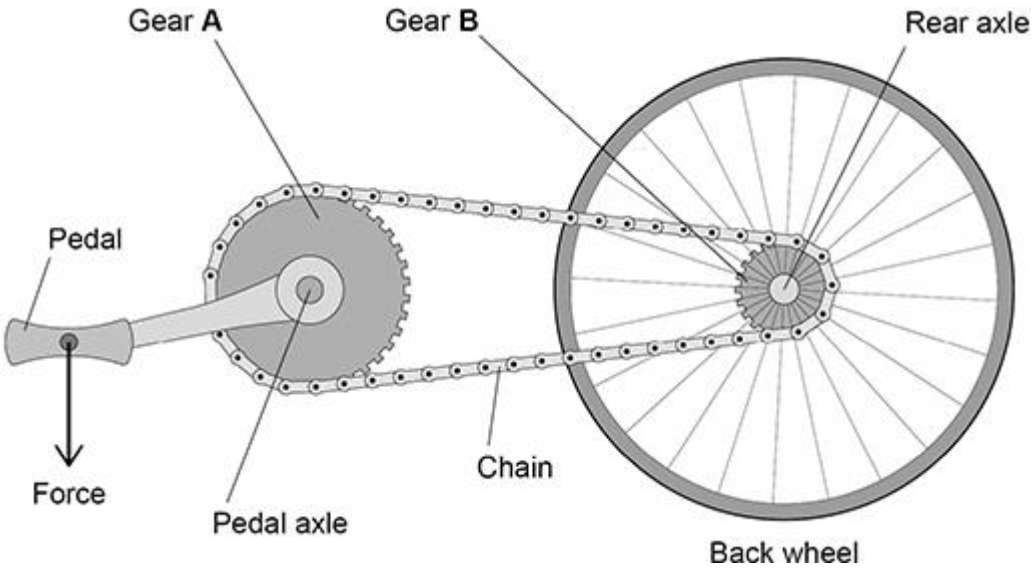
Distance travelled by the cyclist between **Y** and **Z** = _____ m

(3)

(c) **Figure 3** shows the gears on the bicycle.

Figure 3



Describe how the force on the pedal causes a moment about the rear axle.

(2)

Figure 4 shows a different cyclist towing a trailer.

Figure 4

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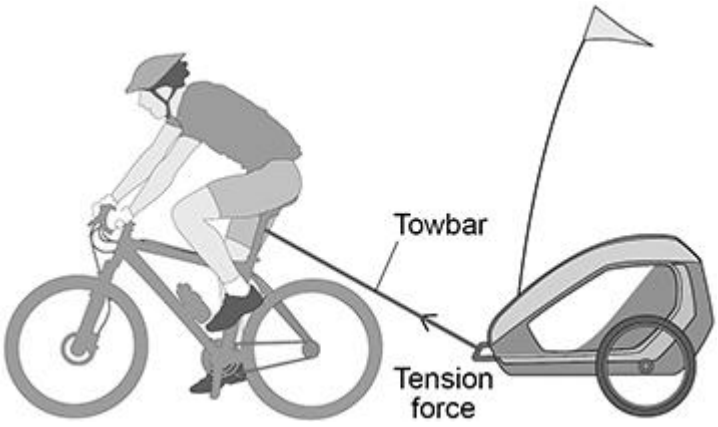

(d) The speed of the cyclist and trailer increased uniformly from 0 m/s to 2.4 m/s.

The cyclist travelled 0.018 km while accelerating.

Calculate the initial acceleration of the cyclist.

_____

_____

_____

_____

_____

Acceleration = _____ m/s^2

(3)

(e) The resultant force of the towbar on the trailer has a horizontal component and a vertical component.

horizontal force = 200 N

vertical force = 75 N

Determine the magnitude and direction of the resultant force of the towbar on the trailer by drawing a vector diagram.

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Magnitude of force = _____ N

Direction of force = _____ degrees

(4)

(Total 13 marks)

Q4.

(a) **Figure 1** shows an aircraft flying at a constant velocity and at a constant height above the ground.

Figure 1

Complete the free body diagram in **Figure 2** to show the other two forces acting on the aircraft.

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Figure 2

[2]

(b) A small aircraft accelerated down a runway at 4.0 m/s^2

The aircraft started from rest and reached a speed of 34 m/s just before take-off.

Calculate the distance the aircraft travelled while accelerating.

Give your answer to 2 significant figures.

_____

_____

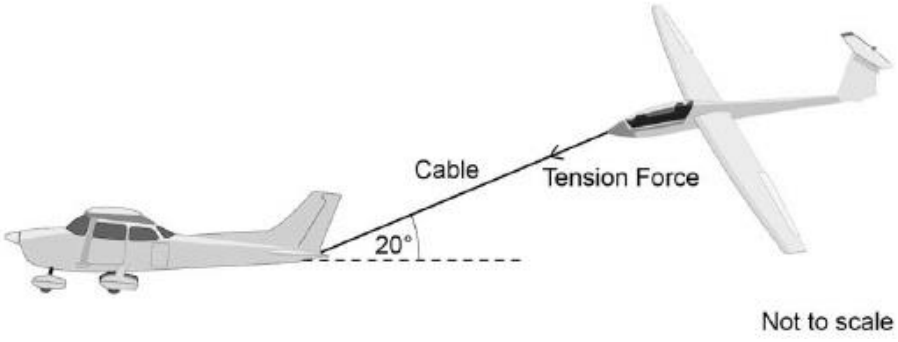
_____

Distance = _____ m

(4)

(c) **Figure 3** shows the small aircraft being used to tow a glider.

Figure 3



The tension force in the cable can be resolved into a horizontal component and a vertical component. The tension in the cable is 2000 N. The cable makes an angle of 20° with the horizontal.

Draw a vector diagram to determine the magnitude of the two components of the tension force in the cable.

Magnitude of the horizontal component = _____ N

Magnitude of the vertical component = _____ N

(1)

(Total 10 marks)

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Mark schemes

Q1.

(a) (i) horizontal arrow pointing to the left

judge by eye

drawn anywhere on the diagram

1

(ii) 60 (N)

1

(at steady speed) resultant force must be zero

accept forces must balance/are equal

accept no acceleration

*do **not** accept constant speed*

1

(b) 1680

*allow **1** mark for correct substitution, ie 60 x 28 provided no subsequent step shown*

2

joule

accept J
do not accept j

1

[6]

Q2.

(a) C

1

(b) weight = 2.5 × 9.8

1

weight = 24.5 (N)

*an answer of 24.5 rounded to 25 scores **2** marks*

1

*an answer of 24.5 scores **2** marks*

(c) the upthrust is the same as the weight

1

(d) (resultant) force = mass × acceleration

allow F = m a

1

(e) 4.0 = 2.5 × a

1

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$$a = \frac{4.0}{2.5}$$

1

a = 1.6 (m/s²)

1

*an answer of 1.6 scores **3** marks*

[8]

Q3.

(a) friction

1

(b) (area of rectangle =) 108 (m)

1

(area of triangle =) 54 (m)

1

(total area / distance =) 162 (m)

allow a correctly calculated total area / distance from an

incorrectly calculated area of rectangle and / or triangle

1

(c) (the force on the pedal) causes a moment about the pedal axle

1

which causes a force on the chain (which causes a moment about the rear axle)

allow gear B for chain

1

(d) $2.4^2 (- 0^2) = 2 \times a \times 18$

1

$$a = \frac{2.4 \times 2.4}{36}$$

1

a = 0.16 (m/s²)

1

<u>alternative method</u>

t = 18 / 1.2
t = 15 (s) (1)

a = 2.4 / 15 (1)

this mark may be awarded if the time is incorrectly calculated

a = 0.16 (m/s²) (1)

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allow a correctly calculated acceleration from an incorrectly calculated time 1

(e) horizontal (200N) **and** vertical (75N) forces drawn to the same scale

1

resultant force drawn in the correct direction

shown by an arrow head from bottom right to top left

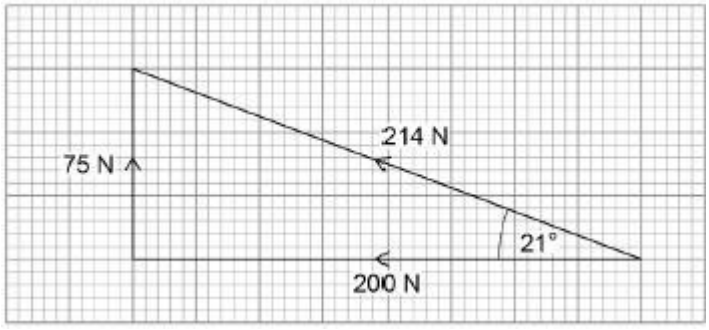
1

resultant force with a value in the range 212 to 218 (N)

allow a calculated value of 213.6 ***or*** *214 (N)*

1

direction in the range 20–22 (degrees from the horizontal)



allow 68–70 (degrees from the vertical)

allow a bearing in the range 290–292

to gain full marks a vector diagram must have been drawn

1

[13]

Q4.

(a) arrow vertically down – same size as lift – labelled weight

judge by eye

1

arrow to the left – same size as drag - labelled thrust

judge by eye

two correct arrows without labels gains ***1*** *mark*

1

(b) $34^2 - (0^2) = 2 \times 4.0 \times s$

1

$$\frac{34 \times 34}{8} = s$$

1

s = 144.5

1

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s = 140 (2 sig figs)

*an answer of 140 scores **4** marks*

*an answer of 144.5 scores **3** marks*

1

(c) tension force drawn to a suitable scale and in correct direction

1

triangle completed showing correct components

1

scale used to determine both component forces

1

horizontal component = 1900 N
vertical component = 680 N

allow 1850 to 1925 inclusive

allow 660 to 700 inclusive

1

[10]