AQA Physics Paper 2
Revision Test: Forces and their Interactions (HT)

Q1

Complete the following sentences by writing one word in each of the spaces provided.

Scalars and vectors are similar because both types of quantities have _____ but they are also different because only vector quantities have _____.

In scientific diagrams, a vector quantity may be represented by an arrow. The length of the arrow represents the _____ of the vector. The direction of the arrow represents the _____ of the vector.

(2 marks)

Q2

The table below list three scalars that have matching vector quantities.
Complete the table by adding the missing vector quantities.

Scalar quantity	Vector quantity
mass	
distance	
speed	

(3 marks)

Q3

Some cycling races take place on velodrome tracks that have a semi-circle at each end separated by straight sections in between, as shown in Figure 1.

The velocity of the cyclist at one point on the track is indicated by Q.

A short time later, the cyclist reaches another point on the track, indicated by R.

The cyclist has the same speed at point Q and at point R.

Complete the diagram to indicate the velocity of the cyclist at point R.

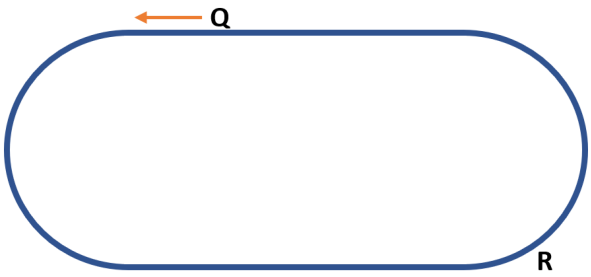


Figure 1

(3 marks)

Q4

All forces can be categorised as either contact forces or non-contact forces.

Tick one column in each row of the table below to identify the following forces as either a contact force or a non-contact force.

Force	Contact	Non-Contact
water resistance		
air resistance		
gravitational force		
friction		

(4 marks)

Q5

A string is tied to a block of iron that rests on the floor.
A student lifts the block off the floor by pulling the string gently upwards at a constant velocity.

Which of the following statements is not true?
Tick the box that corresponds with the false statement

☐ **A** When the weight is lifted, the upwards force is greater than the weight of the block

☐ **B** The downwards force acting on the block is equal to the weight of the block

☐ **C** All forces have the same SI unit, which is the newton (N)

☐ **D** The downwards force acting on the block is the same when lifted as it is on the floor.

(1 mark)

Q6

Two forces act on a book that rests on a table. The diagram below, Figure 2, shows one of the forces.

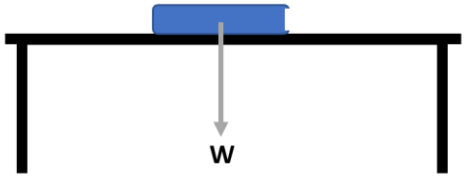


Figure 2

a) What is represented by **W** in Figure 2?

_____

(1 mark)

b) Draw an arrow on Figure 2 to represent the normal contact force for the book. Label the arrow N.

(2 marks)

Q7

The weight of a mass in a gravitational field is given by the equation;

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$W = m\,g$$

a) Use the equation given above to calculate the value of g that would cause a 165 g snooker ball to have a weight of 1.62 N. You must give your answer to three significant figures and state the appropriate unit.

g = _____ unit _____

(4 marks) *(1 mark)*

b) State the name that is given to the single point where the weight of an object can be considered to act.

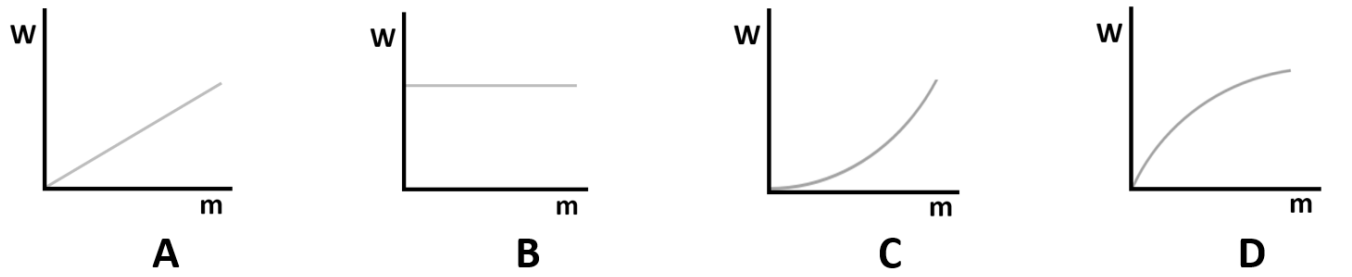
_____

(1 mark)

Q8

Which of the graphs below shows the general relationship between W and m for a constant value of g?

Circle the letter under the graph that is your answer.



(1 mark)

Q9

The diagram below, Figure 3, shows an object that is suspended from a short piece of rope. The rope is attached to two identical strings that are thinner than the rope. The strings are fixed at the same height above the ground on facing parallel walls.

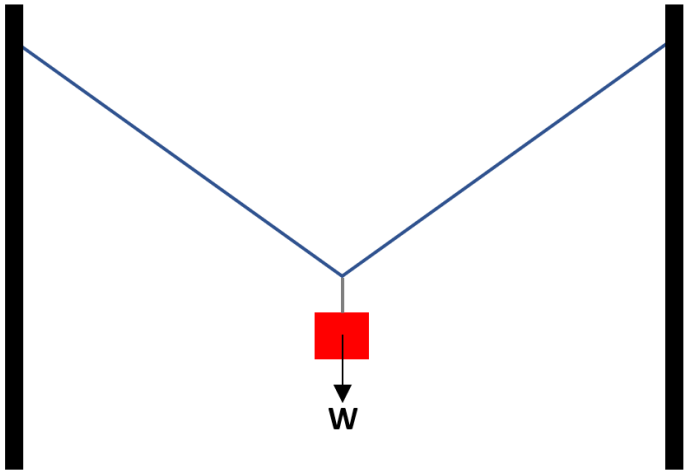


Figure 3

a) State the name the force that acts through the rope and state its direction.

(2 marks)

b) State the direction of the force in the left-hand string, linking the rope to the left-hand wall.

(1 mark)

c) Deduce the sum of the vertical components of the forces that act through the two strings.

(1 mark)

d) Describe the horizontal components of the forces that act through the two strings.

(2 marks)

Exam-style questions

Q1

The International Space Station (ISS) is in orbit above Earth. The ISS travels at a constant average speed and takes 90 minutes to complete one orbit, which is a total distance of 42 600 km.

a) Calculate the average speed of the ISS.

average speed _____ km/h

(3 marks)

b) Describe the velocity of the International Space Station as it makes one complete orbit of the Earth.

(3 marks)

Q2

The vector diagram below, Figure 1, shows the four forces acting on a toy aeroplane powered by a rubber band.

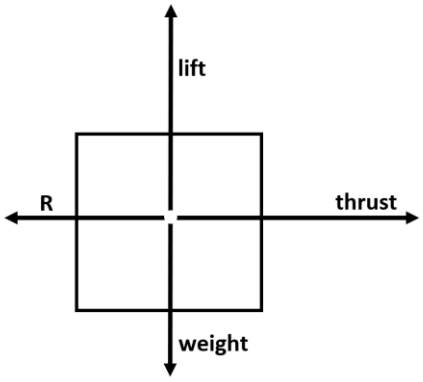


Figure 1

a) State the name the force represented by vector **R**.

(1 mark)

b) State the name that is given to this type of diagram.

(1 mark)

c) The four forces shown in Figure 1 can be replaced by a single vector.

(i) State the name that is given to the single vector.

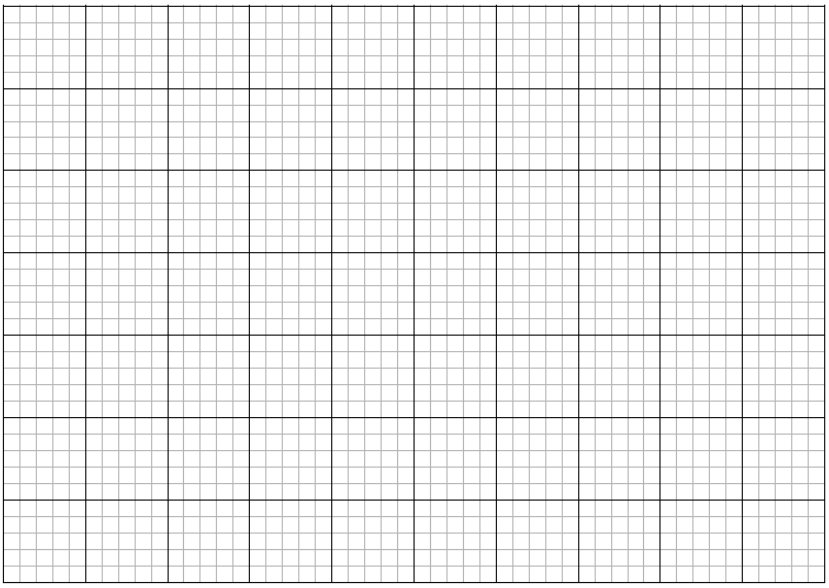
_____

(1 mark)

(ii) Use the grid below to make a scale drawing to determine the single vector.
The magnitudes of the four vectors are given in Table 1.

Vector	Magnitude (N)
lift	0.80
thrust	0.90
weight	0.55
R	0.60

Table 1



(6 marks)

Q3

An astronaut travels from Earth to the moon. The overall journey is shown in Figure 2.

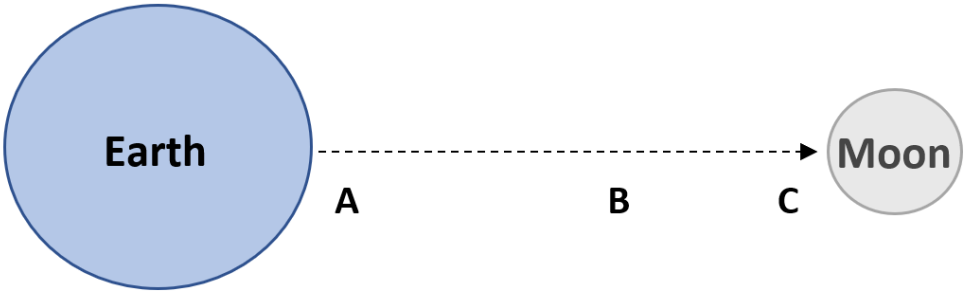


Figure 2

Describe and explain the pattern of weight change that the astronaut will experience during the journey.

Your answer must include specific details about the astronaut's weight at points A, B and C.

(6 marks)

ANSWERS: CORE QUESTIONS

Q1

One mark for each correct paragraph (both answers must be correct to score the paragraph mark)…

Scalars and vectors are similar because both types of quantities have **magnitude** but they are also different because only vector quantities have **direction**.

In scientific diagrams, a vector quantity may be represented by an arrow. The length of the arrow represents the **magnitude** of the vector. The direction of the arrow represents the **direction** of the vector.

(2 marks)

Q2

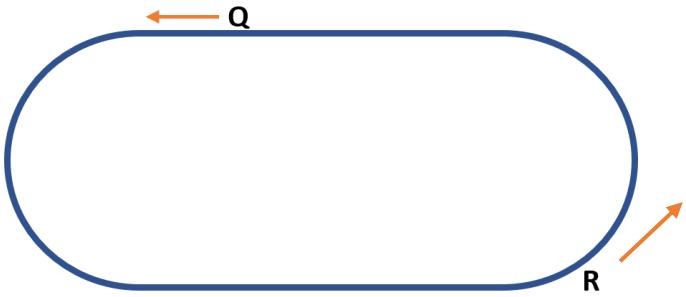
One mark for each correct answer…

Scalar quantity	Vector quantity
mass	***weight***
distance	***displacement***
speed	***velocity***

(3 marks)

Q3

Arrow expected as shown below…



Marking points; (visually) straight, (visually) same length as arrow for Q, (visually) direction tangential to curve.

(3 marks)

Q4

One mark for each correct answer…

Force	Contact	Non-Contact
water resistance	✓	
air resistance	✓	
gravitational force		✓
friction	✓	

(4 marks)

Q5

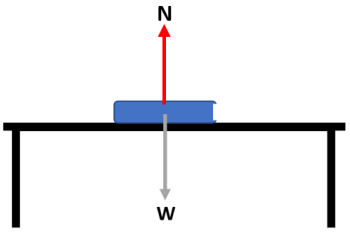
A is the false statement as the upwards force is equal to the weight when the block is lifted at constant velocity.

(1 mark)

Q6

(a) The arrow represents the **weight of the book** (acting on the table) *(1 mark)*

(b) Arrow expected as shown below…



Marking points; (visually) straight line that is the same length as arrow for W **<u>with</u>** upwards arrow *(1 mark)*
line originating from the same point as W (centre of mass of book) *(1 mark)*

Q7

a) Convert ball's mass to SI unit (165 g = 0.165 kg) *(1 mark)*
Correctly rearrange equation to give g = 1.62 / 0.165 (may deduce from correct final answer) *(1 mark)*
Correct final value (9.81818) *(1 mark)*
Answer recorded to three significant figures (9.82) *(1 mark)*
Independent mark for unit (N/kg) *(1 mark)*

b) Accept any of the following; centre of mass / centre of gravity / centre of weight *(1 mark)*

Q8

A is the correct answer as weight is always directly proportional to mass *(1 mark)*

Q9

a) Name of force: **tension** Direction of force: **upwards** (do not accept any other direction) *(2 marks)*
b) Diagonally, upwards and to the left (both components of direction are required) *(1 mark)*
c) The sum of the vertical components is equal to W (in magnitude and in direction) *(1 mark)*
d) The horizontal components are equal and in opposite directions (OWTTE) *(2 marks)*

ANSWERS: EXAM-STYLE QUESTIONS

Q1

a) Convert minutes to hours (90 minutes = 1.5 hours) *(1 mark)*
Correct method (may be implied from final answer) – independent of correct conversion *(1 mark)*
Correct final answer (28 400) – unit not required *(1 mark)*

b) Marking points as follows;
the velocity changes (even though the average speed stays the same)… *(1 mark)*
because the **direction** of travel is (constantly) changing *(1 mark)*
but the **magnitude** of the velocity stays the same (as the average speed is constant) *(1 mark)*

Q2

a) Accept drag / air resistance / friction *(1 mark)*
b) Free Body Diagram (do not accept initials alone, FBD) *(1 mark)*
c) (i) Resultant *(1 mark)*
(ii) Evidence of resultant for horizontal components (0.30 N) *(1 mark)*
Evidence of resultant for vertical components (0.25 N) *(1 mark)*
Construction of right-angle triangle *(1 mark)*
Right-angle triangle has correct proportions (5:6) - provides evidence for resultant marks *(1 mark)*
Arrows placed on both vertical and horizontal components *(1 mark)*
Diagonal resultant drawn **with** arrow marked to show direction *(1 mark)*
NOTE. Using lift and thrust alone gives 2:3 proportions: maximum of three marks to be awarded.

Q3

Maximum available award is 6 marks: for full marks, all three specific details (second group) are required.

General description answer (makes no mention of specific points but describes a viable pattern of change);
the astronaut's weight will **decrease** (going away from the Earth) *maximum*
then increase (to a lower value) (when on to the moon) *2 marks*
No mark is to be awarded for reference to "change" alone as this is include in the question.

Specific description answer (responses must refer relative values and specific locations to achieve these marks);
at point A, the weight has its **maximum value** (accept, very close to / on Earth)
at point B, the weight will decrease to a **minimum value** at point B (far away from the Earth) *maximum*
at point C, the weight will have increased to a value lower than at point A (accept, on Earth) *4 marks*
some valid reference to gravity / gravitational field is required for 4 marks

Explanation answer (responses link the values of weight to the cause of weight);
relative values at all three specific descriptions must be given (as detailed above)
weight is dependent on the gravitational field *maximum*
close to the Earth, the astronaut is in a strong gravitational field, maximising weight *6 marks*
the Moon's gravitational field is weaker than Earth's, so the astronaut's is less at C than at A
the location of the minimum gravitational field is closer to the Moon than to Earth