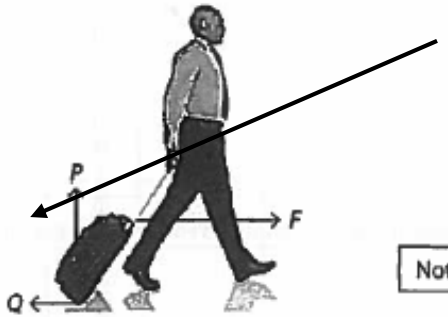
DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

**3** A man pulls a suitcase with a horizontal force, *F*, as shown in Figure 5.

Two other forces acting on the suitcase are labelled *P* and *Q*.




Not to scale

**Figure 5**

(a) (i) Which of these gives the correct names for the forces *P* and *Q*?

(1)

| | name of force *P* | name of force *Q* |
|---|---|---|
| ☑ A | upthrust | reaction |
| ☐ B | reaction | friction |
| ☐ C | reaction | reaction |
| ☐ D | friction | upthrust |

X

(ii) Draw an arrow on the diagram to represent the weight of the suitcase.

(1)

Q3 a i. Why is this wrong? Clue: friction always acts in the opposite direction to the movement.

Q3 a ii. Add on the arrow, weight always acts down.

(b) The man pulls the suitcase for 80 m along a horizontal path.

The mass of the man and the suitcase is 85 kg.

The man does 1200 J of work on the suitcase as he pulls the suitcase along.

He walks with an average velocity of 1.5 m/s.

(i) Calculate the kinetic energy of the man and the suitcase.

(2)

80 x 1200 = 96.000

Q3 b i. Why is this wrong? What is the equation for kinetic energy? Now substitute in the numbers. What have they missed off the answer?

kinetic energy = 96.000

(ii) Calculate the horizontal force, *F*, that the man exerts on the suitcase.

Use the equation:

work done = force × distance moved in the direction of the force

(2)

80

1200

1.5 x 80 = 120

Q3 b ii. Why is this wrong? Look at the question and pull out the numbers that you need for work done and distance moved. Rearrange the equation. Substitute in the numbers. What have they missed off the answer?

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**Figure 5**

(a) (i) Which of these gives the correct names for the forces *P* and *Q*?

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| ☑ A | upthrust | reaction |
| ☐ B | reaction | friction |
| ☐ C | reaction | reaction |
| ☐ D | friction | upthrust |

Q3 a i. B

X

(ii) Draw an arrow on the diagram to represent the weight of the suitcase.

(1)

Q3 a ii. Arrow from the centre of the suitcase to downwards.

(b) The man pulls the suitcase for 80 m along a horizontal path.

The mass of the man and the suitcase is 85 kg.

The man does 1200 J of work on the suitcase as he pulls the suitcase along.

He walks with an average velocity of 1.5 m/s.

(i) Calculate the kinetic energy of the man and the suitcase.

(2)

80 x 1200 = 96.000

Q3 b i. ½ m v2

½ x 85 x 1.5 x 1.5 = 96J

kinetic energy = 96.000

(ii) Calculate the horizontal force, *F*, that the man exerts on the suitcase.

Use the equation:

work done = force × distance moved in the direction of the force

(2)

1.5 x 80 = 120

Q3 b ii. Work done = 1200
Distance = 80m

Force = work done/distance

Force = 15 N

# Answers!

| Question number | Answer | Mark |
|---|---|---|
| 3(a)(i) | C | (1) |

| Question number | Answer | Mark |
|---|---|---|
| 3(a)(ii) | Vertical arrow, acting downward through the suitcase | (1) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(b)(i) | Substitution (1)<br>$(KE =) \frac{1}{2} \times 85 \times (1.5)^2$<br><br>Answer (1)<br>96 (J) | award full marks for correct numerical answer without working<br><br>allow 95.625 (J) | (2) |

| Question number | Answer | Additional guidance | Mark |
|---|---|---|---|
| 3(b)(ii) | Rearrange (1)<br>force = work done ÷ distance<br><br>Answer (1)<br>(force) = 15 (N) | accept rearrangement with values subst., i.e. (force) = 1200 ÷ 80<br><br>award full marks for correct numerical answer without working | (2) |

# Now try this!

A car is travelling along a level road when the driver applies the brakes to stop it.
The work done to stop the car is 510 000 J.
The car has a mass of 1400 kg.

(i) State the value of the kinetic energy of the car when the brakes were first applied.
**(1)**

kinetic energy = ..... J

(ii) Calculate the velocity of the car when the brakes were first applied.
**(3)**

velocity = ..... m/s

(iii) The brakes applied an average force of 15 000 N.
Calculate the distance it takes for the brakes to stop the car.
**(2)**

distance = ..... m

**(Total for question = 6 marks)**

A car is travelling along a level road when the driver applies the brakes to stop it.
The work done to stop the car is 510 000 J. The car has a mass of 1400 kg.

(i) State the value of the kinetic energy of the car when the brakes were first applied.

**(1)**

| Question number | Answer | Acceptable answers | Marks |
|---|---|---|---|
| (i) | 510 000 (J) | 510 kJ | **(1)** |

kinetic energy = ..... J

(ii) Calculate the velocity of the car when the brakes were first applied.

**(3)**

| | | | |
|---|---|---|---|
| (ii) | Substitution<br>510 000 = ½ x 1400 x $v^2$ (1)<br><br>Transposition<br>$v^2$ = 2 x 510 000 / 1400 (1)<br><br>Evaluation<br>(v =) 27 (m/s) (1) | Allow ECF from ci<br><br>v = √730 for 2 marks<br><br>Values which round to 27 e.g. 26.992<br><br>Allow correct value with no working shown for 3 marks | **(3)** |

velocity = ..... m/s

(iii) The brakes applied an average force of 15 000 N.
Calculate the distance it takes for the brakes to stop the car.

**(2)**

| | | |
|---|---|---|
| Substitution<br>510 000 = 15 000 x d (1)<br><br>Transposition and evaluation<br>(d =) 34 (m) (1) | Allow correct value with no working shown for 2 marks | **(2)** |

distance = ..... m

**(Total for question = 6 marks)**