N5

DYNAMICS

Practice Exam Questions

Physics
Section 1—Questions

DATA SHEET

Speed of light in materials

Material	*Speed* in $m s^{-1}$
Air	$3 \cdot 0 \times 10^8$
Carbon dioxide	$3 \cdot 0 \times 10^8$
Diamond	$1 \cdot 2 \times 10^8$
Glass	$2 \cdot 0 \times 10^8$
Glycerol	$2 \cdot 1 \times 10^8$
Water	$2 \cdot 3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in $N kg^{-1}$
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in $J kg^{-1}$
Alcohol	$0 \cdot 99 \times 10^5$
Aluminium	$3 \cdot 95 \times 10^5$
Carbon Dioxide	$1 \cdot 80 \times 10^5$
Copper	$2 \cdot 05 \times 10^5$
Iron	$2 \cdot 67 \times 10^5$
Lead	$0 \cdot 25 \times 10^5$
Water	$3 \cdot 34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in $J kg^{-1}$
Alcohol	$11 \cdot 2 \times 10^5$
Carbon Dioxide	$3 \cdot 77 \times 10^5$
Glycerol	$8 \cdot 30 \times 10^5$
Turpentine	$2 \cdot 90 \times 10^5$
Water	$22 \cdot 6 \times 10^5$

Speed of sound in materials

Material	*Speed* in $m s^{-1}$
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in $J kg^{-1} °C^{-1}$
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	−98	65
Aluminium	660	2470
Copper	1077	2567
Glycerol	18	290
Lead	328	1737
Iron	1537	2737

Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

SECTION 1

14. Which of the following contains two vectors and one scalar quantity?

A Acceleration, mass, displacement

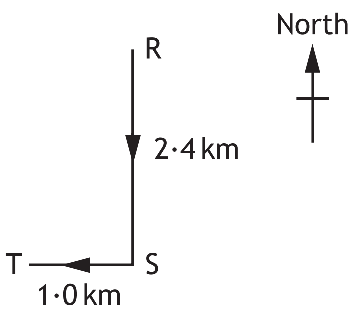
B Displacement, force, velocity

C Time, distance, force

D Displacement, velocity, acceleration

E Speed, velocity, distance

15. A vehicle follows a course from R to T as shown.



The total journey takes 1 hour.

Which row in the table gives the average speed and the average velocity of the vehicle for the whole journey?

	Average speed	*Average velocity*
A	$2{\cdot}6\,\text{km}\,\text{h}^{-1}$ (023)	$3{\cdot}4\,\text{km}\,\text{h}^{-1}$
B	$2{\cdot}6\,\text{km}\,\text{h}^{-1}$	$3{\cdot}4\,\text{km}\,\text{h}^{-1}$ (203)
C	$3{\cdot}4\,\text{km}\,\text{h}^{-1}$ (203)	$2{\cdot}6\,\text{km}\,\text{h}^{-1}$
D	$3{\cdot}4\,\text{km}\,\text{h}^{-1}$	$2{\cdot}6\,\text{km}\,\text{h}^{-1}$ (023)
E	$3{\cdot}4\,\text{km}\,\text{h}^{-1}$	$2{\cdot}6\,\text{km}\,\text{h}^{-1}$ (203)

16. A force of 10 N acts on an object for 2 s.

During this time the object moves a distance of 3 m.

The work done on the object is

A 6·7 J

B 15 J

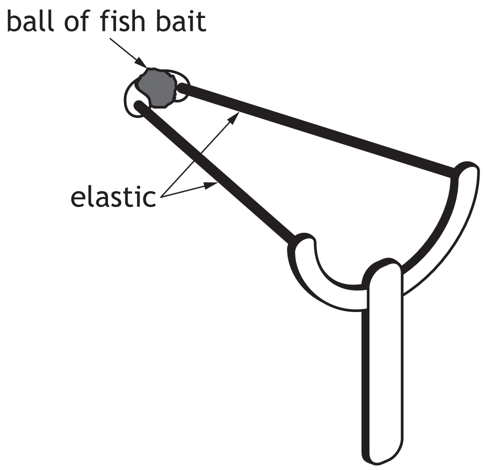
C 20 J

D 30 J

E 60 J.

17. Catapults are used by anglers to project fish bait into water.

A technician designs a catapult for this use.



Pieces of elastic of different thickness are used to provide a force on the ball.

Each piece of elastic is the same length.

The amount of stretch given to each elastic is the same each time.

The force exerted on the ball increases as the thickness of the elastic increases.

Which row in the table shows the combination of the thickness of elastic and mass of ball that produces the greatest acceleration?

	Thickness of elastic (mm)	*Mass of ball* (kg)
A	5	0·01
B	10	0·01
C	10	0·02
D	15	0·01
E	15	0·02

18. A spacecraft completes the last stage of its journey back to Earth by parachute, falling with constant speed into the sea.

The spacecraft falls with constant speed because

A the gravitational field strength of the Earth is constant near the Earth's surface

B it has come from space where the gravitational field strength is almost zero

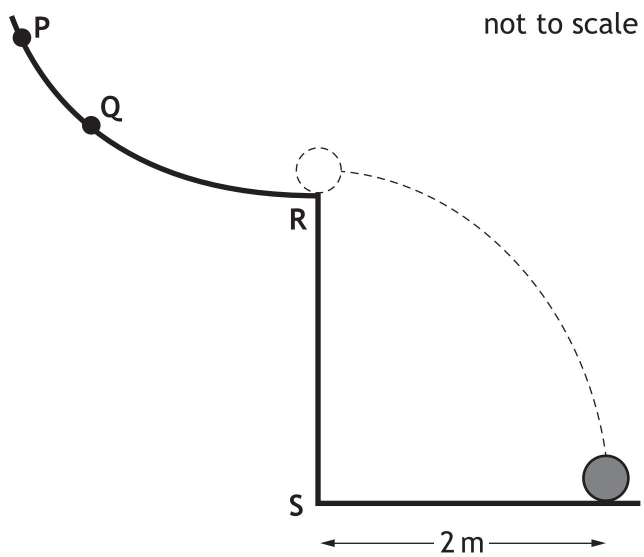
C the air resistance is greater than the weight of the spacecraft

D the weight of the spacecraft is greater than the air resistance

E the air resistance is equal to the weight of the spacecraft.

19. A ball is released from point **Q** on a curved rail, leaves the rail horizontally at R and lands 1 s later.

The ball is now released from point **P**.



Which row describes the motion of the ball after leaving the rail?

	Time to land after leaving rail	*Distance from S to landing point*
A	1 s	less than 2 m
B	less than 1 s	more than 2 m
C	1 s	more than 2 m
D	less than 1 s	2 m
E	more than 1 s	more than 2 m

14. Which of the following quantities is fully described by its magnitude?

A Force

B Displacement

C Energy

D Velocity

E Acceleration

15. The table shows the velocities of three objects X, Y and Z over a period of 3 seconds. Each object is moving in a straight line.

Time (s)	0	1	2	3
Velocity of X ($m\,s^{-1}$)	2	4	6	8
Velocity of Y ($m\,s^{-1}$)	0	1	2	3
Velocity of Z ($m\,s^{-1}$)	0	2	5	9

Which of the following statements is/are correct?

I X moves with constant velocity.

II Y moves with constant acceleration.

III Z moves with constant acceleration.

A I only

B II only

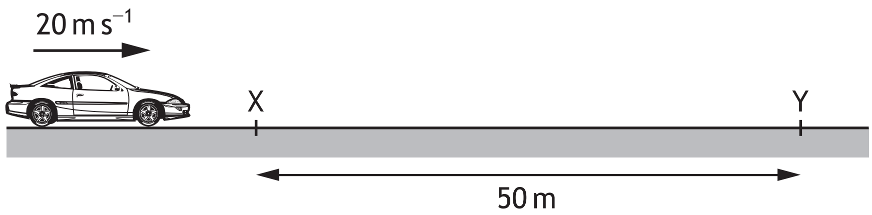
C I and II only

D I and III only

E II and III only

16. A car of mass 1200 kg is travelling along a straight level road at a constant speed of $20\,m\,s^{-1}$.

The driving force on the car is 2500 N. The frictional force on the car is 2500 N.



The work done moving the car between point X and point Y is

A 0 J

B 11 800 J

C 125 000 J

D 240 000 J

E 250 000 J.

17. A person sits on a chair which rests on the Earth. The person exerts a downward force on the chair.

Which of the following is the reaction to this force?

A The force of the chair on the person

B The force of the person on the chair

C The force of the Earth on the person

D The force of the chair on the Earth

E The force of the person on the Earth

18. A package falls vertically from a helicopter. After some time the package reaches its terminal velocity.

A group of students make the following statements about the package when it reaches its terminal velocity.

I The weight of the package is less than the air resistance acting on the package.

II The forces acting on the package are balanced.

III The package is accelerating towards the ground at $9{\cdot}8\,m\,s^{-2}$.

Which of these statements is/are correct?

A I only

B II only

C III only

D I and III only

E II and III only

14. Which of the following is a vector quantity?

A Mass

B Time

C Speed

D Kinetic energy

E Acceleration

16. A cyclist is travelling at $10\,m\,s^{-1}$ along a level road.

The cyclist applies the brakes and comes to rest in a time of 5 s.

The combined mass of the cycle and cyclist is 80 kg.

The maximum energy converted to heat by the brakes is

A 160 J

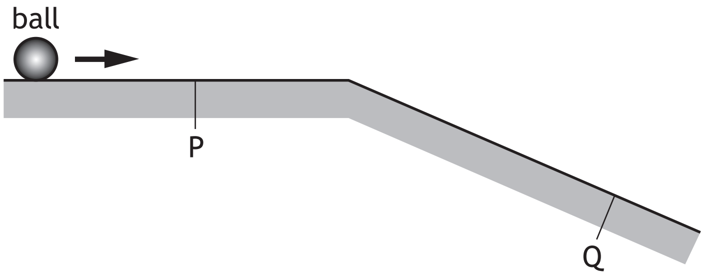
B 400 J

C 800 J

D 4000 J

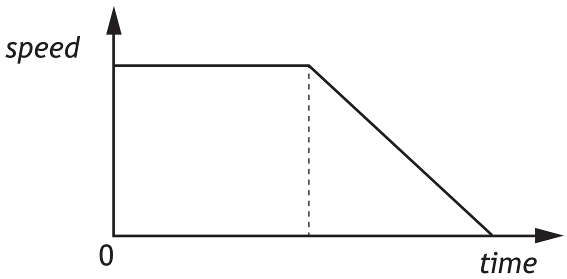
E 8000 J.

15. A ball moves along a horizontal frictionless surface and down a slope as shown.

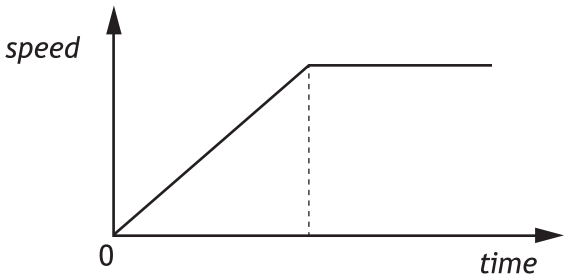


Which of the following graphs shows how the speed of the ball varies with time as it travels from P to Q?

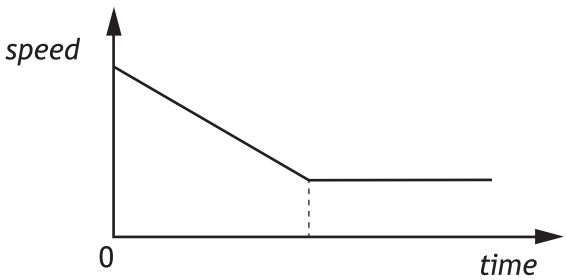
A



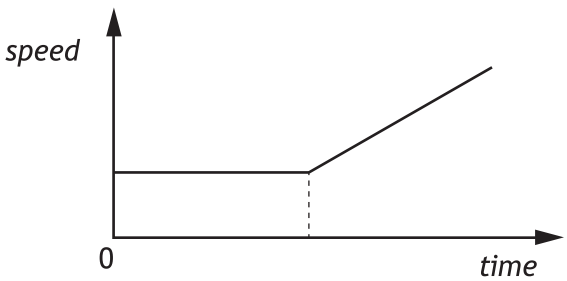
B



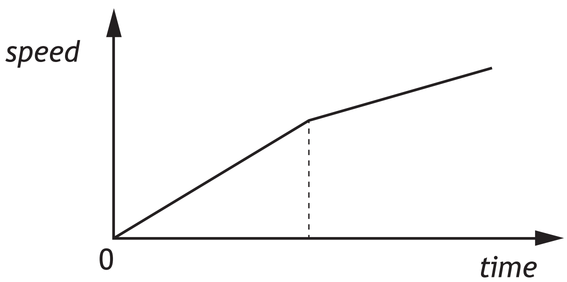
C



D



E



17. A rocket is taking off from the surface of the Earth. The rocket engines exert a force on the exhaust gases.

Which of the following is the reaction to this force?

A The force of the Earth on the exhaust gases.

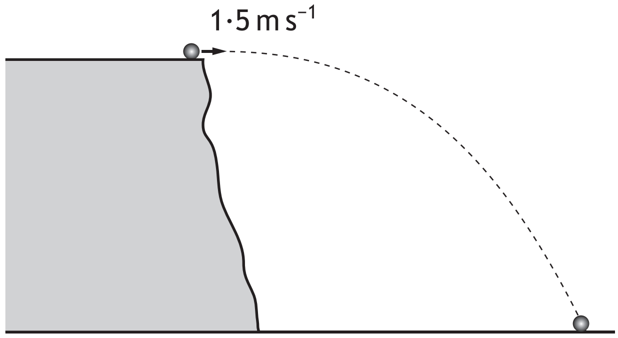
B The force of the Earth on the rocket engines.

C The force of the rocket engines on the Earth.

D The force of the exhaust gases on the Earth.

E The force of the exhaust gases on the rocket engines.

18. A ball is projected horizontally with a velocity of $1{\cdot}5\,\text{m}\,\text{s}^{-1}$ from a cliff as shown.



The ball hits the ground $1{\cdot}2\,\text{s}$ after it leaves the cliff.

The effects of air resistance are negligible.

Which row in the table shows the horizontal velocity and vertical velocity of the ball just before it hits the ground?

	Horizontal velocity ($\text{m}\,\text{s}^{-1}$)	*Vertical velocity* ($\text{m}\,\text{s}^{-1}$)
A	12	12
B	12	1·5
C	1·5	12
D	1·5	13
E	0	12

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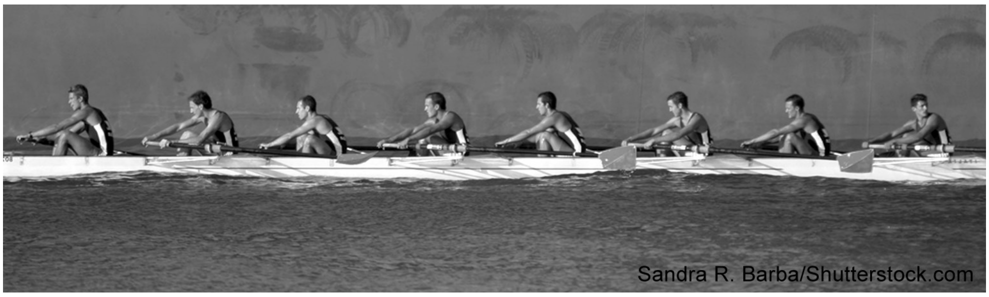
DYNAMICS

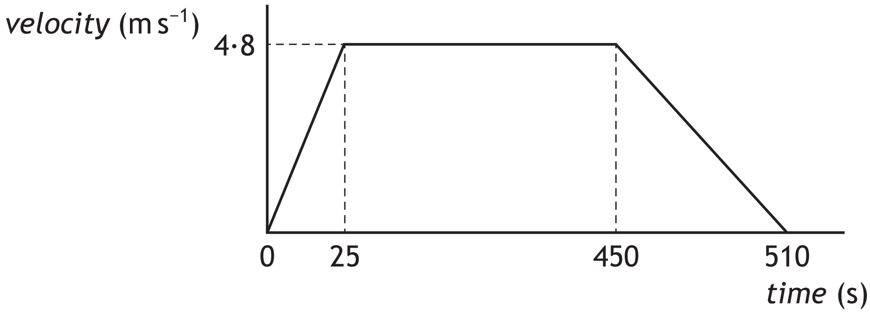
Practice Questions

Physics
Section 2

10. In a rowing event a boat moves off in a straight line.



A graph of the boat's motion is shown.



(a) (i) Calculate the acceleration of the boat during the first 25 s. **3**

Space for working and answer

(ii) Describe the motion of the boat between 25 s and 450 s. **1**

10. (a) (continued)

(iii) Draw a diagram showing the horizontal forces acting on the boat between 25 s and 450 s.

You **must** name these forces and show their directions. **2**

(b) The boat comes to rest after 510 s.

(i) Calculate the total distance travelled by the boat. **3**

Space for working and answer

(ii) Calculate the average velocity of the boat.

A direction is not required. **3**

Space for working and answer

Total marks 12

MARKS | DO NOT WRITE IN THIS MARGIN

11. A helicopter is used to take tourists on sightseeing flights.

Information about the helicopter is shown in the table.

weight of empty helicopter	13 500 N
maximum take-off weight	24 000 N
cruising speed	$67\ m\ s^{-1}$
maximum speed	$80\ m\ s^{-1}$
maximum range	610 km

(a) The pilot and passengers are weighed before they board the helicopter.

Explain the reason for this. **1**

(b) Six passengers and the pilot with a combined weight of 6125 N board the helicopter.

Determine the minimum upward force required by the helicopter at take-off. **1**

Space for working and answer

MARKS | DO NOT WRITE IN THIS MARGIN

11. (continued)

(c) The helicopter travels 201 km at its cruising speed.

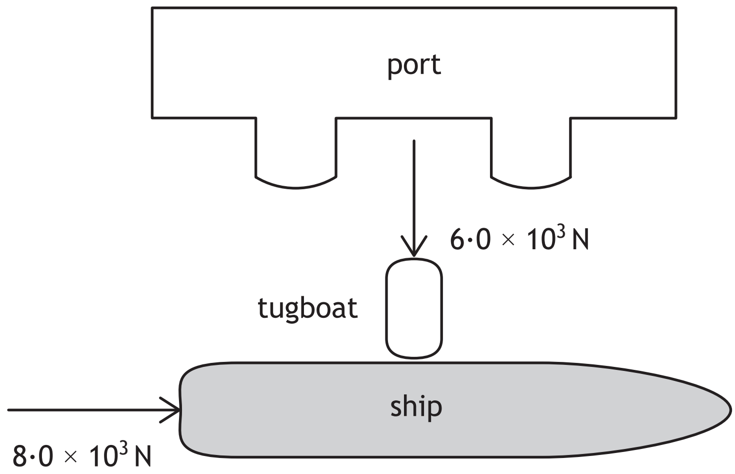
Calculate the time taken to travel this distance. **3**

Space for working and answer

Total marks 5

[Turn over

7. A ship of mass $5{\cdot}0 \times 10^6$ kg leaves a port. Its engine produces a forward force of $8{\cdot}0 \times 10^3$ N. A tugboat pushes against one side of the ship as shown. The tugboat applies a pushing force of $6{\cdot}0 \times 10^3$ N.



(a) (i) By scale drawing, or otherwise, determine the size of the resultant force acting on the ship. **2**

Space for working and answer

(ii) Determine the direction of the resultant force relative to the $8{\cdot}0 \times 10^3$ N force. **2**

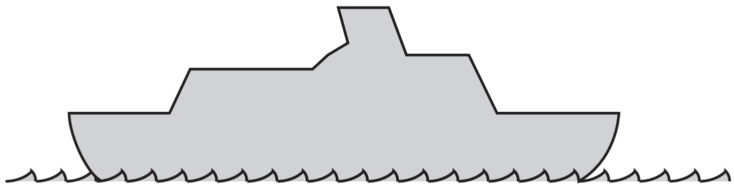
Space for working and answer

7. (a) (continued)

(iii) Calculate the size of the acceleration of the ship. **3**

Space for working and answer

(b) Out in the open sea the ship comes to rest.



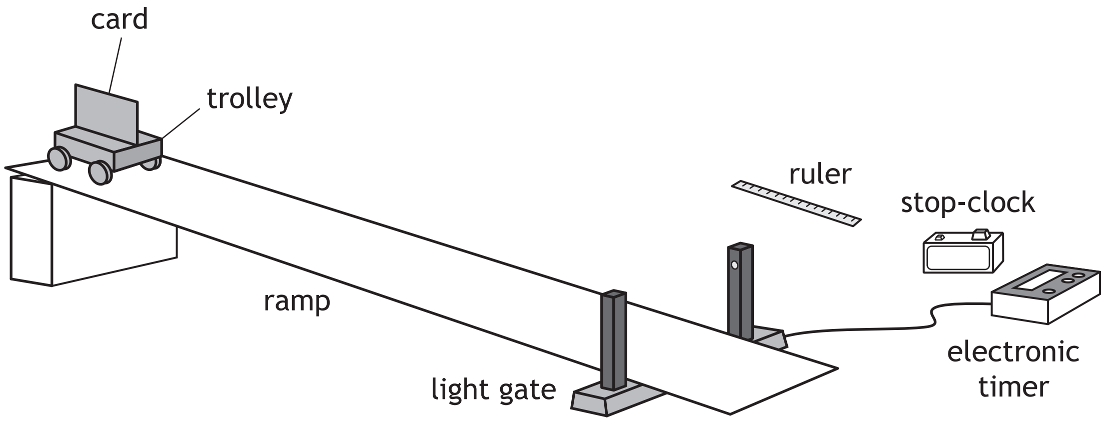
Explain, with the aid of a labelled diagram, why the ship floats. **3**

[Turn over

8. A student is investigating the motion of a trolley down a ramp.

(a) The student uses the apparatus shown to carry out an experiment to determine the acceleration of a trolley as it rolls down a ramp.

The trolley is released from rest at the top of the ramp.

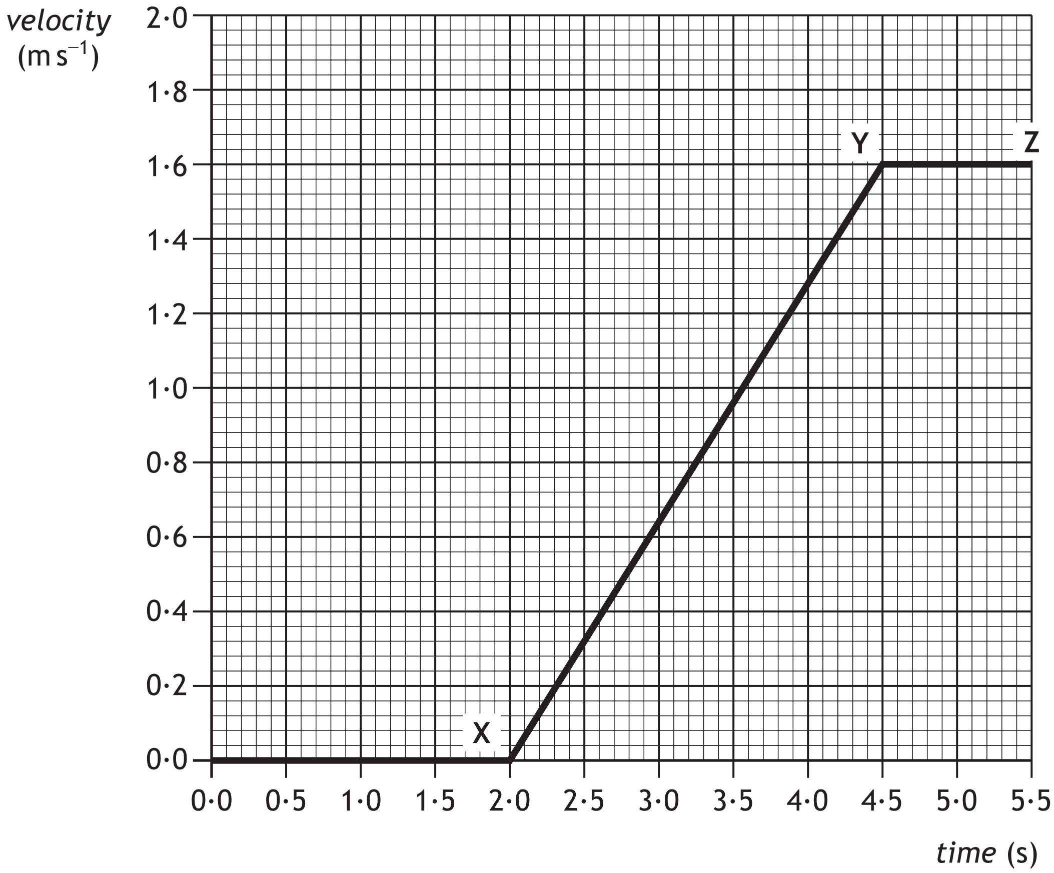


(i) State the measurements the student must make to calculate the acceleration of the trolley. **3**

(ii) Suggest one reason why the acceleration calculated from these measurements might not be accurate. **1**

8. (continued)

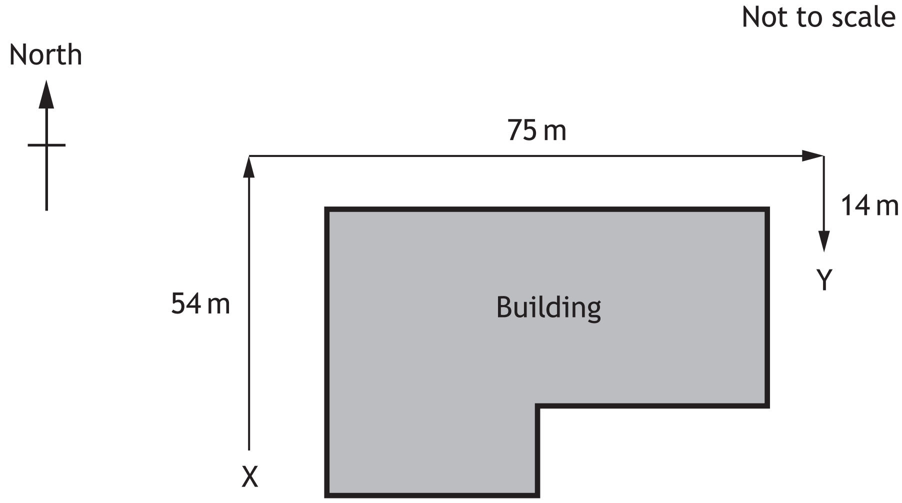
(b) In a second experiment, the student uses a motion sensor and computer to produce the following velocity-time graph for the trolley



Calculate the acceleration of this trolley between X and Y. **3**

Space for working and answer

9. A student walks around a building from point X to point Y.



(a) By scale diagram, or otherwise, determine:

(i) the magnitude of the displacement of the student from point X to point Y; **2**

Space for working and answer

(ii) the direction of displacement of the student from point X to point Y. **2**

Space for working and answer

9. (continued)

(b) The student takes 68 s to travel from point X to point Y.

(i) Determine the average velocity of the student from point X to point Y. **3**

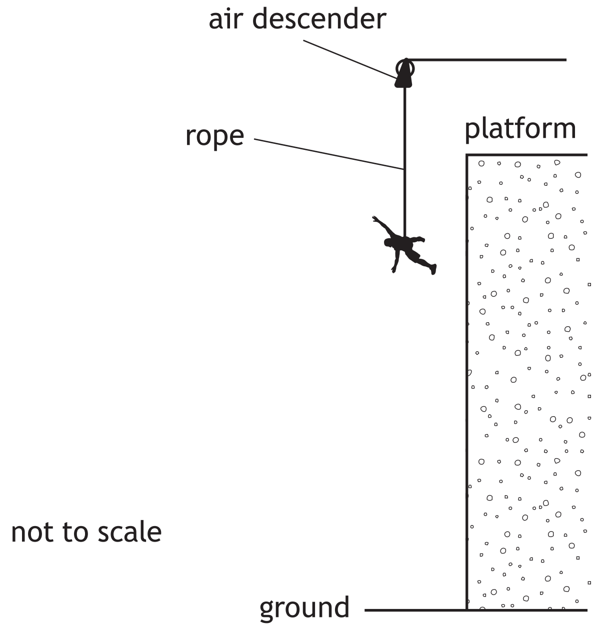
Space for working and answer

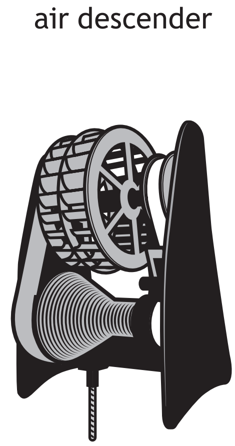
(ii) The student states that their average speed between point X and point Y is greater than the magnitude of their average velocity between point X and point Y.

Explain why the student is correct. **2**

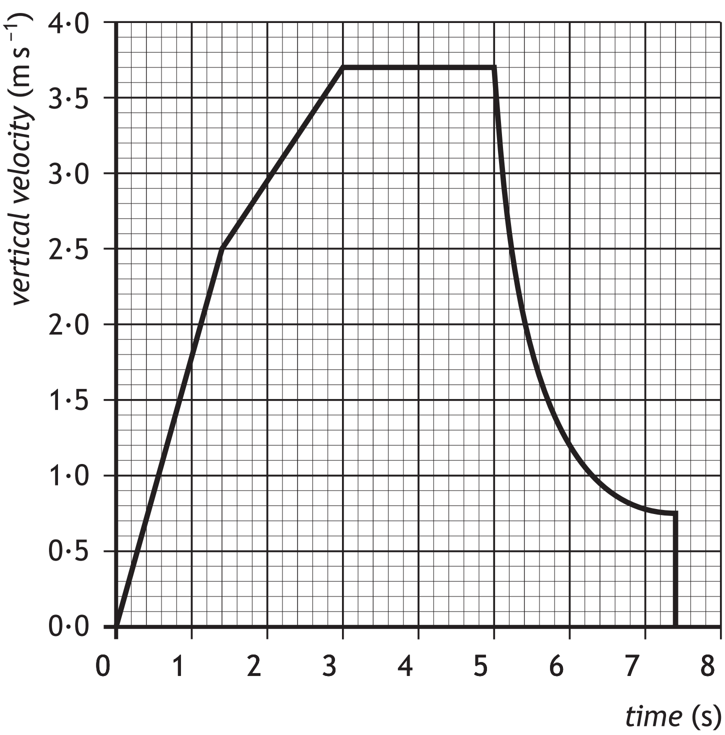
10. An air descender is a machine that controls the rate at which a climber drops from a platform at the top of a climbing wall.

A climber, attached to the air descender by a rope, steps off the platform and drops towards the ground and lands safely.





The graph shows how the vertical velocity of the climber varies with time from the instant the climber leaves the platform until landing.



10. (continued)

(a) Calculate the acceleration of the climber during the first 1·4 s of the drop. **3**

Space for working and answer

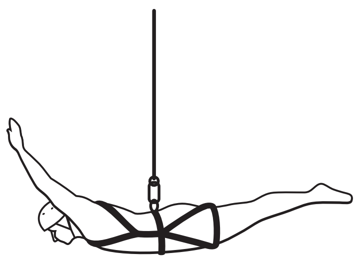
(b) Calculate the distance the climber drops during the first 3·0 s. **3**

Space for working and answer

(c) During part of the drop the forces on the climber are balanced.

On the diagram below show all the forces acting vertically on the climber during this part of the drop.

You must name these forces **and** show their directions. **3**



(An additional diagram, if required, can be found on *Page 33*)

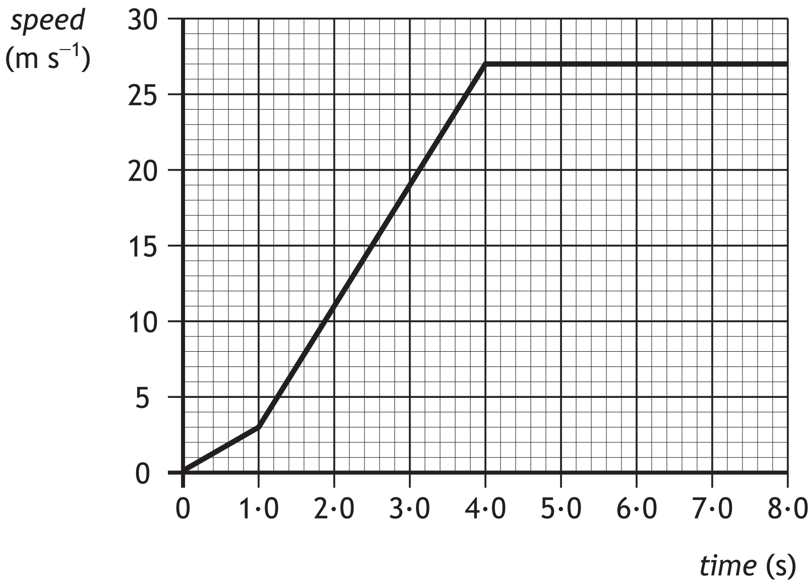
MARKS | DO NOT WRITE IN THIS MARGIN

8. In speedway, motorbikes are raced anticlockwise round an oval track.

A race consists of four laps of a 380 m track.

(a) State the displacement of a motorbike from the start line to the finish line for a complete race. **1**

(b) The speed-time graph of a motorbike for the first 8·0 s of a race is shown.



8. (b) (continued)

(i) Calculate the distance travelled by the motorbike in the first 4·0 s of the race. **3**

Space for working and answer

(ii) Determine the **greatest** acceleration of the motorbike during the first 8·0 s of the race. **3**

Space for working and answer

(c) The winner of the race completes all four laps in a time of 79 s.

Calculate the average speed of the winner. **3**

Space for working and answer

MARKS | DO NOT WRITE IN THIS MARGIN

9. A weightlifter applies an upwards force of 1176 N to a barbell to hold it in a stationary position as shown.

(a) Describe how the upward force exerted by the weightlifter on the barbell compares to the weight of the barbell. **1**

(b) Calculate the mass of the barbell. **3**

Space for working and answer

(c) The weightlifter increases the upward force on the barbell to 1344 N in order to lift the barbell above their head.

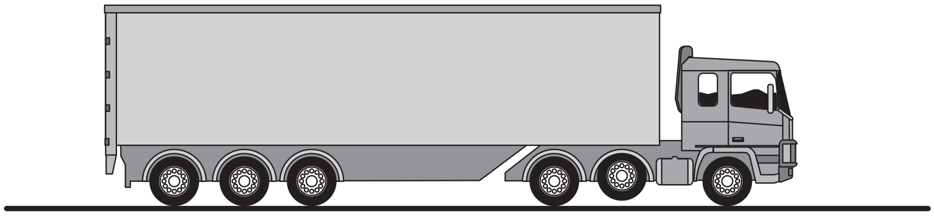
Calculate the initial acceleration of the barbell. **4**

Space for working and answer

MARKS DO NOT WRITE IN THIS MARGIN

10. An articulated lorry has six pairs of wheels.

One pair of wheels can be raised off the ground.



Using your knowledge of physics, comment on situations in which the wheels may be raised or lowered. **3**

N5

Physics
Relationships Sheet

$$E_p = mgh$$

$$E_k = \tfrac{1}{2}mv^2$$

$$Q = It$$

$$V = IR$$

$$R_T = R_1 + R_2 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_s$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$$P = \frac{E}{t}$$

$$P = IV$$

$$P = I^2R$$

$$P = \frac{V^2}{R}$$

$$E_h = cm\Delta T$$

$$p = \frac{F}{A}$$

$$\frac{pV}{T} = \text{constant}$$

$$p_1V_1 = p_2V_2$$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$d = vt$$

$$v = f\lambda$$

$$T = \frac{1}{f}$$

$$A = \frac{N}{t}$$

$$D = \frac{E}{m}$$

$$H = Dw_R$$

$$\dot{H} = \frac{H}{t}$$

$$s = vt$$

$$d = \bar{v}t$$

$$s = \bar{v}t$$

$$a = \frac{v-u}{t}$$

$$W = mg$$

$$F = ma$$

$$E_w = Fd$$

$$E_h = ml$$

Additional Relationships

Circle

circumference $= 2\pi r$

area $= \pi r^2$

Sphere

area $= 4\pi r^2$

volume $= \frac{4}{3}\pi r^3$

Trigonometry

$$\sin\Theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\Theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\Theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin^2\Theta + \cos^2\Theta = 1$$

Electron Arrangements of Elements

Key

Atomic number Symbol Electron arrangement Name

Transition Elements

Group 1 (1)	Group 2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Group 3 (13)	Group 4 (14)	Group 5 (15)	Group 6 (16)	Group 7 (17)	Group 0 (18)
1 **H** 1 Hydrogen																	2 **He** 2 Helium
3 **Li** 2,1 Lithium	4 **Be** 2,2 Beryllium											5 **B** 2,3 Boron	6 **C** 2,4 Carbon	7 **N** 2,5 Nitrogen	8 **O** 2,6 Oxygen	9 **F** 2,7 Fluorine	10 **Ne** 2,8 Neon
11 **Na** 2,8,1 Sodium	12 **Mg** 2,8,2 Magnesium											13 **Al** 2,8,3 Aluminium	14 **Si** 2,8,4 Silicon	15 **P** 2,8,5 Phosphorus	16 **S** 2,8,6 Sulfur	17 **Cl** 2,8,7 Chlorine	18 **Ar** 2,8,8 Argon
19 **K** 2,8,8,1 Potassium	20 **Ca** 2,8,8,2 Calcium	21 **Sc** 2,8,9,2 Scandium	22 **Ti** 2,8,10,2 Titanium	23 **V** 2,8,11,2 Vanadium	24 **Cr** 2,8,13,1 Chromium	25 **Mn** 2,8,13,2 Manganese	26 **Fe** 2,8,14,2 Iron	27 **Co** 2,8,15,2 Cobalt	28 **Ni** 2,8,16,2 Nickel	29 **Cu** 2,8,18,1 Copper	30 **Zn** 2,8,18,2 Zinc	31 **Ga** 2,8,18,3 Gallium	32 **Ge** 2,8,18,4 Germanium	33 **As** 2,8,18,5 Arsenic	34 **Se** 2,8,18,6 Selenium	35 **Br** 2,8,18,7 Bromine	36 **Kr** 2,8,18,8 Krypton
37 **Rb** 2,8,18,8,1 Rubidium	38 **Sr** 2,8,18,8,2 Strontium	39 **Y** 2,8,18,9,2 Yttrium	40 **Zr** 2,8,18, 10,2 Zirconium	41 **Nb** 2,8,18, 12,1 Niobium	42 **Mo** 2,8,18,13, 1 Molybdenum	43 **Tc** 2,8,18,13, 2 Technetium	44 **Ru** 2,8,18,15, 1 Ruthenium	45 **Rh** 2,8,18,16, 1 Rhodium	46 **Pd** 2,8,18, 18,0 Palladium	47 **Ag** 2,8,18, 18,1 Silver	48 **Cd** 2,8,18, 18,2 Cadmium	49 **In** 2,8,18, 18,3 Indium	50 **Sn** 2,8,18, 18,4 Tin	51 **Sb** 2,8,18, 18,5 Antimony	52 **Te** 2,8,18, 18,6 Tellurium	53 **I** 2,8,18, 18,7 Iodine	54 **Xe** 2,8,18, 18,8 Xenon
55 **Cs** 2,8,18,18, 8,1 Caesium	56 **Ba** 2,8,18,18, 8,2 Barium	57 **La** 2,8,18,18, 9,2 Lanthanum	72 **Hf** 2,8,18,32, 10,2 Hafnium	73 **Ta** 2,8,18, 32,11,2 Tantalum	74 **W** 2,8,18,32, 12,2 Tungsten	75 **Re** 2,8,18,32, 13,2 Rhenium	76 **Os** 2,8,18,32, 14,2 Osmium	77 **Ir** 2,8,18,32, 15,2 Iridium	78 **Pt** 2,8,18,32, 17,1 Platinum	79 **Au** 2,8,18, 32,18,1 Gold	80 **Hg** 2,8,18, 32,18,2 Mercury	81 **Tl** 2,8,18, 32,18,3 Thallium	82 **Pb** 2,8,18, 32,18,4 Lead	83 **Bi** 2,8,18, 32,18,5 Bismuth	84 **Po** 2,8,18, 32,18,6 Polonium	85 **At** 2,8,18, 32,18,7 Astatine	86 **Rn** 2,8,18, 32,18,8 Radon
87 **Fr** 2,8,18,32, 18,8,1 Francium	88 **Ra** 2,8,18,32, 18,8,2 Radium	89 **Ac** 2,8,18,32, 18,9,2 Actinium	104 **Rf** 2,8,18,32, 32,10,2 Rutherfordium	105 **Db** 2,8,18,32, 32,11,2 Dubnium	106 **Sg** 2,8,18,32, 32,12,2 Seaborgium	107 **Bh** 2,8,18,32, 32,13,2 Bohrium	108 **Hs** 2,8,18,32, 32,14,2 Hassium	109 **Mt** 2,8,18,32, 32,15,2 Meitnerium	110 **Ds** 2,8,18,32, 32,17,1 Darmstadtium	111 **Rg** 2,8,18,32, 32,18,1 Roentgenium	112 **Cn** 2,8,18,32, 32,18,2 Copernicium						

Lanthanides	57 **La** 2,8,18, 18,9,2 Lanthanum	58 **Ce** 2,8,18, 20,8,2 Cerium	59 **Pr** 2,8,18,21, 8,2 Praseodymium	60 **Nd** 2,8,18,22, 8,2 Neodymium	61 **Pm** 2,8,18,23, 8,2 Promethium	62 **Sm** 2,8,18,24, 8,2 Samarium	63 **Eu** 2,8,18,25, 8,2 Europium	64 **Gd** 2,8,18,25, 9,2 Gadolinium	65 **Tb** 2,8,18,27, 8,2 Terbium	66 **Dy** 2,8,18,28, 8,2 Dysprosium	67 **Ho** 2,8,18,29, 8,2 Holmium	68 **Er** 2,8,18,30, 8,2 Erbium	69 **Tm** 2,8,18,31, 8,2 Thulium	70 **Yb** 2,8,18,32, 8,2 Ytterbium	71 **Lu** 2,8,18,32, 9,2 Lutetium
Actinides	89 **Ac** 2,8,18,32, 18,9,2 Actinium	90 **Th** 2,8,18,32, 18,10,2 Thorium	91 **Pa** 2,8,18,32, 20,9,2 Protactinium	92 **U** 2,8,18,32, 21,9,2 Uranium	93 **Np** 2,8,18,32, 22,9,2 Neptunium	94 **Pu** 2,8,18,32, 24,8,2 Plutonium	95 **Am** 2,8,18,32, 25,8,2 Americium	96 **Cm** 2,8,18,32, 25,9,2 Curium	97 **Bk** 2,8,18,32, 27,8,2 Berkelium	98 **Cf** 2,8,18,32, 28,8,2 Californium	99 **Es** 2,8,18,32, 29,8,2 Einsteinium	100 **Fm** 2,8,18,32, 30,8,2 Fermium	101 **Md** 2,8,18,32, 31,8,2 Mendelevium	102 **No** 2,8,18,32, 32,8,2 Nobelium	103 **Lr** 2,8,18,32, 32,9,2 Lawrencium