



Mechanics

FREE Online Physics A Level Course

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Name _____ Date _____

TIME ALLOWED

90 minutes

TOTAL MARKS

78

YOU WILL NEED

a calculator, a ruler and a black or blue pen

Instructions

- Answer **all** questions in the spaces provided.
- Question 1 is multiple choice: tick **one** box for each part.
- Show your working in calculations, and include units where appropriate.
- Use $g = 9.81 \text{ N kg}^{-1}$.

Information

- The marks for each question are shown in brackets: use them as a guide to how long to spend.
- This test covers Edexcel A Level Physics Topic 2, spec points 9–30.
- In the question marked with an asterisk (*), marks are awarded for structuring your answer logically.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Total	%
Out of	10	3	9	8	6	7	10	9	10	6	78	100
Your mark												

Marking your test

The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1

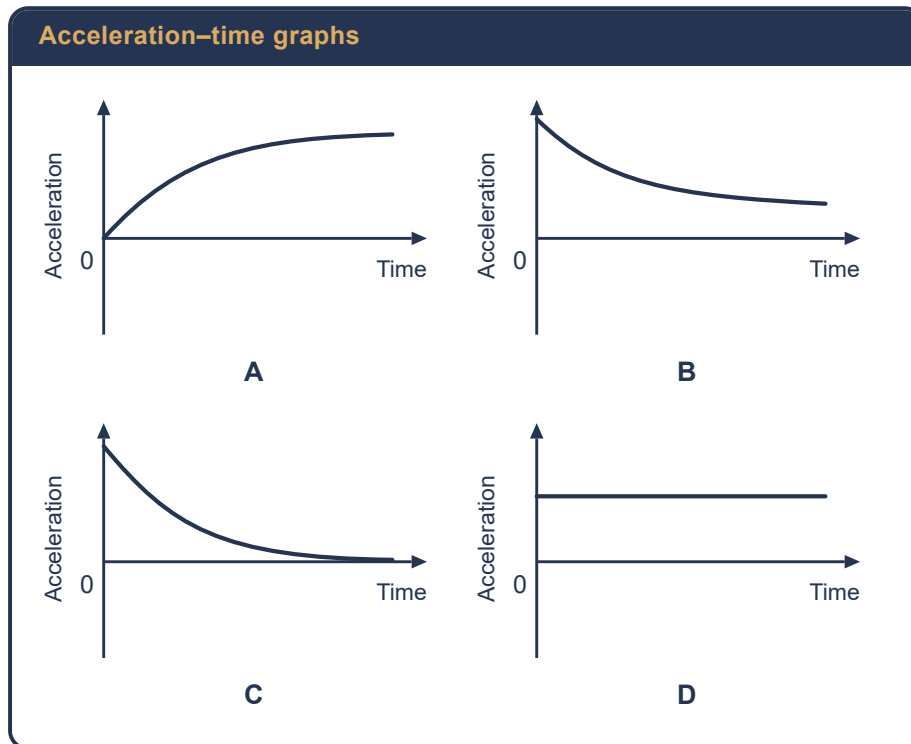
Multiple choice

10 marks

For each part, put a tick (✓) in **one** box. Each part is worth 1 mark.

- (a) A constant forward force acts on a car. The car accelerates along a straight road. After a while, the speed of the car reaches a constant value.

Which graph shows the variation of acceleration with time for the car?



Tick (✓) **one** box.

A

☐

B

☐

C

☐

D

☐

(1)

- (b) An object is falling at terminal velocity. Which of the following is **not** a valid conclusion from this statement?

Tick (✓) **one** box.

A The acceleration of the object is zero.

☐

B There is a resistive force acting on the object.

☐

C There is a resultant force acting on the object.

☐

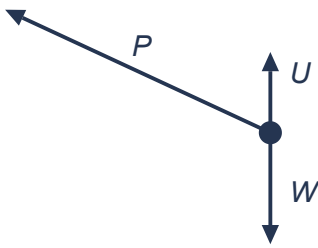
D The object has weight.

☐

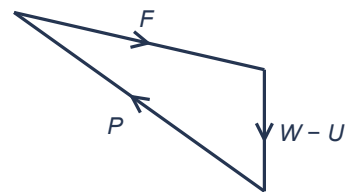
(1)

- (c) A soap bubble is being blown by the wind. The free-body force diagram shows the forces acting on the bubble. P is the force of the wind, W is the weight of the bubble and U is the upthrust acting on the bubble.

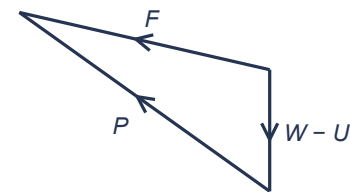
Free-body diagram



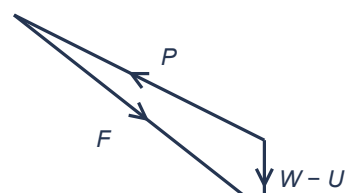
Vector diagrams



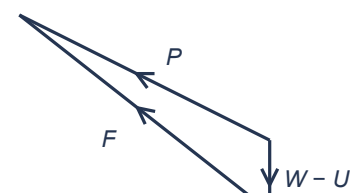
A



B



C



D

Which of the vector diagrams shows the resultant force F acting on the bubble?

Tick (✓) **one** box.

A

☐

B

☐

C

☐

D

☐

(1)

(d) A student determined a value for g by dropping a metal sphere from rest. The student measured the distance fallen and the time taken for the sphere to fall. The student obtained a value for g of 11.2 m s^{-2} .

Which of the following could explain the difference between the student's value and the accepted value?

Tick (✓) **one** box.

A The air resistance was not negligible.

☐

B The student's measured distance was greater than the actual distance.

☐

C The sphere did not fall vertically.

☐

D The student's measured time was greater than the actual time taken.

☐

(1)

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- (e) A ball of mass m is projected vertically upwards. An air resistance F acts on the ball at all times. Which of the following equations would apply to the ball as it is travelling upwards?

Tick (✓) **one** box.

A $mg - F = 0$

☐

B $mg + F = 0$

☐

C $mg - F = ma$

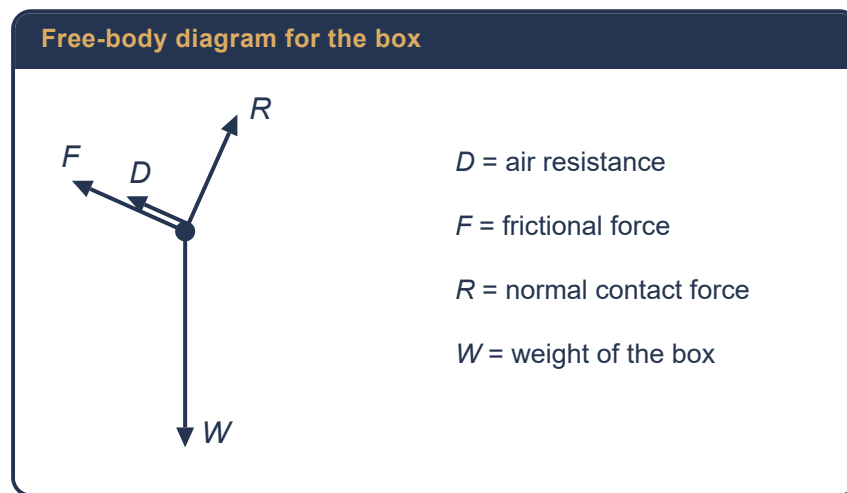
☐

D $mg + F = ma$

☐

(1)

- (f) A box was placed at the top of a ramp and released. The free-body force diagram for the box as it moved down the ramp at a constant velocity is shown.



Which two forces acting on the box have, according to Newton's third law, corresponding forces acting on the ramp?

Tick (✓) **one** box.

A F and D

☐

B F and R

☐

C W and D

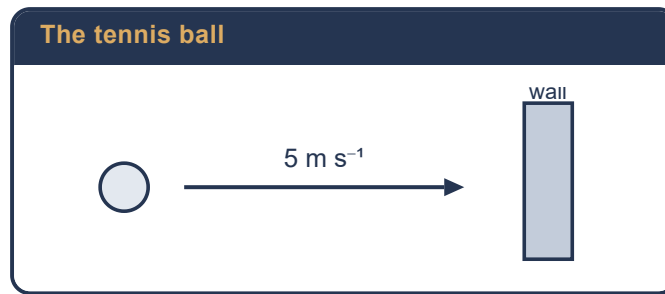
☐

D W and R

☐

(1)

- (g) A tennis ball of mass 0.06 kg moves towards a wall at a velocity of 5 m s^{-1} . It hits the wall perpendicularly and rebounds at the same speed. What is the change in momentum of the ball?



Tick (✓) **one** box.

A 0.60 kg m s^{-1}

☐

B 0.30 kg m s^{-1}

☐

C $-0.30 \text{ kg m s}^{-1}$

☐

D $-0.60 \text{ kg m s}^{-1}$

☐

(1)

- (h) A trolley, mass 0.50 kg , has a speed of 2.0 m s^{-1} . A second trolley, mass 1.0 kg , has a speed of 2.0 m s^{-1} . The two trolleys are travelling in opposite directions and collide.

Which of the following could be a correct value of total momentum, in kg m s^{-1} , after the collision?

Tick (✓) **one** box.

A 0

☐

B 1.0

☐

C 2.0

☐

D 3.0

☐

(1)

- (i) A car of mass $1.2 \times 10^3 \text{ kg}$ is travelling at a speed of 18 m s^{-1} . The driver applies the brakes and the car comes to rest. What is the work done by the brakes in stopping the car?

Tick (✓) **one** box.

A 11 kJ

☐

B 22 kJ

☐

C 190 kJ

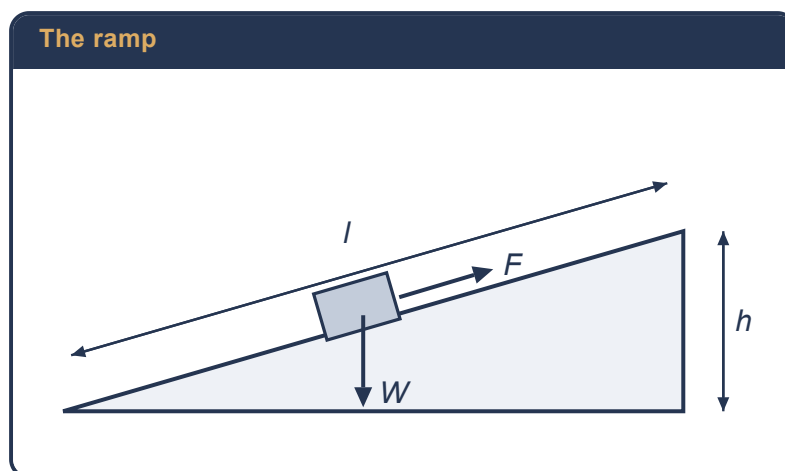
☐

D 390 kJ

☐

(1)

- (j) A student uses a force F to push a block of weight W all the way up a frictionless ramp, at a constant speed.



The work done by the student can be calculated using

Tick (✓) **one** box.

A Fh

☐

B $(F - W)l$

☐

C Wh

☐

D Wl

☐

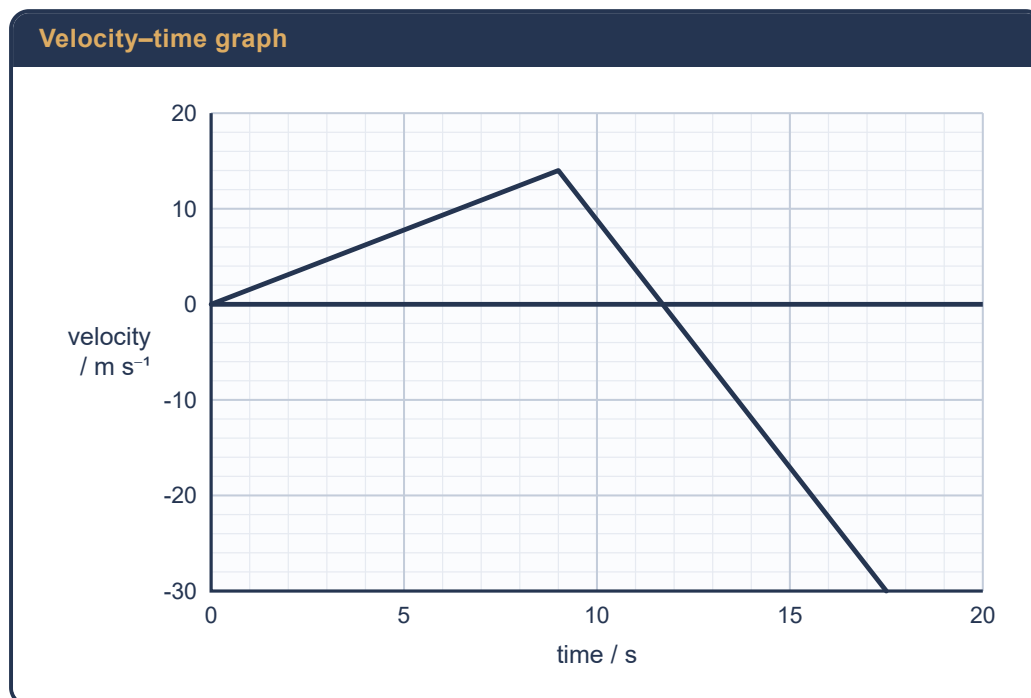
(1)

Total for this question: 10 marks

2 Question 2

3 marks

The graph shows how the velocity of an object varies with time.



Describe how the acceleration of the object varies with time. Your answer should include calculations.

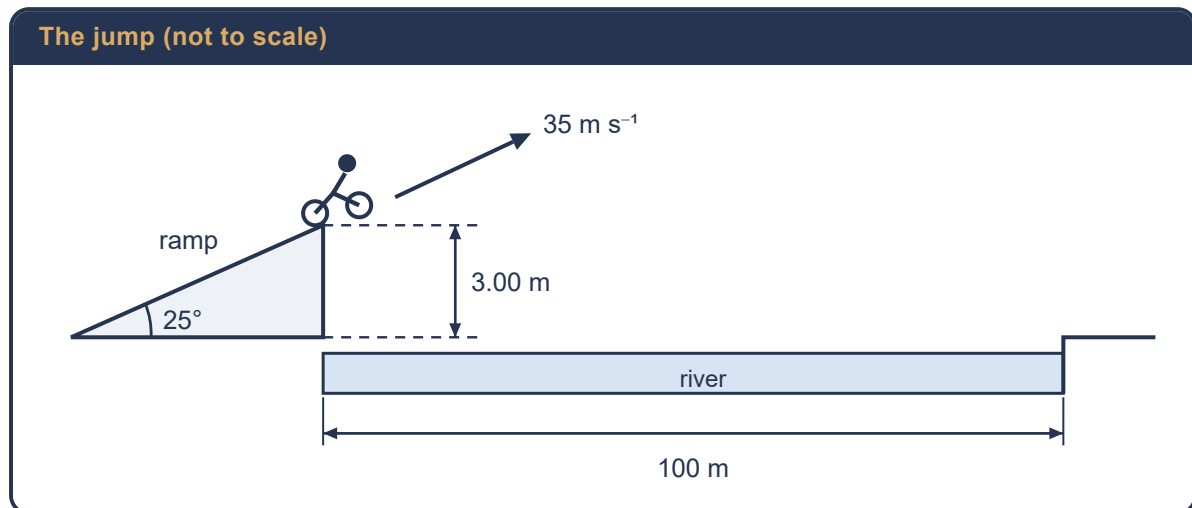
(3)

Total for this question: 3 marks

3 Question 3

9 marks

A stunt motorcyclist wants to jump across a river to land on the other side. The diagram shows the motorcyclist driving off a ramp at the edge of a river.



The ramp is at an angle of 25° to the horizontal and the height at the end of the ramp is 3.0 m . The width of the river is 100 m . The initial velocity of the motorcyclist is 35 m s^{-1} .

- (a) Calculate the horizontal and vertical components of the motorcycle's initial velocity as it leaves the ramp.

Horizontal component = _____ m s^{-1}

Vertical component = _____ m s^{-1}
(2)

- (b) Deduce whether the rider lands on the other side of the river. The effects of air resistance can be ignored.

(4)

(c) Explain how air resistance would affect the jump.

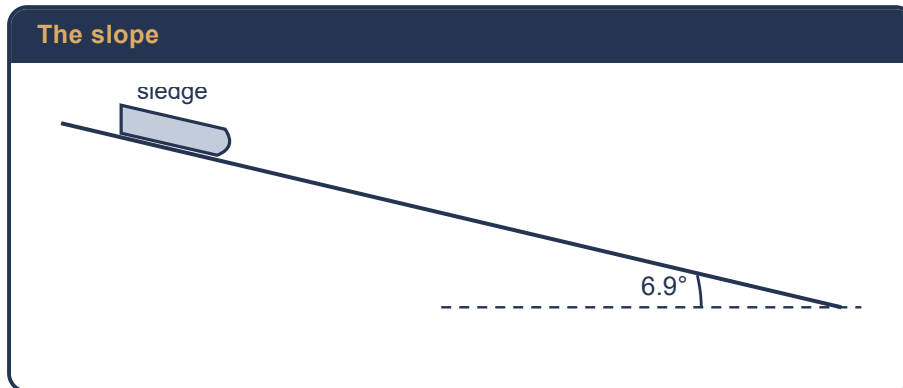
(3)

Total for this question: 9 marks

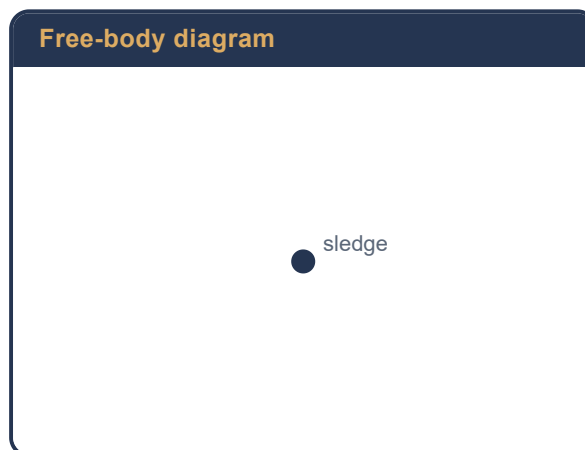
4 Question 4

8 marks

A sledge accelerates, due to gravity, from rest down a frictionless slope. Air resistance can be ignored. The slope is at an angle of 6.9° to the horizontal, as shown.



(a) Complete the free-body force diagram below for the sledge.



(2)

(b) The slope has a total length of 60 m.

(i) Show that the initial acceleration of the sledge along the slope is about 1 m s^{-2} .

(2)

(ii) Determine the speed of the sledge at the end of the slope.

Speed at end of slope = _____ m s^{-1}
(2)

(iii) Determine the time taken for the sledge to travel to the end of the slope.

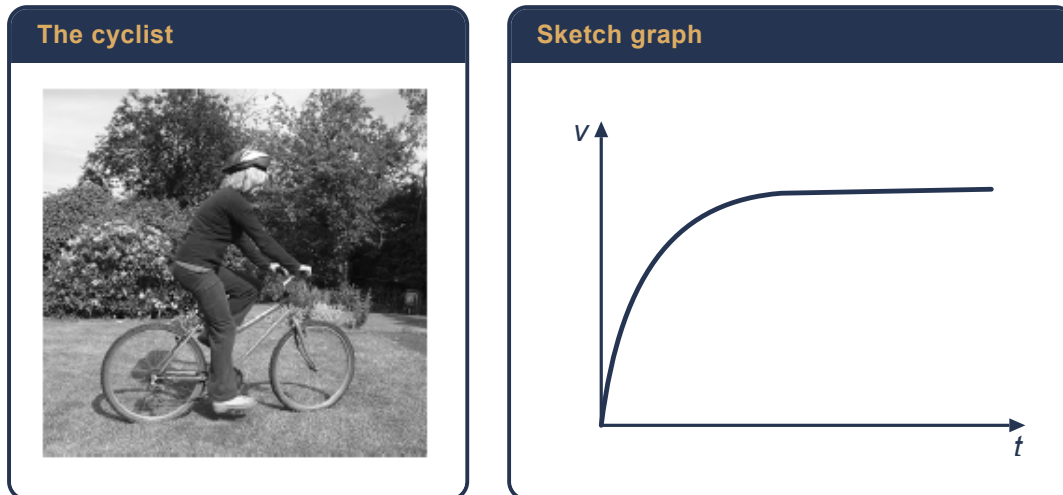
Time taken = _____ s
(2)

Total for this question: 8 marks

5 Question 5

6 marks

A sports class is studying cycling. They produce a video of a cyclist on a horizontal lawn. The cyclist starts from rest. They produce a sketch graph of the velocity v of the cyclist against time t .



- (a) Explain the shape of this graph and include a consideration of force as part of your answer.

(3)

- (b) A student makes the following statement.

“The work done by the cyclist is converted into the kinetic energy of the cyclist and bicycle.”

Criticise this statement.

(3)

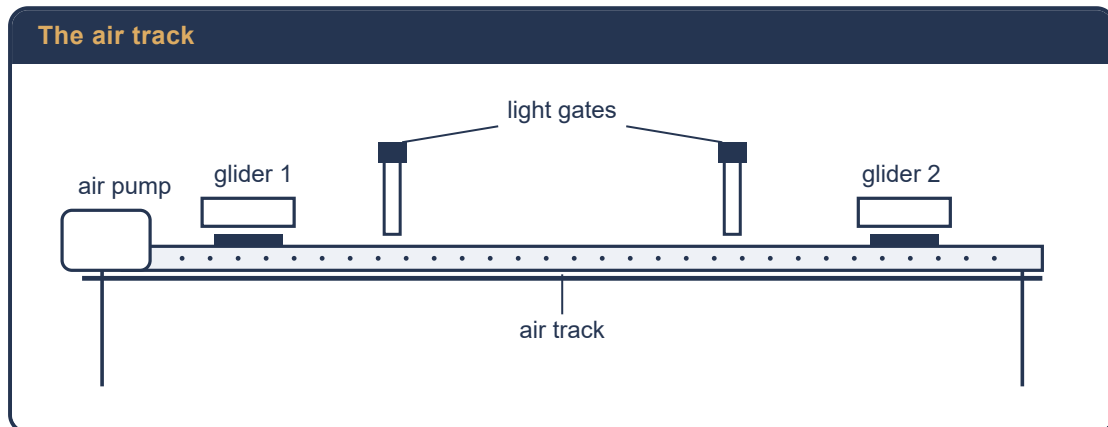
Total for this question: 6 marks

6 Question 6

7 marks

A teacher uses a linear air track to provide a frictionless surface for two gliders, each of mass m . She uses this, with a pair of light gates connected to a computer, to investigate a collision between the gliders.

The gliders are each given a small push and travel towards the centre of the track. The gliders collide and move off together.



- (a) The computer displays the velocity of the gliders as they pass through the light gates.

initial velocity of glider 1 = 0.30 m s^{-1} to the right

initial velocity of glider 2 = 0.70 m s^{-1} to the left

Calculate the velocity of the gliders after the collision, using the principle of conservation of linear momentum.

Magnitude of velocity = _____ m s^{-1}

Direction of velocity = _____

(3)

- (b) The teacher asked a student to justify the change in velocity of glider 1 using Newton's laws of motion. The student began his explanation with the statement:

"During the collision there is a force on glider 2."

Complete the explanation to justify the change in velocity of glider 1, making reference to Newton's laws of motion where appropriate.

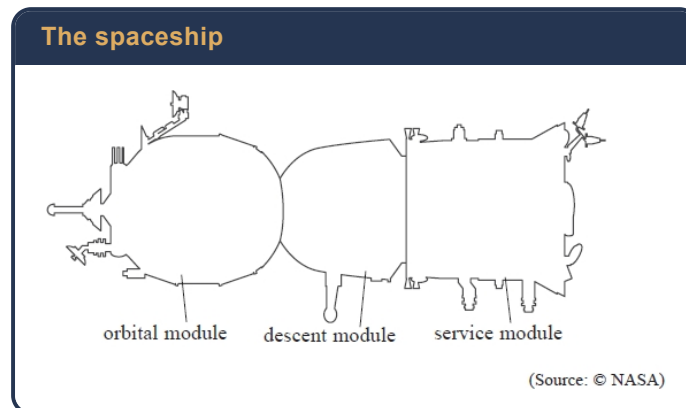
(4)

Total for this question: 7 marks

7 Question 7

10 marks

A spaceship is used to take astronauts and equipment to the International Space Station. The spaceship consists of an orbital module, a descent module and a service module, as shown.



The astronauts return to Earth in the descent module. Before entering the Earth's atmosphere, the modules separate.

The orbital module (O) and service module (S) move away from the descent module (D) in opposite directions, as shown below. The velocities are measured relative to the spaceship before the modules separated.



- (a) Determine the velocity v of the descent module after separation.

You should only consider momentum along a horizontal line through the centres of the three modules.

mass of O = 1350 kg mass of D = 2950 kg mass of S = 2100 kg

Magnitude of v = _____ m s^{-1}

Direction of v = _____

(4)

- (b) The velocity of the descent module can be changed using a rocket motor. The rocket motor ejects hot gases at high velocity.
- (i) Explain why the velocity of the descent module changes when the rocket motor is used. Your answer should refer to Newton's laws of motion.

(3)

- (ii) When the rocket motor is operating, the velocity of the descent module changes by 0.58 m s^{-1} during a time of 5.0 seconds.

mass of descent module = 2950 kg

Calculate the average force exerted on the hot gas during this time.

Average force = _____ N

(3)

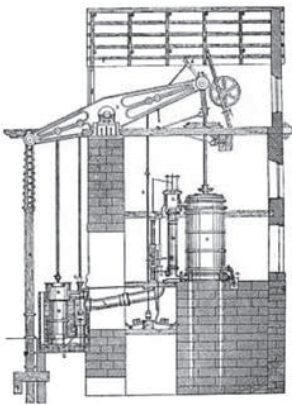
Total for this question: 10 marks

8 Question 8

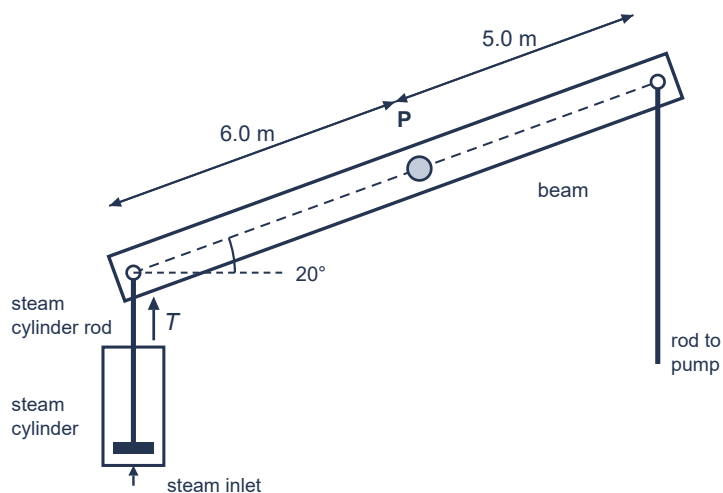
9 marks

Beam engines contributed to powering the Industrial Revolution in Britain in the 18th century. A beam engine consisted of a beam which could rock to and fro around a well-oiled pivot. Attached to the beam there are two rods, one connected to a piston in a steam cylinder and the other connected to a pump.

A beam engine



Simplified arrangement



- (a) The beam has a constant thickness and a mass of 3.05×10^4 kg. The length of the beam is 11.0 m. The pivot P is positioned 6.0 m from the steam cylinder end of the beam.

In its resting position the steam cylinder rod is supported by the base of the steam cylinder with the beam at an angle of 20° to the horizontal. The steam cylinder rod exerts a force T on the beam. The force exerted on the beam by the pump rod can be neglected.

Calculate the force T .

$T =$ _____ N
(4)

- (b) The engine, which ran continuously, could lift a mass of 2500 kg of water through 12 m each minute. The engine used 1250 kg of coal a day. 1 kg of coal can release 22.3 MJ of energy. The beam engine was said to have an efficiency of 10%. Deduce whether this claim for efficiency was correct.

(5)

Total for this question: 9 marks

9

Question 9

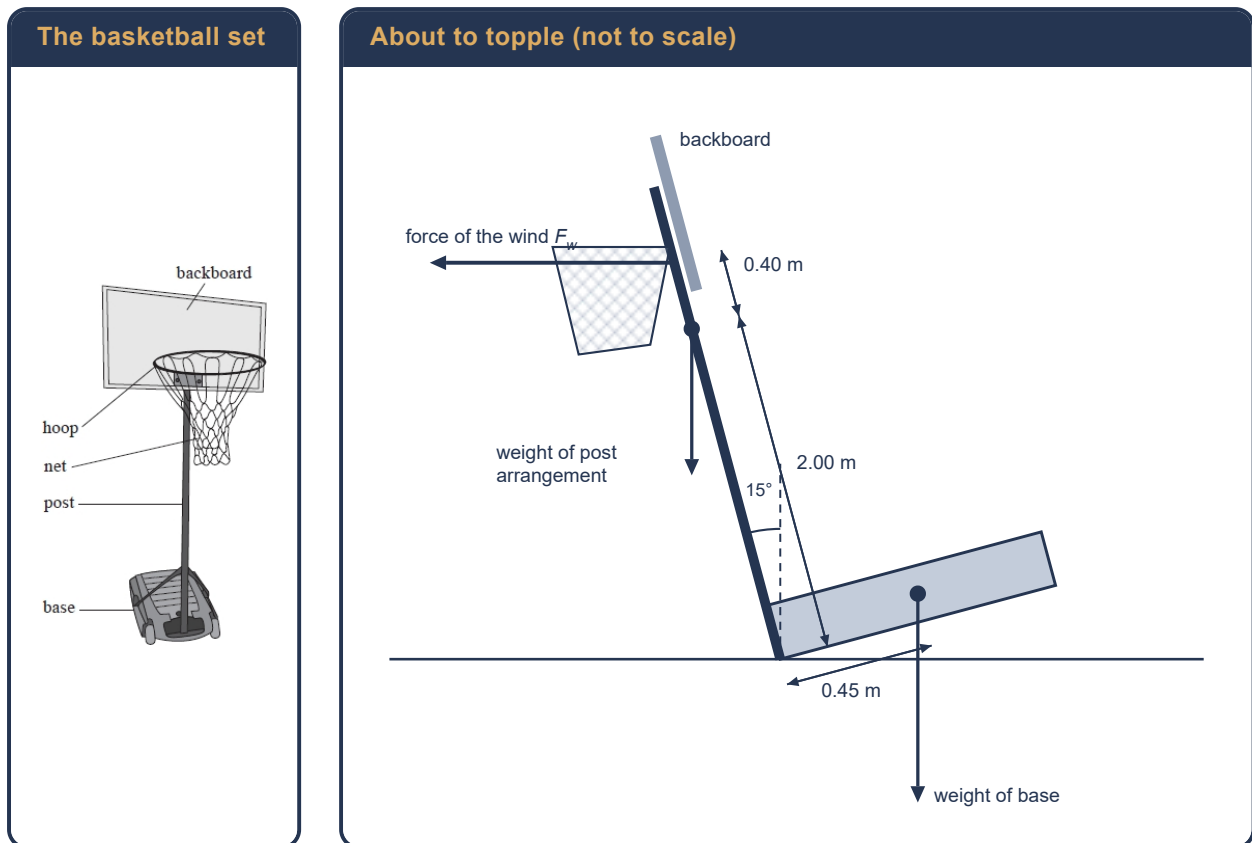
10 marks

A portable basketball set has a base and a post arrangement. The post arrangement consists of a post, backboard, hoop and net. The base can be filled with water to increase stability.

- (a) The base has a capacity of 85.0 litres. Show that the maximum weight of the base is about 870 N.
mass of 1.00 litre of water = 1.00 kg mass of base when empty = 3.50 kg

(2)

- (b) Due to the large area of the backboard, the basketball set may topple over when the wind blows.



Calculate the minimum force of the wind F_w that will cause the basketball set to be blown over when it is at the angle shown. Ignore the effect of the wind on the base.

weight of post arrangement = 27.0 N

Minimum force of the wind $F_w =$ _____ N
 (5)

- (c) The base is filled with sand instead of water. The density of sand is greater than the density of water.

State and justify what would happen to the value of F_w calculated in part (b).

(3)

Total for this question: 10 marks

10 Question 10

* extended answer

6 marks

The following extract comes from a section on forces, on a website written for children.

The website extract

Forces act in pairs. The lift force on a plane pushing it up into the sky is paired with gravity, which pulls the plane back towards the centre of the Earth.

If both forces in the pair are equal, the plane will stay at rest in the same place.

- * Criticise this extract.

In this question, marks are awarded for your ability to structure your answer logically, showing how the points you make are related or follow on from each other.

(6)

Total for this question: 6 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

Mechanics · Topic Test

[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

Multiple choice

10 marks

PART	ANSWER	MARK
(a)	C <i>A, B and D: the acceleration never reaches zero, but at constant speed it must.</i>	1
(b)	C There is a resultant force acting on the object. KEY EQUATION $\Sigma F = ma$ terminal velocity $\rightarrow a = 0 \rightarrow \Sigma F = 0$ <i>A is true: v is constant so a = 0. B is true: a resistive force balances the weight. D is true: the object has weight.</i>	1
(c)	B <i>A gives the force needed for balance. C gives (W - U) - P. D gives P - (W - U).</i>	1
(d)	B KEY EQUATION $s = \frac{1}{2} g t^2$ so $g = 2s \div t^2$ a distance too big gives g too big <i>A: air resistance would make g smaller. C: the fall time does not depend on horizontal motion. D: a longer time gives a smaller g.</i>	1
(e)	D $mg + F = ma$ KEY EQUATION $\Sigma F = ma$ going up, weight and air resistance both act downwards <i>A and B: the velocity is not constant. C: air resistance does not act opposite to gravity on the way up.</i>	1
(f)	B F and R <i>D is paired with a force on the air. W is paired with a force on the Earth.</i>	1
(g)	D $-0.60 \text{ kg m s}^{-1}$ KEY EQUATION $\Delta p = m v - m u = 0.06 \times (-5) - 0.06 \times 5$	1
(h)	B 1.0 KEY EQUATION total momentum before = total momentum after $1.0 \times 2.0 - 0.50 \times 2.0 = 1.0$ <i>A: as if each trolley had the same momentum. C: the second trolley only. D: as if they moved the same way.</i>	1

(i) C 190 kJ

1

KEY EQUATION $E_k = \frac{1}{2} m v^2$ $\frac{1}{2} \times 1.2 \times 10^3 \times 18^2 = 194 \text{ kJ}$

A: v not squared. B: v not squared and no $\frac{1}{2}$. D: no $\frac{1}{2}$.

(j) C Wh

1

KEY EQUATION $\Delta W = F\Delta s = \Delta E_{\text{grav}} = mg\Delta h$

frictionless, constant speed: all the work goes into GPE

Total: 10 marks

2 Question 2 — mark scheme

3 marks

PART	ANSWER	MARK
	Use of $a = (v - u) \div t$ (the gradient of the graph)	1
	KEY EQUATION $a = (v - u) \div t$	
	See 1.6 m s^{-2} or see $(-4.9 \text{ to } -5.2 \text{ m s}^{-2})$	1
	e.g. 0 to 9 s: $a = 14 \div 9 = 1.56 \text{ m s}^{-2}$. After 9 s: $a = (-30 - 14) \div 8.5 = -5.2 \text{ m s}^{-2}$	
	Max 1 of: at 9 s the acceleration becomes negative / from 9 s to 12 s the object is decelerating / from 12 s to 17.5 s the object accelerates while moving in the opposite direction	1

Total: 3 marks

3 Question 3 — mark scheme

9 marks

PART	ANSWER	MARK
(a)	Use of appropriate trigonometry	1
	KEY EQUATION $v_x = v \cos \theta$ $v_y = v \sin \theta$	
	$v_x = 32 \text{ m s}^{-1}$ and $v_y = 15 \text{ m s}^{-1}$	1
	$35 \times \cos 25^\circ = 31.7 \text{ m s}^{-1}$ $35 \times \sin 25^\circ = 14.8 \text{ m s}^{-1}$	
(b)	Use of $s = u_x t$ to find the time to travel 100 m horizontally	1
	KEY EQUATION $s = u t + \frac{1}{2} a t^2$ horizontal: $a = 0$ vertical: $a = -g$	
	Use of $s = u_y t + \frac{1}{2} a t^2$ with $a = -g$ to find the distance fallen in that time	1
	accept other correct SUVAT methods	
	Distance fallen = 2.1 m	1

Conclusion consistent with their values, e.g. $2.1 \text{ m} < 3.0 \text{ m}$ so the rider lands on the other side

1

Example: $t = 100 \div 31.7 = 3.15 \text{ s}$; vertical displacement = $14.8 \times 3.15 - \frac{1}{2} \times 9.81 \times 3.15^2 = -2.12 \text{ m}$

Or find the time to fall 3 m (3.21 s) and then the horizontal distance (102 m), **or** compare times: $3.15 \text{ s} < 3.21 \text{ s}$. Same four marks.

(c) Air resistance acts to oppose the motion of the motorcyclist

1

KEY EQUATION $\Sigma F = ma$ a resistive force means a deceleration

So it decreases the time in the air **or** there is deceleration in the horizontal direction **or** the horizontal speed is reduced **or** the maximum height reached is reduced

1

Horizontal distance travelled is reduced

1

dependent on one of the two marks above

Total: 9 marks

4 Question 4 — mark scheme

8 marks

PART	ANSWER	MARK
(a)	Vertical downwards force labelled “weight” or W	1
	Force perpendicular to the slope labelled “reaction”, “(normal) contact” or R or N	1
		
(b)(i)	Resolves the acceleration along the slope	1
	KEY EQUATION $a = g \sin \theta$ from $\Sigma F = ma$: $mg \sin \theta = ma$	
	Acceleration = 1.2 m s^{-2}	1
	$9.81 \times \sin 6.9^\circ = 1.18 \text{ m s}^{-2}$	
(ii)	Use of $v^2 = u^2 + 2as$ or of $E_k = \frac{1}{2}mv^2$ with $\Delta E_{\text{grav}} = mg\Delta h$	1
	KEY EQUATION $v^2 = u^2 + 2as$	
	Final speed = 12 m s^{-1}	1
	$\sqrt{(2 \times 1.18 \times 60)} = 11.9 \text{ m s}^{-1}$. Allow error carried forward from (i).	

(iii) Use of $v = u + at$ or another valid SUVAT equation

1

KEY EQUATION $v = u + at$

Time = 10 s

1

11.9 ÷ 1.18 = 10.1 s. Allow error carried forward from (i) and (ii).

Total: 8 marks

5 Question 5 — mark scheme

6 marks

PART	ANSWER	MARK
(a)	Initial acceleration due to a resultant force	1
	KEY EQUATION $\Sigma F = ma$ the gradient of a $v-t$ graph is the acceleration	
	Decreasing acceleration as the resistive forces increase or as the resultant force decreases	1
	accept reference to the gradient for this mark and the next	
	No acceleration as the resultant force is zero or constant velocity as the resultant force is zero	1
	accept terminal velocity for constant velocity	
(b)	Work done (by the cyclist) results in a <u>transfer</u> of energy	1
	KEY EQUATION $\Delta W = F\Delta s$ work done = energy transferred	
	Initially there is an increase in E_k (of the cyclist and bicycle) or work done is transferred to other forms of energy	1
	When the velocity of the cyclist is constant, all the energy is being transferred to other forms (against resistive forces)	1

Total: 6 marks

6 Question 6 — mark scheme

7 marks

PART	ANSWER	MARK
(a)	Use of $p = mv$	1
	KEY EQUATION $\Sigma p \text{ before} = \Sigma p \text{ after}$ $p = mv$	
	see 0.3m, 0.7m or 2mv	
	Use of the principle of conservation of momentum	1

Magnitude of velocity = 0.2 m s^{-1} , direction to the left

1

accept "in the initial direction of glider 2" for "to the left"

Example, taking right as positive: $0.3\text{m} - 0.7\text{m} = 2mv$ so $v = -0.2 \text{ m s}^{-1}$

(b) Glider 1 exerts this force on glider 2, so according to Newton's third law...

1

KEY EQUATION $F_{1 \text{ on } 2} = -F_{2 \text{ on } 1}$ Newton's third law

...glider 2 exerts an (equal and) opposite force on glider 1

1

There is now a resultant force on glider 1

1

KEY EQUATION $\Sigma F = ma$ Newton's second law

Glider 1 accelerates (according to N2) or glider 1 now moves to the left

1

Total: 7 marks

7 Question 7 — mark scheme

10 marks

PART	ANSWER	MARK
(a)	Use of $p = mv$	1
	KEY EQUATION $\Sigma p \text{ before} = \Sigma p \text{ after} = 0$	
	Use of momentum conservation	1
	$v = 0.04 \text{ m s}^{-1}$	1
	$1350 \times 0.82 + 2950v - 2100 \times 0.58 = 0$ so $v = (1218 - 1107) \div 2950 = 0.0376 \text{ m s}^{-1}$	
	Towards O, away from S, to the left	1
	dependent on the mark above	
(b)(i)	The rocket motor exerts a force on the gases, so the gases exert a force on the rocket motor	1
	KEY EQUATION $F = \Delta p \div \Delta t$ the motor changes the momentum of the gas	
	The forces are equal and opposite according to Newton's third law	1
	dependent on the mark above	
	So there is a resultant force on the descent module, which accelerates according to Newton's second law	1
	accept Newton's first law. Independent mark.	
(ii)	Use of $v = u + at$ to find a	1
	KEY EQUATION $\Sigma F = ma$ $a = \Delta v \div t$	
	Use of $\Sigma F = ma$	1

$$\Sigma F = 3.4 \times 10^2 \text{ N}$$

$$a = 0.58 \div 5 = 0.116 \text{ m s}^{-2}; \Sigma F = 2950 \times 0.116 = 342 \text{ N}$$

1

Total: 10 marks

8 Question 8 — mark scheme

9 marks

PART	ANSWER	MARK
(a)	Takes a correct moment about pivot P, e.g. $T \times 6 \times \cos 20$ KEY EQUATION moment = $F x$ x = perpendicular distance from the pivot <i>if $\cos 20$ is missing from both sides, all 4 marks can still be given</i>	1
	Converts the mass of the beam to its weight: $\times 9.81$ seen	1
	Appreciates the centre of mass is 0.5 m from P <i>the beam is uniform, so its weight acts 5.5 m from the end</i>	1
	$T = 25 \text{ kN}$ $T \times 6 \cos 20 = 3.05 \times 10^4 \times 9.81 \times 0.5 \times \cos 20$ so $T = 24.9 \text{ kN}$	1
(b)	Use of $\Delta E_{\text{grav}} = mg\Delta h$ KEY EQUATION efficiency = useful energy output ÷ total energy input	1
	Converts for a unit time, e.g. a day, or a second (watts)	1
	Calculates the energy input from the coal in the same time	1
	Use of efficiency = energy output ÷ energy input or in terms of power	1
	Efficiency = 1.5% so the claim is not correct $2500 \times 9.81 \times 12 = 294 \text{ kJ a minute}; \times 60 \times 24 = 424 \text{ MJ a day. Input} = 1250 \times 22.3 = 27\,900 \text{ MJ. } 424 \div 27\,900 = 1.5\%$ <i>allow the reverse argument, starting from 10%, for full credit</i>	1

Total: 9 marks

9 Question 9 — mark scheme

10 marks

PART	ANSWER	MARK
(a)	Use of $W = mg$ KEY EQUATION $W = m g$	1
	$W = 868 \text{ N}$ $(85.0 + 3.50) \times 9.81 = 868.2 \text{ N}$	1

(b) See $868 \times 0.45 \times \cos 15$ ($= 377.3 \text{ N m}$)

1

KEY EQUATION $\Sigma \text{ clockwise moments} = \Sigma \text{ anticlockwise moments}$

about the corner it tips on

accept $\sin 75$ for $\cos 15$

See $27 \times 2.0 \times \cos 75$ ($= 13.98 \text{ N m}$)

1

accept $\sin 15$ for $\cos 75$

See $F_w \times 2.4 \times \cos 15$ ($= 2.31F_w$)

1

accept $\sin 75$ for $\cos 15$

Use of the principle of moments, e.g. moment of weight of base = moment of weight of post arrangement + moment of wind

1

accept > used correctly in place of = to show the tipping point; error carried forward for W from (a)

$F_w = 157 \text{ N}$ or 158 N

1

$377.3 = 13.98 + 2.31F_w$ so $F_w = 157 \text{ N}$

(c) F_w would increase

1

KEY EQUATION $\text{moment} = Fx$

The weight of the base would be greater

1

This increases the clockwise moment **or** increases the moment of the (weight of the) base

1

Total: 10 marks

10 Question 10 — mark scheme

* extended answer

6 marks

PART ANSWER

MARK

Marks are awarded for indicative content **and** for how well the answer is structured.

Indicative points seen	Marks for content
6	4
4–5	3
2–3	2
1	1
0	0

Structure and lines of reasoning	Marks
Coherent, logical structure with linkage and fully sustained lines of reasoning throughout	2
Partially structured, with some linkages and lines of reasoning	1
No linkage between points; unstructured	0

KEY EQUATION $F_{A \text{ on } B} = -F_{B \text{ on } A}$ Newton's third law

KEY EQUATION $\Sigma F = 0 \Rightarrow a = 0$ Newton's first law

Indicative content

- 1 A Newton's third law pair of forces must be of the same type **or** must act on different bodies
- 2 The two forces mentioned are not a third-law pair **or** "gravity" is not a good description of a force
- 3 The lift on the plane should be paired with the push of the plane on the air **or** the Earth's gravitational pull on the plane should be paired with the plane's gravitational pull on the Earth
- 4 If the vertical resultant force is zero, the plane will not accelerate vertically
- 5 So the plane could be "at rest" or moving with uniform velocity in the vertical direction
- 6 There must be some horizontal motion, so the plane can't stay in the same place

Linkage: two of points 1–3 linked can score one linkage mark; two of points 4–6 linked can score one linkage mark.

Total: 6 marks

END OF MARK SCHEME