A-Level Edexcel

# PHYSICS

## UNIT 1(IAL)

2020 — 2025




EXAMINENT

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**1** - (WPH11/1(IAL)_Summer_2020_Q1) - *Mechanics*

Which of the following units is only used with vector quantities?

☒ **A** J

☒ **B** m

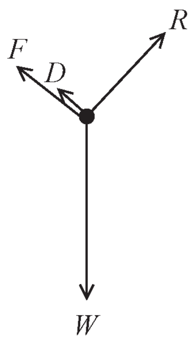
☒ **C** N

☒ **D** W

**2** - (WPH11/1(IAL)_Summer_2020_Q2) - *Mechanics*

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.




$D$ = air resistance

$F$ = frictional force

$R$ = normal contact force

$W$ = weight of the box

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

☒ **A** $F$ and $D$

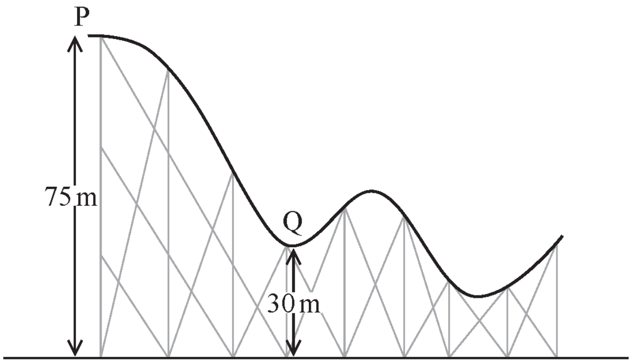
☒ **B** $F$ and R

☒ **C** $W$ and D

☒ **D** $W$ and $R$

**3** - (WPH11/1(IAL)_Summer_2020_Q3) - *Mechanics*

The diagram shows a roller coaster. A roller coaster car stops momentarily at P before descending towards Q.




Which of the following expressions could be used to determine the velocity of the roller coaster car at Q?

☒ **A** $\sqrt{75g} - \sqrt{30g}$

☒ **B** $\sqrt{150g} - \sqrt{60g}$

☒ **C** $\sqrt{45g}$

☒ **D** $\sqrt{90g}$

**4** - (WPH11/1(IAL)_Summer_2020_Q4) - *Mechanics*

A car travels north with a velocity of $+50\,\mathrm{m\,s^{-1}}$. While still travelling north, the car slows to a velocity of $+20\,\mathrm{m\,s^{-1}}$.

Which of the following is the change of velocity of the car?

☒ **A** $+30\,\mathrm{m\,s^{-1}}$

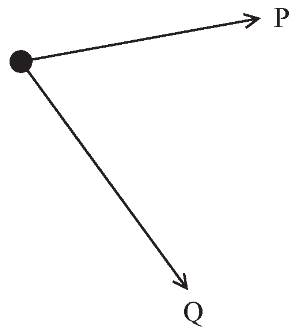
☒ **B** $-30\,\mathrm{m\,s^{-1}}$

☒ **C** $+70\,\mathrm{m\,s^{-1}}$

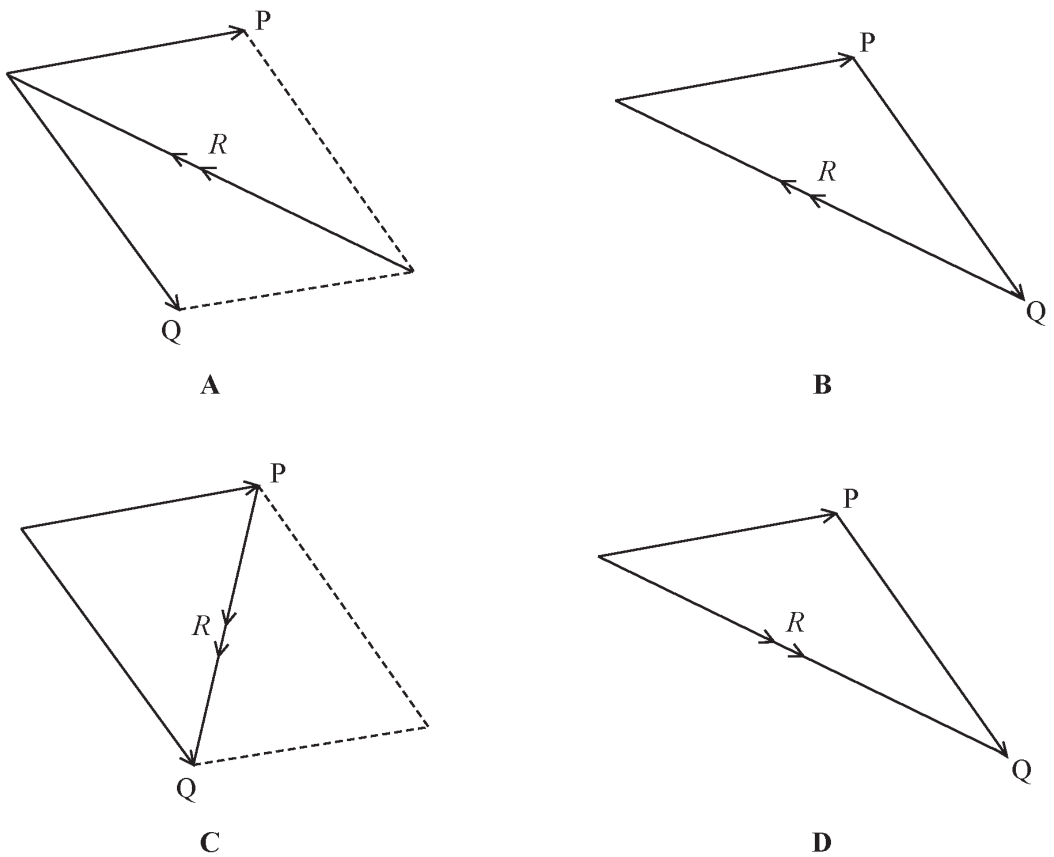
☒ **D** $-70\,\mathrm{m\,s^{-1}}$

**5** - (WPH11/1(IAL)_Summer_2020_Q5) - *Mechanics*

Two forces P and Q act on an object as shown.




Which of the following is a correctly drawn, scaled, vector diagram for the resultant $R$ of forces P and Q?




- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

**6** - (WPH11/1(IAL)_Summer_2020_Q6) - *Mechanics*

A lamp with an efficiency of 0.68 usefully transfers 120 J of energy.

Which of the following can be used to determine $E$, the energy supplied to the lamp?

☒ **A** $E = 0.68 \times 120 \times 100$

☒ **B** $E = 0.68 \times 120$

☒ **C** $E = \dfrac{120}{0.68} \times 100$

☒ **D** $E = \dfrac{120}{0.68}$

**7** - (WPH11/1(IAL)_Summer_2020_Q7) - *Mechanics*

A student used a falling sphere to determine the acceleration of free-fall $g$. The sphere was released from rest.

Which two quantities would require the fewest measurements to be taken in order to determine $g$?

☒ **A** displacement and initial velocity

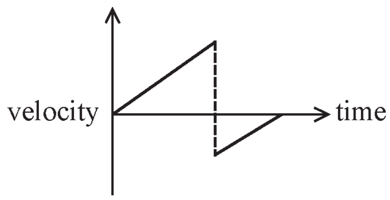
☒ **B** displacement and time

☒ **C** final velocity and displacement

☒ **D** final velocity and time

**8** - (WPH11/1(IAL)_Summer_2020_Q9) - *Mechanics*

The velocity-time graph for the motion of a ball is shown.




Which of the following correctly describes the motion of the ball?

☒ **A** The ball is dropped and rebounds to its original position.

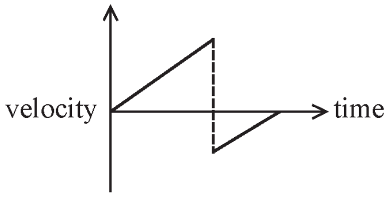
☒ **B** The ball is dropped and rebounds to a lower position.

☒ **C** The ball is thrown upwards and is caught at its original position.

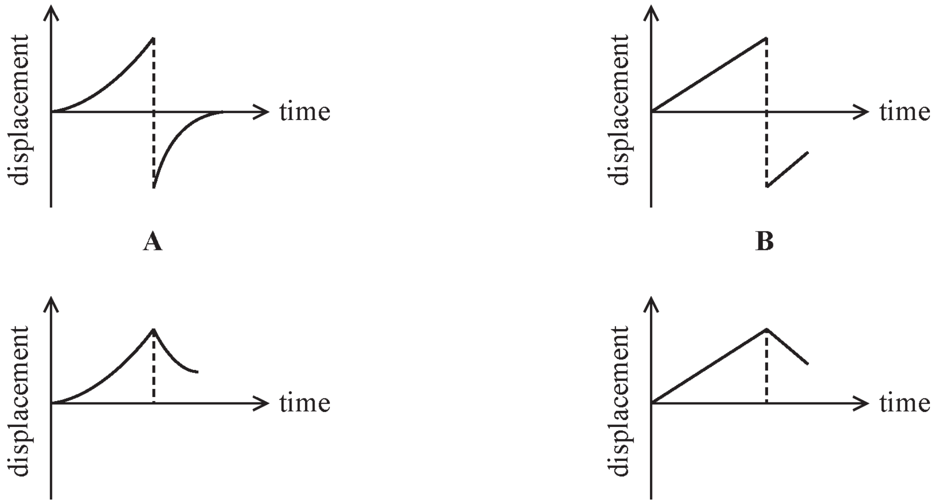
☒ **D** The ball is thrown upwards and is caught at a higher position.

**9** - (WPH11/1(IAL)_Summer_2020_Q10) - *Mechanics*

The velocity-time graph for the motion of a ball is shown.




Which of the following graphs of displacement against time could represent the motion of the ball?




**A** **B**

**C** **D**

☒ **A**

☒ **B**

☒ **C**

☒ **D**

**10** - (WPH11/1(IAL)_Summer_2020_Q11) - *Mechanics*

Every litre of fuel used in a car engine releases 32 MJ of energy. During one journey the car used 65 litres of fuel. The car journey lasted 8 hours.

(a) Show that the average power input to the engine was about 70 kW.

**(2)**

(b) The car travelled a total distance of 730 km during the journey.

The average force of the engine was 2.1 kN.

Show that the average power output of the engine was about 50 kW.

**(3)**

(c) Determine the efficiency of the engine.

**(2)**

Efficiency of engine = ..............................

**11** - (WPH11/1(IAL)_Summer_2020_Q12) - *Mechanics*

The photograph shows a person riding a unicycle. The unicycle moves at a constant speed on a horizontal surface. The vertical forces $R$ and $W$ act as shown.




The magnitude of each force is represented by the length of the arrow on the photograph.

(a) Assess whether forces $R$ and $W$ are a Newton's third law pair of forces.

**(3)**

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(b) Explain the motion of the unicycle. Your answer should make reference to all of the forces acting on the unicycle.

**(2)**

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**12** – (WPH11/1(IAL)_Summer_2020_Q13) – *Mechanics*

A uniform, horizontal flagpole is connected by a hinge to a wall at position O.
An aluminium wire connects the pole to the wall at A, as shown.

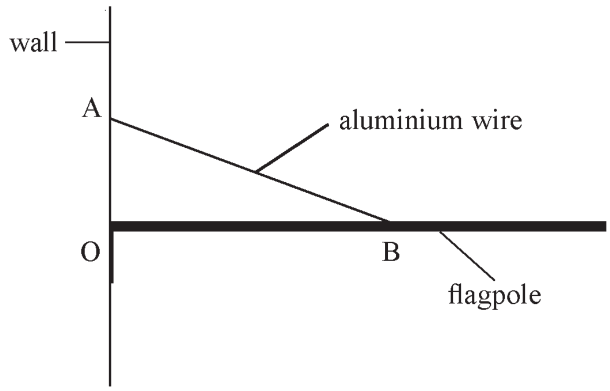
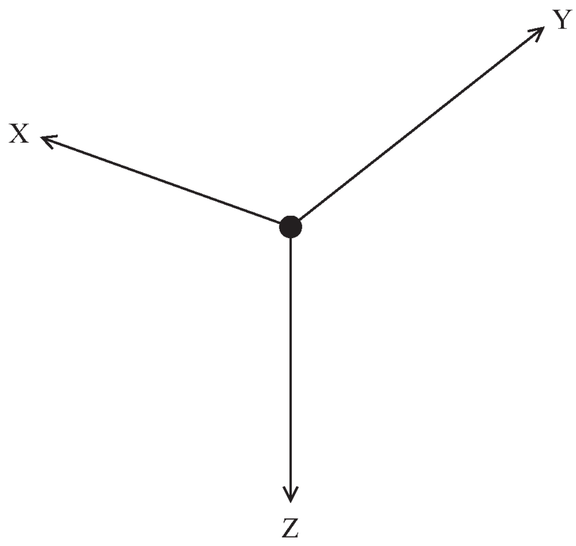



Diagram not to scale

(a) A free-body force diagram for the flagpole is shown below.

Identify the forces X, Y and Z.

**(3)**




X ..............................................................................................................................................

Y ..............................................................................................................................................

Z ..............................................................................................................................................

(b) The aluminium wire will break if the tension in the wire exceeds 350 N.

The wire is attached to the flagpole at B, 0.8 m from the wall.

The wire is at an angle of 20° to the flagpole.

Assess whether the wire will break. You should use the principle of moments, taking moments about O.

length of flagpole = 1.2 m

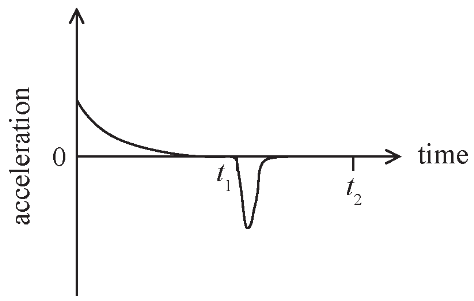
mass of flagpole and flag = 15 kg

**(3)**

**13** – (WPH11/1(IAL)_Summer_2020_Q14) – *Mechanics*

A skydiver jumps from an aeroplane and accelerates until she reaches terminal velocity. At a time $t_1$, she opens a parachute and a second, lower terminal velocity is reached before landing safely at time $t_2$.

The acceleration-time graph for the motion of the skydiver is shown.




Explain the shape of the graph. You should refer to the forces acting on the skydiver.

**(6)**

**14** - (WPH11/1(IAL)_Summer_2020_Q17) - *Mechanics*

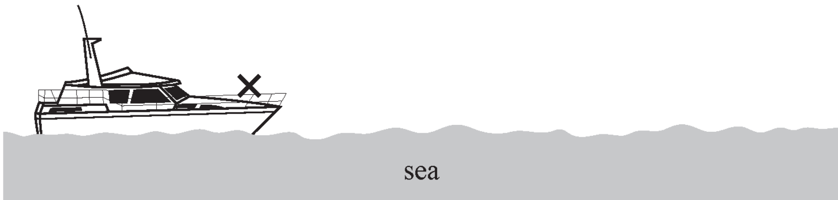
A distress flare may be launched from a boat, to signal for help.

(a) A flare was launched from a stationary boat at an angle of 30° to the horizontal.

(i) The flare was launched to the right from the launch position marked × on the boat in the diagram below.

Complete the diagram to show the path taken by the flare before it hit the sea.

**(1)**




(ii) The maximum height of the flare above the launch position was 42 m.

Show that the flare was launched at a speed of about $60\,\text{m}\,\text{s}^{-1}$.

**(3)**

(iii) The flare was visible from a maximum distance of 8 km. A rescue boat was 8.2 km from the boat in distress.

Determine whether the flare travelled a sufficient distance to be visible from the rescue boat. You should assume that the flare was launched in the direction of the rescue boat.

**(4)**

(b) State one assumption you made in (a)(iii).

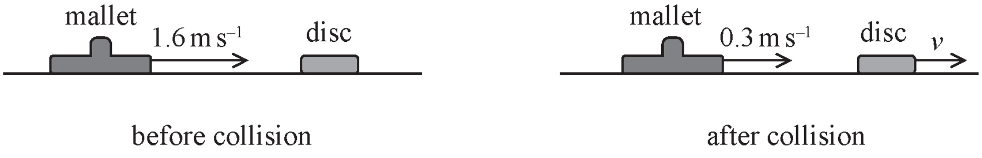
**(1)**

**15** - (WPH11/1(IAL)_Summer_2020_Q18) - *Mechanics*

A game is played where each player must use a 'mallet' to hit a disc across a table into the opponent's goal.

One player accidentally lets go of a mallet. The mallet travels at a speed of $1.6\,\mathrm{m\,s^{-1}}$ and collides with a stationary disc.

After the collision, the mallet continues in the same direction at a lower speed of $0.3\,\mathrm{m\,s^{-1}}$. The disc moves in the same direction as the mallet with a velocity $v$, as shown.



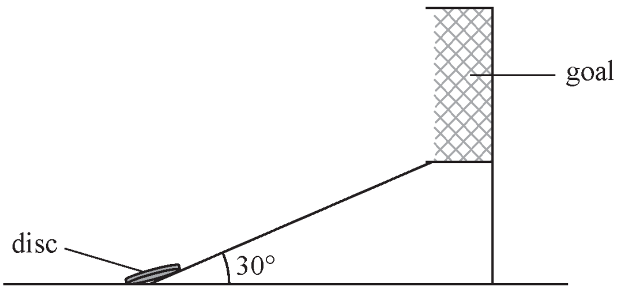

(a) Calculate a value for $v$.
Assume that frictional forces are negligible.

mass of disc = 0.035 kg
mass of mallet = 0.17 kg

**(3)**

$v$ = ..................................

(b) To reach the goal, the disc must move up a ramp which is at an angle of 30° to the horizontal.



The velocity of the disc at the bottom of the ramp is $5.0\,\mathrm{m\,s^{-1}}$. The disc moves up the ramp and work is done by the disc against the frictional force. The disc moves a distance of 6.5 cm up the ramp before moving back down.

Determine the frictional force acting on the disc.

**(6)**

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Frictional force = ..................................................

**16** - (WPH11/1(IAL)_Winter_2020_Q1) - *Mechanics*

Which of the following quantities has the SI base units $\mathrm{kg\,m^2\,s^{-3}}$?

☒ **A** force

☒ **B** momentum

☒ **C** power

☒ **D** work done

**17** - (WPH11/1(IAL)_Winter_2020_Q2) - *Mechanics*

Which of the following statements describes the gravitational field strength acting on a body at a point?

- **A** gravitational force per unit length
- **B** gravitational force per unit mass
- **C** gravitational potential energy per unit length
- **D** gravitational potential energy per unit mass

**18** - (WPH11/1(IAL)_Winter_2020_Q3) - *Mechanics*

The diagrams below show the velocity of an object before and after a force is applied.

The magnitude of the velocity did not change.

before after

Which of the following arrows represents the direction of the change in velocity?

**A** **B** **C** **D**

- **A**
- **B**
- **C**
- **D**

**19** - (WPH11/1(IAL)_Winter_2020_Q4) - *Mechanics*

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?

- **A** $mg - F = 0$
- **B** $mg + F = 0$
- **C** $mg - F = ma$
- **D** $mg + F = ma$

# ANSWERS

**1** - (WPH11/1(IAL)_Summer_2020_Q1) - *Mechanics*

C

**2** - (WPH11/1(IAL)_Summer_2020_Q2) - *Mechanics*

B

**3** - (WPH11/1(IAL)_Summer_2020_Q3) - *Mechanics*

D

**4** - (WPH11/1(IAL)_Summer_2020_Q4) - *Mechanics*

B

**5** - (WPH11/1(IAL)_Summer_2020_Q5) - *Mechanics*

D

**6** - (WPH11/1(IAL)_Summer_2020_Q6) - *Mechanics*

D

**7** - (WPH11/1(IAL)_Summer_2020_Q7) - *Mechanics*

B

**8** - (WPH11/1(IAL)_Summer_2020_Q9) - *Mechanics*

B

**9** - (WPH11/1(IAL)_Summer_2020_Q10) - *Mechanics*

C

**10** - (WPH11/1(IAL)_Summer_2020_Q11) - *Mechanics*

| | | | |
|---|---|---|---|
| **(a)** | • Use of Power = $\frac{\text{energy}}{\text{time}}$<br>• $P$ = 72 (kW)<br><br><u>Example of calculation</u><br>$P = \frac{32 \times 10^6 \text{ J l}^{-1} \times 65 \text{ l}}{8 \text{ h} \times 3600 \text{ s}}$ = 72.2 kW | **(1)**<br>**(1)** | **2** |
| **(b)** | • Use of $\Delta W = F\Delta s$<br>• Use of power = $\frac{\text{energy}}{\text{time}}$<br>• Average power output of engine = 53 (kW)<br><u>Example of calculation</u><br>$W = 2.1 \times 10^3$ N × 730 × $10^3$ m = $1.53 \times 10^6$ J<br>$P = \frac{2100 \text{ N} \times 730 \times 10^3 \text{ m}}{8 \text{ h} \times 3600 \text{ s}}$ = 53.2 kW | **(1)**<br>**(1)**<br>**(1)** | **3** |
| **(c)** | • Use of efficiency = $\frac{\text{useful power output}}{\text{total power input}}$<br>• Efficiency = 0.74 or 74 % (ECF from (a) and (b))<br><br><u>Example of calculation</u><br>$E = \frac{53.2 \times 10^3 \text{ W}}{72.2 \times 10^3 \text{ W}}$ = 0.74 | **(1)**<br>**(1)** | **2** |

**11** - (WPH11/1(IAL)_Summer_2020_Q12) - *Mechanics*

| | | | |
|---|---|---|---|
| **(a)** | • States that $W$ is the weight of the rider (and unicycle) and $R$ is the push/reaction force (from the ground)<br>• $R$ and $W$ are different types of force<br>**Or**<br>$R$ and $W$ act on the same object<br>**Or**<br>$R$ and $W$ are not equal.<br>• They are **not** a N3 pair of forces<br><br>MP3 conditional on MP2 | (1)<br>(1)<br>(1) | **3** |
| **(b)** | • The resultant force acting in the vertical direction is zero so the unicycle will remain at that height<br>**Or**<br>The resultant force acting in the vertical direction is zero so zero acceleration in the vertical direction<br>• The unicycle moves at a constant (forward) speed because the resultant horizontal force is zero or horizontal forces are balanced (because forward frictional force balances backward drag forces) | (1)<br>(1) | **2** |

**12** - (WPH11/1(IAL)_Summer_2020_Q13) - *Mechanics*

| | | | |
|---|---|---|---|
| **(a)** | • X is the force (or pull or tension) of the wire (on the flagpole) (accept tension in the wire)<br>• Y is force (or reaction or push, ignore "normal") of the hinge (or wall) (on the flagpole).<br>• Z is weight or force of gravity (of/on the flagpole) | (1)<br>(1)<br>(1) | **3** |
| **(b)** | • Use of moment of a force = $Fx$<br>• Use of the principle of moments<br>• $T$ = 323 (N) < 350 (N) so wire will not break<br>**Or**<br>Moment of weight about hinge = 88.3 (Nm) < 95.8 (Nm), max poss from wire<br>**Or**<br>Correct conclusion based on comparison of student's value with 350 N or 95.8 Nm<br><br>MP3 depends on MP1 and MP2 being seen<br><br>Example of calculation<br>$(15 \text{ kg} \times 9.81 \text{ N kg}^{-1} \times 0.6 \text{ m}) - (T \sin 20° \times ⅔ \times 1.2 \text{ m}) = 0$<br>$T = (15 \text{ kg} \times 9.81 \text{ N kg}^{-1} \times 0.6 \text{ m}) \div (0.8 \text{ m} \times \sin 20°)$<br>$= 88.29 \text{ Nm} \div 0.2736$<br>$T = 322.7$ N<br>max available moment = 350 N × 0.8 m × sin 20° = 95.77 Nm > 88.29 Nm | (1)<br>(1)<br>(1) | **3** |

**13** - (WPH11/1(IAL)_Summer_2020_Q14) - *Mechanics*

| | | |
|---|---|---|
| * | This question assesses a student's ability to show a coherent and logically structured answer with linkages and fully-sustained reasoning.<br>Marks are awarded for indicative content and for how the answer is structured and shows lines of reasoning.<br>The following table shows how the marks should be awarded for indicative content. | **6** |

| Number of indicative marking points seen in answer | Number of marks awarded for indicative marking points | Linkage marks available |
|---|---|---|
| 6 | 4 | 2 |
| 5 | 3 | 2 |
| 4 | 3 | 1 |
| 3 | 2 | 1 |
| 2 | 2 | 0 |
| 1 | 1 | 0 |
| 0 | 0 | 0 |

The following table shows how the marks should be awarded for structure and lines of reasoning.

| | Number of marks awarded for structure of answer and sustained line of reasoning |
|---|---|
| Answer shows a coherent and logical structure with linkages and fully sustained lines of reasoning demonstrated throughout | 2 |
| Answer is partially structured with some linkages and lines of reasoning | 1 |
| Answer has no linkages between points and is unstructured | 0 |

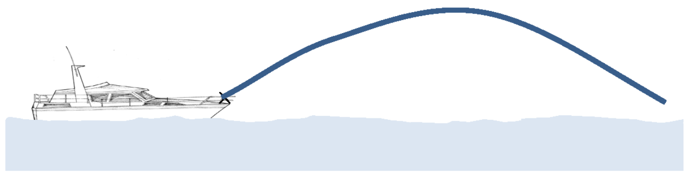
Total marks awarded is the sum of marks for indicative content and the marks for structure and lines of reasoning

**Indicative content**

- Acceleration is maximum (or acceleration = $g$) initially
- As velocity increases the air resistance increases
- Resultant force decreases until it becomes zero and diver reaches terminal velocity
  **Or**
  (Eventually) forces balance and the diver reaches terminal velocity
- At $t_1$ the air resistance increases or is greater then the weight
- Skydiver decelerates or the resultant force is now upwards/negative
- Second terminal velocity is lower because air resistance = weight at a lower velocity.

Ignore mention of upthrust.

**14** – (WPH11/1(IAL)_Summer_2020_Q17) – *Mechanics*

| | | | |
|---|---|---|---|
| **(a)(i)** | • Initial angle at approximately 30° (by eye) with approximately parabolic shape.<br> | **(1)** | **1** |
| **(a)(ii)** | • Use of $v^2 = u^2 + 2as$ (with $u$ and $v$ the correct way around)<br>**Or**<br>Loss of KE = gain of GPE (i.e. $u_V^2 = 2gh$)<br>• See $u$ sin 30° for initial vertical component of velocity $u_V$<br>• $u$ = 57 (m s$^{-1}$)<br><u>Example of calculation</u><br>$0^2 = (u \sin 30°)^2 + (2\times -9.81 \text{ N kg}^{-1} \times 42 \text{ m})$<br>$u_V = u \sin 30° = 28.7 \text{ m s}^{-1}$<br>$u = 57.4 \text{ m s}^{-1}$ | **(1)**<br><br><br>**(1)**<br>**(1)** | **3** |
| **(a)(iii)** | • Use of trig to determine the horizontal component of the initial velocity<br><u>METHOD 1</u><br>• Use of suitable equation(s) of motion to determine the time of flight<br>• Use of $v = s/t$ to determine the horizontal distance travelled by the flare<br>• Comparison of distance to boat to distance flare travelled with conclusion consistent with student's value<br>e.g. 7.9 km is less than 8.0 km so the flare can be seen.<br><br><u>Example of calculation</u><br>$0 = (57.4 \text{ m s}^{-1}\times \sin 30° \times t) - (0.5\times 9.81 \text{ N kg}^{-1}\times t^2)$<br>$t = 5.85$ s<br>$s = (57.4 \text{ m s}^{-1}\times \cos 30° \times 5.85 \text{ s}) = 49.7 \text{ m s}^{-1} \times 5.85 \text{ s} = 291 \text{ m}$ | **(1)**<br>**(1)**<br>**(1)**<br>**(1)** | **4** |

| | | |
|---|---|---|
| | <u>METHOD 2</u><br>• Use of $v = s/t$ to determine the time to reach 200 m<br>• Use of $s = ut + ½at^2$ to find height reached after 200 m travel<br>• Explains conclusion consistent with student's value<br>e.g. flare above the sea and in range so visible | |
| **(b)** | • Air resistance/drag is ignored **Or** air resistance/drag is (presumed to be) negligible **(1)** | **1** |

**15** - (WPH11/1(IAL)_Summer_2020_Q18) - *Mechanics*

| | | | |
|---|---|---|---|
| **(a)** | • Use of $p = mv$<br>• Use of conservation of momentum<br>• $v = 6.3\ \text{m s}^{-1}$<br><br><u>Example of calculation</u><br>Before: $p_{\text{mallet}} = 0.17\ \text{kg} \times 1.6\ \text{m s}^{-1} = 0.272\ \text{kg m s}^{-1}$<br>After: $p_{\text{mallet}} = 0.17\ \text{kg} \times 0.3\ \text{m s}^{-1} = 0.051\ \text{kg m s}^{-1}$<br>$0.272\ \text{kg m s}^{-1} = 0.051\ \text{kg m s}^{-1} + (0.035\ \text{kg} \times v)$<br>$v = 6.3\ \text{m s}^{-1}$ | (1)<br>(1)<br>(1) | **3** |
| **(b)** | <u>METHOD 1</u><br>• Use of $E_k = \frac{1}{2}mv^2$<br>• Use of sin 30° to determine vertical height moved by disc<br>• Use of $E_{\text{grav}} = mgh$<br>• Use of $W = Fd$<br>• Use of conservation of energy e.g. $E_k = E_{\text{grav}} + W$<br>• $F_F = 6.6$ N<br><br><u>Example of calculation</u><br>$E_k = \frac{1}{2} \times 0.035\ \text{kg} \times (5.0\ \text{m s}^{-1})^2 = 0.44\ \text{J}$<br>$E_{\text{grav}} = 0.035\ \text{kg} \times 9.81\ \text{N kg}^{-1} \times 0.065\ \text{m} \times \sin 30° = 1.12 \times 10^{-2}\ \text{J}$<br>$0.44\ \text{J} = 1.12 \times 10^{-2}\ \text{J} + (F_F \times 0.065\ \text{m})$<br>$0.44\ \text{J} - 0.0112\ \text{J} = 0.43\ \text{J}$<br>$F_F = 6.56\ \text{N}$<br><br><u>METHOD 2</u><br>• Use of $v^2 = u^2 + 2as$ to determine deceleration along ramp<br>• $v = 0$ and $a$ negative<br>• Use of sin 30° to determine component of weight of disc down slope<br>• Use of $\Sigma F = m\,a$ to determine resultant force along ramp<br>• Subtraction of weight component from resultant force.<br>• $F_F = 6.6$ N | (1)<br>(1)<br>(1)<br>(1)<br>(1)<br>(1) | **6** |

**16** - (WPH11/1(IAL)_Winter_2020_Q1) - *Mechanics*

C

**17** - (WPH11/1(IAL)_Winter_2020_Q2) - *Mechanics*

B

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