Blast-off : Forces Mark Scheme

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1. Forces on books:
    - Weight (downwards).
    - Normal reaction force (upwards).
2. Forces on car:
    - T (thrust) - Forward direction.
    - F (friction) - Backward direction.

Marking Scheme: 2 marks for identifying each force.

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1. Parachute:
    - G (gravity) pulls down.
    - A (air resistance) slows the parachute.
2. Ship:
    - U (upthrust) acts upwards.
    - W (weight) acts downwards.

Marking Scheme: 2 marks for correct forces on each scenario.

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1. Newton meter readings:
    - Left to right: 2 N, 4 N, 6 N, 8 N.

Marking Scheme: 1 mark for each correct reading.

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1. Weight calculations: a) 220 N b) 11,100 N c) 3 N d) 6 N (bag) + 25 N (books) = 31 N e) 0.58 N

Marking Scheme: 1 mark per calculation.

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1. Mass calculations: a) 49 kg b) 1 kg c) 250 kg
2. Table:
    - 1st row: 600 N
    - 2nd row: 180 kg
    - 3rd row: 10 N/kg remains constant.

Marking Scheme: 1 mark per correct value.

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1. Force: $F = 0.63 \times 10 = 6.3$ N
2. Spring constant: $k = F / x = 4 / 0.2 = 20$ N/m
3. Force needed: $F = k \times x = 5 \times 0.3 = 1.5$ N

Marking Scheme: 1 mark for each correct calculation.

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1. Forces and Measurement
   a) The device used to measure forces: Newton meter (1 mark)
   The resolution of the instrument: 0.1 N (1 mark)

b) Forces on a parachutist:

- Downward force: Weight (1 mark)
- Upward force: Air resistance (1 mark)

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3. Box on the Ground
   a) Weight of the box: 50 N (1 mark)
   b) Name of force preventing movement: Friction (1 mark)
   c) Size of the force preventing movement: 10 N (1 mark)
4. Bungee Jumper
   a) Force making him fall: Gravity/Weight (1 mark)
   b) Force stopping him: Tension (1 mark)

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5. Earth's Gravity on the Moon
   - Correctly drawn arrow pointing toward Earth (1 mark)
6. Box on a Table
   - Correct answer: C (1 mark)
7. Plane in Flight
   a) Correctly labelled forces: Thrust, lift, weight, drag (4 marks)
   b) How forces change when speeding up:
   - Thrust increases (1 mark)
   - Drag remains the same initially but increases slightly (1 mark)
   - Weight and lift remain balanced (1 mark)

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8. Tug of War
   a) What happens to the rope: It moves toward the team pulling with more force (1 mark)
   b) Extra person joins:
   - Rope moves to the right as the forces are now balanced (1 mark)

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9. Mass and Weight on Different Planets
   a) Largest mass: Mars (1 mark)
   b) Gravity greater on Earth: Because weight on Earth is greater for the same mass (1 mark)
   c) Comparison between Moon and Earth:
   - Weight on Moon is less than on Earth (1 mark)
   - Mass is the same on Moon and Earth (1 mark)

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10. Forces on a Plane in Flight
    a) Arrow for air resistance: D (1 mark)
    b)
    i) Balanced forces for constant height: C and A (1 mark)
    ii) Balanced forces for constant speed: D and B (1 mark)

c)
i) True statement before take-off: Force D is greater than Force B (1 mark)
ii) True statement just as the plane leaves the ground: Force A is greater than Force C (1 mark)

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1. See-saw Balancing
   a) Direction of movement: Andy's end moves down (1 mark)
   b) People balancing the see-saw: Ellie and Rosie (1 mark)

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(c)

- Rosie on end A: Up
- Jack on end B: Down
  1 mark

(d)

- Person on end B: Andy
  1 mark

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(a) (i)

- Arrows pointing towards the centre of the Earth from A, B, C, and D.
  1 mark

(a) (ii)

- Ball and string positioned directly towards the centre of the Earth at each position (B, C, D).
  1 mark

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(a) (i)

- Between 2 seconds and 6 seconds: Moving at constant speed
  1 mark

(ii)

- Between 9 seconds and 10 seconds: Stationary
  1 mark

(b)

- Average speed = Total distance / Total time
  = 20 m / 10 s = 2 m/s
  2 marks

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(c) (i)

- The forward force was zero, and friction was greater than zero. (Tick this box)
  1 mark

(ii)

- The car started to slow down after 8 seconds.
  1 mark

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(a) Match forces to letters:

- The weight of the buggy → D
- The force pulling the buggy along → A
- The friction between the skis and the snow → C
  3 marks

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(b) Distance travelled in 10 days = 80 km/day × 10 days = 800 km
1 mark
(c) At the start, the buggy had a greater total mass (295 kg), so it exerted a greater force on the snow, causing it to sink deeper. At the end, with less mass (130 kg), it exerted less force and did not sink as much.
1 mark
(d) Skis distribute the weight over a larger surface area compared to wheels, reducing pressure on the snow and preventing sinking.
1 mark
(e) A bigger sail captures more wind, providing a greater force to pull the buggy, increasing its speed.
1 mark
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Question 8: Planning an Investigation

1. Example investigation question:
   "How does the angle of the ramp affect the speed of an object moving down the ramp?"

Page 38
(a) Independent variable:
The angle of the ramp (measured in degrees)
(b) Dependent variable:
The speed of the object (measured in m/s) using a stopwatch and ruler for distance
(c) Control variable:
The surface of the ramp to ensure fair testing.

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Question 1
(a)
(i) Arrow C (gravity acts downward).
(ii) Arrow B (force of the rope pulling Nicola forward).
(b) Calculation:
Speed = distance ÷ time
Distance = speed × time = 2 m/s × 10 s = 20 m
(c) One other force:
Friction (acting opposite to the motion of the roller blades).

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Question 8

(a) Direction of movement:
Arrow C (downward), as the force is unbalanced in that direction.
(b) Explanation:
The astronaut will move downward because the forces in other directions cancel out, leaving a resultant force of 1 N downward.
(c) Arrow Direction:
Arrow pointing downward (to show resultant movement direction).

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(b) Explanation:
The astronaut will move downward because the forces in the vertical direction are unbalanced. The 9 N downward force is greater than the upward 9 N, creating a net movement downward.
(c) Drawing:
Arrow pointing upward and to the right (resultant force direction from the combined horizontal and vertical forces).