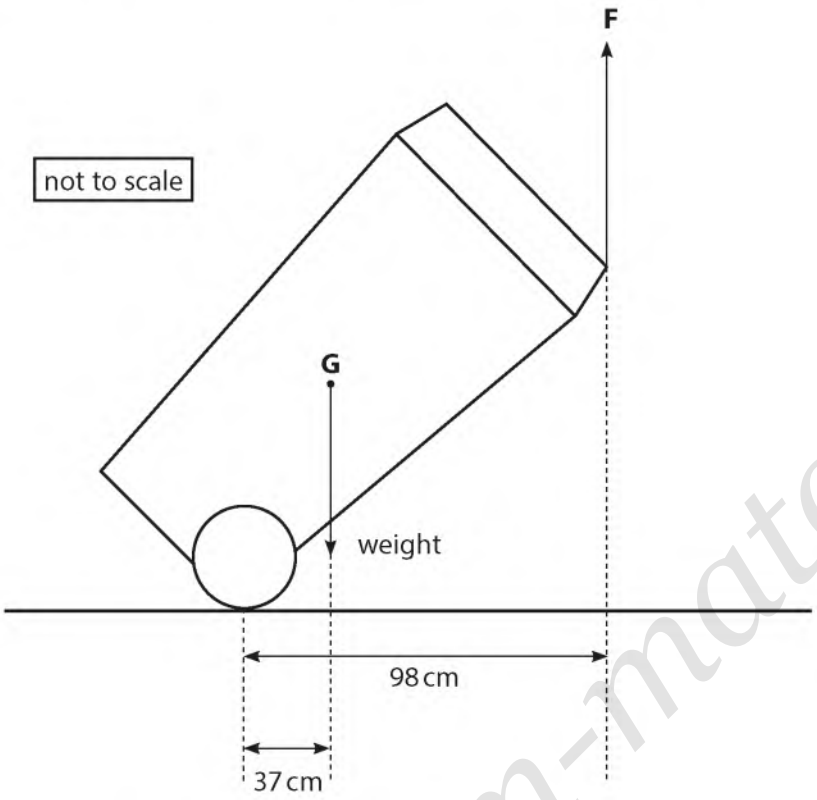
PHYSICS

PAPER 2P, 2PR 2020 - 2025

1 – (4PH1/2P_Summer_2020_Q3) – *Forces And Motion*

The diagram shows some of the forces acting on a large rubbish bin on wheels.



(a) The weight of the bin acts through point G.

Give the name of point G.

(1)

.....

(b) The mass of the bin is 23 kg.

(i) What is the weight of the bin?

(1)

- ☐ **A** 23 kg
- ☐ **B** 230 kg
- ☐ **C** 230 N
- ☐ **D** 23 000 N

(ii) State the principle of moments.

(1)

.....

.....

(iii) A person applies force F to the bin to keep it stationary.

Calculate the magnitude of force F.

(4)

magnitude of force F = ... N

(iv) State the magnitude and direction of the force applied to the person by the bin.

(2)

magnitude = ... N

direction = ...

2 – (4PH1/2PR_Summer_2020_Q3) – *Forces And Motion*

A builder needs to lift a large stone block.

(a) Diagram 1 shows the stone block.

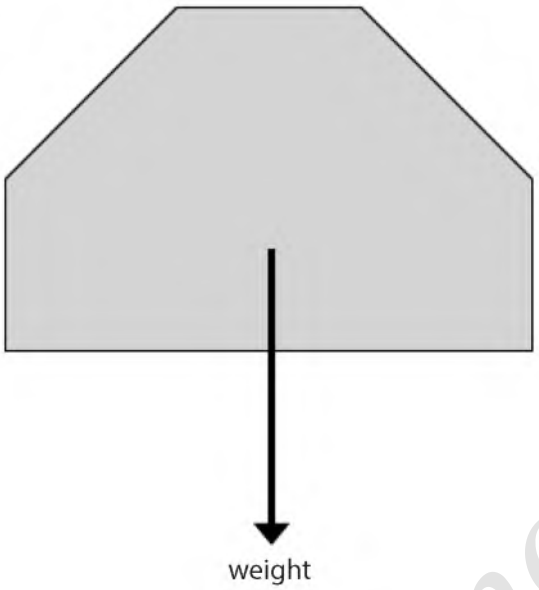


Diagram 1

(i) Draw an X on diagram 1 at the centre of gravity of the stone block.

(1)

(ii) State the formula linking weight, mass and gravitational field strength.

(1)

(iii) The mass of the stone block is 130 kg.

Calculate the weight of the stone block.

(2)

weight = ... N

(b) The builder uses a wooden plank to lift the large stone block.

The plank is uniform and pivoted at its centre.

The builder pushes down on one end of the plank to lift the stone block.

Diagram 2 shows the plank when it is horizontal and stationary.

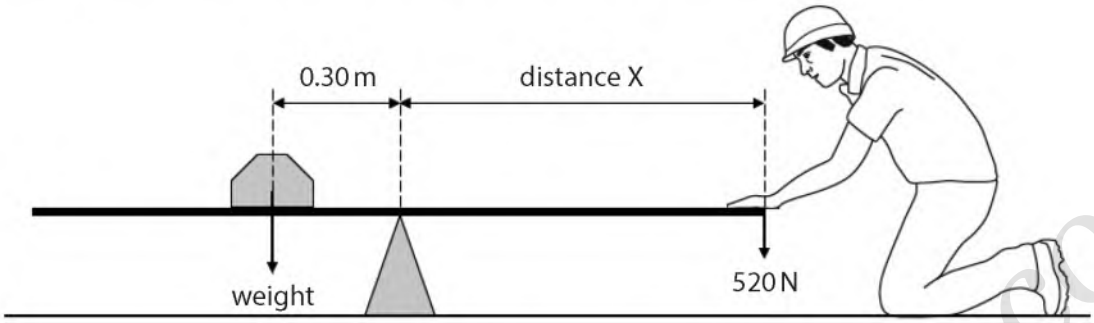


Diagram 2

(i) State the principle of moments.

(2)

.....

.....

.....

.....

(ii) The builder is pushing down with a force of 520 N to keep the plank horizontal.

Calculate distance X.

(3)

distance X = ... m

(iii) Calculate the length of the plank.

(1)

length of plank = ... m

3 – (4PH1/2P_Winter_2020_Q2) – *Forces And Motion*

The photograph shows a brass mass.

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(a) State the formula linking density, mass and volume.

(1)

(b) The brass mass has a mass of 454 g.

The density of brass is 8.46 g/cm^3.

Calculate the volume of the brass mass.

Give the unit.

(3)

volume = ... unit .....

4 – (4PH1/2P_Winter_2020_Q3) – *Forces And Motion*

Curling is a sport played on ice.

A player slides stone A across the ice towards a scoring zone.

The ice reduces friction so that there is negligible friction when the stone is sliding.

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(a) Stone A leaves the player's hand with a velocity of 2.90 m/s.

The mass of stone A is 17 kg.

(i) State the formula linking momentum, mass and velocity.

(1)

(ii) Show that the momentum of stone A is approximately 50 kg m/s.

(2)

(b) Stone A slides towards the scoring zone.

In the scoring zone, stone A collides with a stationary stone, B.

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(i) After the collision, both stones move in the same direction as the initial direction of stone A.

The velocity of stone A after the collision is 0.40 m/s.

Calculate the velocity of stone B after the collision.

[mass of stone B = 19 kg]

(4)

velocity of stone B = ... m/s

(ii) When the stones collided, they were in contact for a time of 25 ms.

Calculate the magnitude of the force stone A exerted on stone B in this collision.

(3)

force = ... N

ANSWERS

1 – (4PH1/2P_Summer_2020_Q3) – *Forces And Motion*

(a)		centre of gravity;	allow centre of mass	1
(b)	(i)	C (230 N); A is not correct as this is the mass of the bin; B is not correct as this has the incorrect unit for force; D is not correct as the mass has been converted to grams before being multiplied by *g*.		1
	(ii)	(in equilibrium) sum of clockwise moments = sum of anticlockwise moments;	condone 'clockwise moment = anticlockwise moment'	1
	(iii)	calculation of moment of weight or expression for moment of F; equating moments; rearrangement for F; correct evaluation of F; e.g. moment of F = 0.98 x F moment of weight = 230 x 0.37 230 x 0.37 = 0.98 x F F = 230 x 0.37 / 0.98 F = 87 (N)	ignore POT for this MP allow 86.8, 86.84, 86.83…	4
	(iv)	Magnitude=candidate's answer for (iii); direction: down(wards);	expect 87 N	2

2 – (4PH1/2PR_Summer_2020_Q3) – *Forces And Motion*

(a)	(i)	X drawn at the base of the weight arrow;	judge by eye	1
	(ii)	weight = mass × gravitational field strength;	allow standard symbols and rearrangements e.g. W = m × *g* ignore 'gravity' for *g*	1
	(iii)	substitution; evaluation; e.g. (W =) 130 × 10 (W =) 1300 (N)	 -1 for POT error only e.g. from incorrectly converting kg to g allow *g* = 9.8, 9.81 allow 1274, 1275.3	2
(b)	(i)	in equilibrium / when balanced; (sum of) clockwise moment(s) = (sum of) anti-clockwise moment(s);	 allow idea that net moment is zero	2
	(ii)	correct expression for either moment; correct use of principle of moments; evaluation of distance X; e.g. 1300 × 0.30 OR 520 × X 1300 × 0.30 = 520 × X X = 0.75 (m)	allow ecf from (a)(iii)	3
	(iii)	(length of plank =) 1.5 (m);	allow ecf from (b)(ii)	1

3 – (4PH1/2P_Winter_2020_Q2) – *Forces And Motion*

(a)	density = mass / volume;	allow standard symbols and rearrangements e.g. ρ = m / V condone use of d for density	1
(b)	substitution OR rearrangement; evaluation; unit; e.g. 8.46 = 454 / V OR V = m / ρ (V =) 53.7 cm^3	equation must be correct -1 for POT error allow m^3 only if consistent with data used 53.664... 5.37×10^{-5} m^3 gains 3 marks	3

4 – (4PH1/2P_Winter_2020_Q3) – *Forces And Motion*

(a) (i)	momentum = mass × velocity;	allow standard symbols and rearrangements e.g. p = m × v reject use of m for momentum	1
(ii)	substitution; evaluation to 2 or 3 s.f.; e.g. (p =) 17 × 2.9 (p =) 49 (kg m/s)	 allow 49.3 (kg m/s)	2
(b) (i)	use of conservation of momentum; momentum of stone A after collision calculated; momentum of stone B after collision calculated; evaluation of velocity of stone B; e.g. momentum before = momentum after p_A = (17 × 0.4 =) 6.8 p_B = (50 - 6.8 =) 43.2 (v_B = 43.2 / 19 =) 2.3 (m/s)	seen written explicitly or implied by working allow, for 1 mark only, "(total) momentum before = (total) momentum after" if no other marks scored. allow 42.5, 42.2 from non-rounded values for (a) allow 2.27… (m/s) allow 2.22…, 2.23…	4
(ii)	conversion of ms to s; substitution into F = Δp / t; evaluation of force; e.g. t = 0.025 s F = 43.2 / 0.025 (F =) 1700 (N)	allow ÷1000 / 0.025 seen anywhere in working no mark for formula alone as given in paper 2 marks max. for POT error e.g. 1.7 (N) allow ecf from (b)(i) allow answers in the range 1688-1728 accept, in full, responses including use of 'F = ma' provided correct values for u, v and Δt to calculate a.	3