1) D
2) C
3) B
4) C
5) A
6) C
7) C
8) A
9) B
10) A
11) D
12) A
13)

(a) force x perpendicular distance M1
(of the force) from the pivot ..... A1 [2]

(b) no resultant force (in any direction) B1
no resultant moment (about any point) ..... B1 [2]

(c) **(i)** correct direction in both ..... B1 [1]

(ii)1 moment = 150 x 0.3 = 45 N m (1 sig. fig. -1) A1

(ii)2 torque = 45 N m i.e. same is (i) A1

(ii)3 45 = 0.12 x T C1
T = 375 N ..... A1 [4]

14)

(a) **(i)** point at which whole weight of body may be considered to act — M1 A1 **[2]**

(ii) sum of forces in any direction is zero — B1
sum of moments about any point is zero — B1 **[2]**

(b) *either*:
T and W have zero moment about P — M1
so F must have zero moment, i.e. pass through P — A1 **[2]**
or:
if all pass through P, distance from P is zero for all forces (M1)
so sum of moments about P is zero (A1)

(c) **(i)** $F\cos\alpha = T\cos\beta$ — B1 **[1]**

(ii) $W = F\sin\alpha + T\sin\beta$ — B1 **[1]**

(iii) $2W = 3T\sin\beta$ — B1 **[1]**

15)

(a)	**(i)**	potential energy: stored energy available to do work	B1	[1]
	(ii)	gravitational: due to height/position of mass OR distance from mass		
		OR moving mass from one point to another	B1	
		elastic: due to deformation/stretching/compressing	B1	[2]
(b)	**(i)**	height raised = (61 – {61 cos18} =) 3.0 cm	C1	
		energy = (mgh = 0.051 × 9.8 × 0.030 =) 1.5 × 10^{-2} J	A1	[2]
	(ii)	moment = force × perpendicular distance		
		= 0.051 × 9.8 × 0.61 × sin18	C1	
		= 0.094 N m	A1	[2]

16)

(a)	moment:	force × perpendicular distance	M1	
		of force from pivot / axis / point	A1	
	couple:	(magnitude of) one force × perpendicular distance	M1	
		between the two forces	A1	[4]
	(*penalise the 'perpendicular' omission once only*)			
(b)	**(i)**	W × 4.8 = (12 × 84) + (2.5 × 72)	C1	
		W = 250 N (248 N)	A1	[2]
	(ii)	*either* friction at the pivot *or* small movement of weights	B1	[1]

17)

sum of forces in any direction is zero	B1	
(allow vector/algebraic sum, resultant force…)		
sum of moments about any point is zero	B1	**[2]**
(allow algebraic sum, resultant…)		
(If no mention of direction or point, allow max ½ overall)		

18)

(a)	product of (magnitude of one) force and distance between forces	M1		
	reference to *either* perpendicular distance between forces *or* line of action of forces and perpendicular distance	A1		[2]
(b)	**(i)** 90°	B1		[1]
	(ii) 130 = F × 0.45 (*allow e.c.f. for angle in* ***(i)***)	C1		
	F = 290 N	A1		[2]
	(*allow 1 mark only if angle stated in* ***(i)*** *is not used in* ***(ii)***)			